Interferential Current Effect, 2000Hz, on the Induced Pain Threshold

LOCOMOTOR APPARATUS IN EXERCISE AND SPORTS

ORIGINAL ARTICLE

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ABSTRACT

This study aimed at evaluating how effective an interferential current is on pain reduction concerning a painful stimulus, under pressure and cold, in healthy subjects. It was applied a bipolar technique on the nerve root. Fourteen volunteers made part of this study and were divided into two groups. On the first day, one group was submitted to the interferential current, while the other did not have such procedure. On the next day, the groups were exchanged. The pain pressure and cold thresholds were evaluated by an algometer device as well as to discomfort by the Visual Analogue Scale (VAS). The interferential current was used as a form of electrical stimulation with the following parameters: 2000 Hz current base, with AMF 100 Hz, ΔF 50%, slope 1/1. The subjects were reevaluated on three occasions: immediately after; 20 minutes and one hour after stimulation. The results of comparison between evaluations with the pressure algometer and discomfort to cold were not significant, neither in the placebo group not the stimulated one. There was decrease on evaluations for the stimulated group concerning pain to cold. Therefore, it was concluded that there was no change in pain to pressure or discomfort to cold based on the interferential current application with the used parameters produced, but lower pain to cold was produced.

Keywords: analgesia, pain measurement, transcutaneous electric nerve stimulation.

INTRODUCTION

Pain is defined by the International Association for the Study of Pain (IASP) as a sensorial, emotional, unpleasant experience related to tissue injury or described in such terms[1]. It is a subjective manifestation which involves physical, psycho and cultural mechanisms. Humans, throughout the years, have progressively tried to comprehend the causes of pain with the aim to get rid of it. It is generally difficult for someone to describe one's pain and impossible to know for sure the experience someone else's pain. This difficulty derives from the fact that pain is an individual experience, with self characteristics of the body[2].

Some methods are used trying to quantify pain; among them we can mention the Visual Analogue Scale (VAS). It consists of an horizontal bar which has a ruler inside it, which the individual uses to subjectively inform the intensity of his/her pain on a scale from 0 to 10[3,4]. Another method for pain measurement is the pressure algometer, which consists of a strength transducer, requiring a perception response of the evaluee[5].

Patients with complaints of chronic pain increasingly search for medical help. Therefore, new techniques are developed ad studied, such as the interferential current, with the aim to promote analgesia for these patients[3]. The therapy with interferential current is simple, non-invasive and widely used by physiotherapists to treat different diseases which produce pain[6]. It is commonly used as means of electrical stimulation, whose main clinical use is the pain relief[7].

The interferential current does not have an anti-inflammatory action and its effect is obtained through the inhibition of the nociceptive stimulus of the pain gates. Pain is caused by stimuli on the peripheral receptors, the nociceptors, through chemical mediators, thermal or mechanical stimuli. The afferent fibers with greater diameter dispute the access within sensory ascendent central tract, in the dorsal horn of the spinal cord, with the ones with narrower diameter. The hyperalgesia is inhibited by the fibers of wider diameter for carrying this stimulus more rapidly; thus, the nociceptive stimulus does not reach a conscious level[3,8]. Moreover, it is stated that the interferential current would cause reduction in the pain intensity by significant increase of the pain threshold and can even cause blocking of the nervous conduction[4,9].

Walker et al.[10] observed that the interferential current, compared with the transcutaneous electrical nervous stimulation (TENS), is more comfortable to the patient, besides acting more deeply into the tissues and having a longer delayed effect[11]. However, Johnson and Tabasam when evaluated induced ischemic pain in healthy volunteers, did not observe differences between techniques[12].

Yet, Palmer et al.[7] report that there are controversies concerning the effectiveness of the interferential current with studies mentioning positive effects[8,13] and other negative effects[14,15].

Due to the wide search for treatments related to pain and some uncertainties of the analgesic effects of the interferential current, when using as current base 2,000Hz (since in the clinical use and in research the mostly used current base is of 4,000Hz[7]), the present study has the aim to verify the effectiveness of the current base 2,000Hz, in the decrease of the nociception exposed to a pressoric pain stimulus as well to cold.

MATERIALS AND METHODS

Study characterization

The present study is characterized as a clinical, quantitative, random, crossed assay with 'blind' evaluator and volunteers, concerning the used stimulation protocol on the day and the use of electrostimulation, respectively.

Subjects of the research

The sample was composed of 14 healthy university students from the State University of Western Paraná (Unioeste), who volunteered to participate in the research after explanation on the aims and procedures. Out of these volunteers, four were male and 10 female, age range from 19 to 34 years with mean of 20.55 ± 4.48 years; weight ranging from 48 to 75kg with mean of 60.55 ± 8.98kg; height range from 1.55 to 1.78cm with mean of 1.68 ± 0.07m and BMI range from 19.47 to 23.67 with mean of 21.85 ± 1.63. The volunteers were clarified on the aims and procedures of the study and signed a Free and Clarified Consent Form, approved by the Ethics in research Committee of Unioeste.

The volunteers were randomly divided in two groups of seven individuals each, G1 (Placebo) and G2 (Experimental), which performed the same activities on consecutive days; that is, what G1 did on the first day, G2 did on the second day, and vice-versa.

Exclusion criteria were: presence of pacemaker or any kind of metallic implant; individuals running fever; neoplasias; tuberculosis; with cognitive or sensory deficit and individuals with suspicion or diagnosis of deep vein thrombosis; open wounds on the application site; circulatory insufficiency; hypersensitivity to cold; presence of the Raynaud Phenomonon; active bleeding; acute inflammatory conditions; acute edema; individuals submitted to radioactive therapy; diabetic individuals; alcoholic individuals and other polyneuropathies; patients with cervical myelopathy which could determine parestesias or other alterations of sensitivity.

Pain evaluation by mechanoreceptors stimulus

The individuals of the two groups immersed their dominant limbs up to the elbow, for five minutes, in warm water at 37ºC, to produce thermal balance between the participants. Subsequently, a dolorimeter brand name Kratos®, with capacity of producing pressure in up to 50Kgf was used as means of pressure pain stimulus. The volunteers for mbot groups were explained about the pain which would be assessed through a pressure stimulation technique, reporting the moment at which the subject started to feel pain. The dolorimeter was used with a metallic handle with pointed end, pressing on the thenar region and later on the hypothenar region of the dominant limbs, with gradual and vertical pressure, until the volunteer uttered the word "pain". After measurement the strength (Kgf) needed so that the painful stimulus could occur in each individual was taken note of. This protocol was adapted from the one proposed by Chesterton et al.[5].

Pain evaluation by thermoceptors stimulus

In order to assess the pain threshold and intensity to cold, the right arm of the individual was immersed up to the elbow in cold water at 5ºC, for 30 seconds. In order to evaluate the pain threshold to cold, the time at the exact moment at which the individual reported his/her painful threshold was taken note of. Therefore, the volunteer was asked that as soon as he/she experienced the pain stimulus, he/she uttered the word "pain"; this time set was the pain threshold to cold. Even after the evaluation of the pain threshold, the limb was kept in the cold water until completion of the 30 seconds; the painful sensation was then evaluated by the VAS, which goes from 0 to10, in which the individual reported the pain subjective sensation experienced during the 30 seconds, where 0 was no pain and 10 the strongest pain as possible, such protocol was adapted from Johnson and Tabasam[6].

Protocol of application of interferential current

Immwdiately after the pain evaluation (about one minute) to pressure and cold (EV1), the interferential current therapy was applied (Ibramed®, Neurovector, geração 2000, Amparo-SP), in the experimental group of the day, for 15 minutes, with the electrodes placed on the nervous roots from C3 to T1, in a transcutaneous way, by the bipolar technique, the current base was 2,000Hz, AMF 100Hz, ΔF 50%, slope 1/1, with current intensity above the sensitive threshold and the volunteer was asked to report it as intense but pleasant, with no motor threshold reach.

On the placebo group of the day, the individual was told that the therapy would be performed with intensity below the sensitive threshold; however, no current was added, the apparatus was simply turned on so that they could see the light over the mark, but could not read the intensity level. The electrodes positioning was identical to the one used in the treated group.

Reevaluation after the application of the interferential current

At the end of the application, the pain to pressure and cold was again assessed in the individuals of the two groups (EV2); after 20 minutes from the end of the electrostimulation, the evaluations were performed once again (EV3) and repeated after one hour (EV4). In all evaluation moments, the evaluator did not recognize which stimulus the volunteer would receive or had received.

STATISTICAL ANALYSIS

In the statistical analysis the Kolmogorov-Smirnov normality test was initially used. Once the normality data were stated, these were analysed for comparison within the groups, with ANOVA test for repeated measures and Tukey post-test, for comparison between groups non-paired t test with significance level of 5% in all cases was used.

RESULTS

There was not significant difference ($p < 0.05$) in the evaluation of the painful threshold to pressure when the placebo and experimental groups were compared; neither in the thenar nor hypothenare regions in any moment of the evaluations (table 1).

In the evaluation of the pain threshold to cold, for the placebo group, again there was not significant difference when comparing the different evaluation moments. However, for the treated group there was alteration in the threshold and in the evaluations subsequent to the treatment, the threshold was lower compared to the EV1 (table 2). Concerning the evaluation of the visual analogue scale, no significant difference was found in any comparison (table 2).

Table 1. Values obtained in the evaluation with pressure dolorimeter, in Kgf, for the different stimulation conditions (Placebo and Experimental), at the different evaluation moments (EV1-EV4), and application sites (thenar and hypothenar regions) for the 14 volunteers.

Group	Evaluations	Thenar region	Hypothenar region
Placebo	EV1	0.6738 ± 0.3579	0.7454 ± 0.3343
	EV2	0.6146 ± 0.2705	0.7100 ± 0.2941
	EV3	0.6962 ± 0.2078	0.7692 ± 0.2287
	EV4	0.6792 ± 0.2353	0.6808 ± 0.2048
Experimental	EV1	0.7015 ± 0.2790	0.7415 ± 0.2847
	EV2	0.6677 ± 0.1762	0.7592 ± 0.2608
	EV3	0.7377 ± 0.2286	0.7692 ± 0.2842
	EV4	0.6692 ± 0.1875	0.7762 ± 0.2783

Table 2. Values obtained by the evaluation of the pain threshold to cold, in seconds. Values of the visual analogue scale (VAS), in centimeters, for the different stimulation conditions (Placebo and Experimental), at the different evaluation moments (EV1--EV4), for the 14 volunteers.

Group	Evaluations	Thershold to cold	VAS
Placebo	EV1	18.23 ± 6.82	3.38 ± 1.87
	EV2	16.69 ± 8.07	3.81 ± 1.74
	EV3	17.69 ± 7.68	3.85 ± 1.39
	EV4	17.85 ± 7.83	4.50 ± 2.29
Experimental	EV1	21.92 ± 7.69	3.08 ± 2.26
	EV2	16.46 ± 8.31*	4.64 ± 2.69
	EV3	17.08 ± 8.32*	4.19 ± 2.05
	EV4	16.69 ± 7.34*	4.42 ± 2.23

*Statistically significant difference when comparing EV2, EV3 and EV4, with EV1 ($p < 0.05$).

DISCUSSION

The medium frequency current has there advantage of reducing the skin resistance, while still producing effects of low frequency within the tissues. It can be reached by the interference on the tissues (tetrapolar) or within the apparatus (bipolar), where the bipolar technique reaches deeper, produces greater torque and is more comfortable[16]. The interferential current, according to the classical theory, copies the low frequency due to the frequency modulated by the amplitude (AMF); however, there is evidence that the AMF is not very important in the activation of the excitable fibers[7]. In the present study, we tried to evaluate the use of the 2,000Hz current over the nociception to cold and pressure, using for this matter the bipolar application of electrodes, and with AMF of 100Hz, since the used equipment did not allow null AMF.

McManus et al.[17] observed hypoalgesia effects, both for the mechanical pain threshold and to cold models, when using medium frequency current with 5,000Hz of base and modulation in 100Hz. However, they did not observe effects concerning the tolerance and discomfort of the mechanical stimulus. It is worth highlighting that the authors mentioned above used the electrodes on the forearm different from what was used in the present study, besides the 5kHz current base. In addition to this difference, in the present study the inferential current with 2,000Hz current base, was not able to increase the mechanical pain threshold and produced increase in the pain and threshold to cold.

Transcutaneosu placement on the nervous roots was based on the study by Hurley et al.[18], who mention that the transcutaneous placement on the nervous roots is an effective technique in reducing pain in patients with low back pain.

Palmer et al.[19] evaluated the thermal thresholds to cold and heat with the use of the inferential with electrodes placement on the median nerve and did not find significant differences in the perception alterations of thermal thresholds, concluding hence that there are not significant differences in the threshold of A, delta and C fibers, neither in the application of inferential current and on the placebo of healthy individuals. Similarly, Johnson and Tabasam[6,20], when assessed healthy individuals, inducing pain through cold, did not find significant differences on the painful threshold in the individuals submitted to interferential current, both ranging the AMF and concerning the scanning delivery way. Such results clash with the ones found in the present study, since the pain threshold to cold was significantly decreased after application of current and during the one-hour follow-up, compared with the EV1 moment. In other words, the stimulation with inferential produces increase of sensitivity to cold.

Despite the controversial effects of the interferential current on the modulation of the threshold sensitive to cold, in healthy individuals[15], Ward et al.[21] mention that the interferential current should be the indication for electrostimulation for its comfort.

Adedoyin et al.[3], performed study with the aim to determine the efficiency of stimulation with interferential current in the pain treatment resulting from knee osteoarthritis in a Nigerian population. They reveal that the interferential current stimulation produces higher pain relief than the placebo. Similarly, Defrin et al.[4] observed that the interferential current is an efficient treatment in chronic pain of knee osteoarthrosis and that the disappearing of the current sensation during the treatment does not stop its analgesic effect. Thus, it is inferred that the use of electrostimulation, in healthy individuals, with the aim to alter nociception, subsequent to the current application, does not produce analgesic effects, but it does not mean that the current cannot produce analgesic effects in individuals with pain, due to some kind of present somatic alteration.

Therefore, the small sample size is mentioned as a limitation to the study. We suggest that further studies with comparative evaluations with different electrode positioning and variations in the modulation frequency, as well as bigger sample size are carried out.

CONCLUSION

The use of interferential current on the cervical nervous roots with 2,000Hz of current base, AMF of 100Hz, did not produce alteration in the pain threshold to pressure neither discomfort to cold, but produced decrease of the pain threshold to cold.

All authors have declared there is not any potential conflict of interests concerning this article.

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