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Pain threshold assessment in relation to neural mobilization therapy

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ABSTRACT. Nervous System Mobilization is used to restore the biomechanics of the nervous system and adjacent structures, promoting the return to their duties. This study evaluated the pain threshold to pressure, to cold, and the cold pain intensity in healthy subjects that underwent intervention with neural mobilization. The sample consisted of 20 volunteers with a mean age of 19.5 ± 1.0 years. The participants were divided randomly into two groups: group 1 (G1) and group 2 (G2); the first group received intervention by means of neural mobilization, and the second, by means of conventional stretching exercises, on the first day; on the subsequent day the procedures were reversed for the groups. The volunteers were evaluated using the pain threshold to pressure and to cold, and the cold pain intensity, prior, immediately after, 20, and 40 minutes after the intervention. No significant differences were found between any assessments. In conclusion, the pain threshold to pressure and to cold, and the cold pain intensity had no significantly change after neural mobilization.

Keywords: pain measurement, nociceptors, nervous system.

Avaliação do limiar de dor frente à terapia com mobilização neural

RESUMO. A mobilização do Sistema Nervoso é utilizada para restabelecer a biomecânica do sistema nervoso e também de estruturas adjacentes, o que promove o retorno às suas funções. O objetivo do presente estudo foi avaliar o limiar de dor à pressão e ao frio e a intensidade da dor ao frio, em indivíduos saudáveis submetidos à intervenção com mobilização neural. A amostra foi composta por 20 voluntárias, com idade média de $19,5 \pm 1,0$ anos. As participantes foram divididas, aleatoriamente, em dois grupos, o grupo 1 (G1) e o grupo 2 (G2), sendo que o primeiro recebeu intervenção por meio de mobilização neural e o segundo por meio de alongamentos convencionais, no primeiro dia, já no dia posterior os grupos inverteram os procedimentos. As voluntárias foram avaliadas por meio do limiar de dor à pressão e ao frio, além da intensidade de dor ao frio, antes das intervenções, imediatamente após, 20 e 40 minutos depois das intervenções. Os resultados demonstraram que em todas as avaliações não houve diferenças significantes. Desta maneira concluiu-se que o limiar de dor à pressão e ao frio e a intensidade de dor ao frio não foram alterados significativamente após mobilização neural.

Palavras-chave: medição da dor, nociceptores, sistema nervoso.

Introduction

The nervous system is a continuous structure, and the lack of neural mobility, in a given segment of the body, is transmitted to the entire system, and may cause limitations in adjacent structures. Thus, the impairment of the nervous system mechanics, including movement, elasticity, conduction and axoplasmic flow, can generate dysfunctions in the nervous system or in the musculoskeletal structures that receive its innervations (ZAMBERLAN; KERPPERS, 2007). The mobilization of the nervous system is used to restore the biomechanics of the nervous system and adjacent structures, promoting the return to their functions; it also represents a specific

technique to address neurogenic diseases and after its application there is a reduction in intensity of pain and in associated symptoms (BUTLER, 2003).

Shacklock et al. (2007) highlight the importance of the neural tissue sensitivity and the slippages effects in adjacent structures of the nervous system, stating that neurodynamic tests distinguish normal nervous tissue from the abnormal, by means of its mechanosensitivity. The treatment can emphasize the categories of diagnosis and systematic progressions, and the techniques of neural mobilization include repetitive movements of the segments, which reproduce the symptoms, besides producing a

combination of distal movements for more proximal segments (KOSTOPOULOS, 2004).

The pain is a subjective, unpleasant, and vital perception. The interpretation of the harmful stimulus protects the organism, like an alarm. It is estimated that 80% of the medical consultations worldwide are due to pain. The high prevalence of chronic pain in Brazil becomes a problem of public health, with an important socioeconomic impact, stimulating the system to investigate efficient interventions for the treatment of pain (SOUZA, 2009).

The neuropathic pain is defined as the pain caused by injury or dysfunction of the somatosensory system, as a result of the abnormal activation of the nociceptive route. There is approximately 17% of neuropathic pain in all patients with chronic pain; such a framework is mainly composed of women and elderly people of low social and economic condition (SCHESTATSKY; NASCIMENTO, 2009).

Recognizing the importance of the pain evaluation, its management and control, the American Society of Pain established this symptom as "the fifth vital sign" and emphasized that the pain assessment is as important as the evaluation of the other four vital signs. Therefore, it is necessary the use of scales to produce measure parameters and, consequently, the appropriate pain control. The Visual Analogic Scale has the purpose to ally the perceived intensity of a physical stimulus to a perceptive modality, providing a subjective response of pain (HORTENSE et al., 2008).

Other way to quantify the threshold of pain is through the dolorimeter of pressure, a device that applies measurable pressures in points of the body surface, and establishes the threshold of the pain appearance and its level of tolerance (TASTEKIN et al., 2010).

There is a lack of studies on the procedures with neural mobilization, its impact in the pain threshold and its projections; therefore there is a need to gather more subsidies about the technique applications and its recommendations, as a therapeutic resource in the nervous system dysfunctions. For that reason, the present study evaluated the pain threshold to pressure and to cold, and the pain intensity to cold, in healthy individuals submitted to intervention with neural mobilization.

Material and methods

Characterization of the study and sample

The criteria of inclusion were healthy individuals with no alterations or skin injuries, tactile alterations, algic state, neuropathies, hypersensitivity or any type of treatment that could interfere in the research.

The individuals signed a consent form. The study was approved by the Research Ethics Committee of the State University of Western Paraná under number 414/2009.

The present study is a clinical trial, crossed and with blind evaluator. The participants were randomly divided into two groups of 10 individuals each, allocated in the group 1 (G1) or in the group 2 (G2) according to the nominal sortition, performed by taking their names from an envelope. G1 received intervention by means of neural mobilization and G2 by conventional stretching, during the first day. On the subsequent day, the procedures were inverted for the groups. The volunteers were evaluated before the interventions (EV1), immediately after (EV2), 20 (EV3) and 40 (EV4) minutes after the interventions; and all the evaluations were performed in the same period of the day and the room temperature ranged from 24 to 26°C during the interventions performance. All the evaluations were performed continually, by two qualified evaluators and the techniques were performed by a third therapist.

Protocols for evaluation

Evaluation of the pain threshold by pressure

In order to stabilize the upper limb temperature, all the volunteers have immersed their right upper limb up to the elbow, for 5 minutes in the water at 38°C.

As a means to stimulate the pain threshold to pressure, it was used a dolorimeter, (Kratos®), with tapered extremity and able to produce pressure up to 50 kgf. It was explained to the participants, of both groups, that it would be evaluated the pain threshold by means of a technique of stimulation by pressure, and they should report the exact moment when the stimulus became painful. The evaluator stabilized the volunteer's right hand and pressed, with growing intensity, the device in the thenar region, quantifying the necessary force (kgf) to occur the painful stimulus in each individual.

Evaluation of pain threshold by means of thermoreceptors stimulation

The evaluation with the cold started immediately after the intervention with the dolorimeter of pressure, the volunteers immersed the right upper limb (up to the elbow articular interline) in the water at 5°C for 30 seconds, and it was registered the exact time when the individuals reported their painful thresholds, that is, when it was mentioned the word 'pain' by the volunteers. After 30 seconds, it was registered the numerical value of the painful sensation, by means of the Visual Analogic Scale of pain (VAS), in which the participants were instructed to refer the degree of

pain felt, being used a device with a line of 0 to 10 cm whose extremities correspond to the absence of pain, situated at the left extremity, and the maximal pain, located in the opposite extremity. The water temperature control was kept by the addition of ice cubes and monitored by means of a mercury thermometer, throughout the procedure.

Protocol for neural mobilization

In the present study were used three techniques of neural mobilization for the median nerves, ulnar and radial. The interventions were performed with 60 oscillations during a minute for each nerve, without intervals, resulting in three minutes of total treatment, with neural mobilization for the right upper limb.

To perform mobilization of the median nerve, the volunteer was positioned in dorsal decubitus, with depression of the scapular waist associated to the abduction in approximately 110° and external rotation of the shoulder, supination of the forearm, elbow extension, fist and fingers, and the cervical was kept on the stretcher support slightly inclined to the opposite side of the right upper limb. After being kept this position, were applied oscillations with maximal extension of fist and return to the neutral position.

To perform the mobilization of the radial nerve, the volunteer remained in dorsal decubitus with the cervical on the stretcher support and slightly inclined to left side, with depression of the scapular waist, internal rotation and abduction of shoulder in approximately 20° and elbow outstretched and pronated. With the hand which was holding the fist the therapist performed oscillations with maximal flexion of the same, together with the fingers in slow and rhythmic way and return to the neutral position.

For the mobilization of the ulnar nerve, the decubitus and cervical position was similar than the previous case, being performed also: extension of fist, supination of forearm, total flexion of elbow, abduction of shoulder, positioning the volunteer's hand by the ear side performing maximal extension of the fist and the return to neutral position, in a rhythmic way.

Protocol for the control group

For this group, stretchings of the supra-spinal muscle were performed, through horizontal adduction of the upper limb, maintaining the shoulders aligned and pressing them down for 30 second and resting for 30 seconds, alternately until reaching the stipulated time of 3 minutes.

Statistical analysis

The statistical analysis occurred by the data presentation in the form of median, first and third quartiles, average and standard deviation, followed by Kolmogorov-Smirnov normality test. For comparison of the results of compression with the dolorimeter, it was used the repeated measures ANOVA, with the Tukey's post-hoc test; and for comparison of the results of pain threshold to cold and the pain intensity to cold, it was used the Friedman test and Dunn's post-hoc test, in all cases the significance level adopted was 5%.

Results

The sample consisted of 20 female volunteers, with mean age of 19.5 ± 1.0 years.

Evaluation of the pain threshold by pressure

Taking into account the comparisons among the neural evaluations pre-mobilization (EV1), post-immediate (EV2), twenty minutes (EV3) and an hour after neural mobilization (EV4), no significant difference ($p > 0.05$) was detected with the dolorimeter, regarding the painful threshold of pressure in the thenar region, regardless of the analyzed group (Table 1).

Table 1. Pain evaluation by pressure, in the thenar region of the right hand, according to the evaluation moments. Values expressed in kgf.

	EV1	EV2	EV3	EV4
Neural Mobilization	0.4080 ± 0.1821	0.4195 ± 0.1974	0.3900 ± 0.1268	0.3675 ± 0.1003
Control	0.4460 ± 0.1789	0.4285 ± 0.1523	0.4035 ± 0.1483	0.4035 ± 0.1565

EV1 - initial evaluation; EV2 - post-immediate; EV3 - after 20 minutes; EV4 - after 40 minutes. No significant difference ($p > 0.05$) was found for any comparison.

Evaluation of pain threshold to cold

As for the evaluation of the painful threshold to the cold, once again both in the placebo and in the neural mobilization group no significant difference ($p < 0.05$) was found (Table 2).

Table 2. Evaluation of the pain threshold to cold, in the right upper limb, according to the evaluation moments. Values expressed in seconds.

		EV1	EV2	EV3	EV4
Neural Mobilization	Q1	5.925	7.250	6.625	7.900
	Median	8.800	9.700	8.450	10.05
	Q3	12.75	22.15	18.58	21.73
Control	Q1	6.075	7.925	7.225	5.975
	Median	9.200	11.65	8.350	10.35
	Q3	13.80	18.00	13.85	20.53

EV1 - initial evaluation; EV2 - post-immediate; EV3 - after 20 minutes; EV4 - after 40 minutes. No significant difference ($p > 0.05$) was found for any comparison.

Evaluation of cold pain intensity

In relation to the painful sensation, evaluated with the VAS, also no significant difference was detected for evaluations in the group G1 and G2 (Table 3).

Table 3. Evaluation with the Visual Analogic Scale of the cold pain intensity, according to the evaluation moments (EV1 - initial evaluation; EV2 - post-immediate; EV3 - after 20 minutes; EV4 - after 40 minutes) and group (neural mobilization or placebo). Values expressed in centimeters.

		EV1	EV2	EV3	EV4
Neural Mobilization	Q1	5.125	3.800	4.250	3.950
	Median	6.450	6.000	6.800	6.250
	Q3	7.425	6.700	7.500	7.450
Control	Q1	3.625	3.500	4.100	3.325
	Median	6.000	6.300	5.450	5.250
	Q3	7.500	6.925	6.775	7.075

EV1 - initial evaluation; EV2 - post-immediate; EV3 - after 20 minutes; EV4 - after 40 minutes. No significant difference ($p > 0.05$) was found for any comparison.

Discussion

In the present study, all evaluations to the pain threshold and pain intensity to cold, or to the pain threshold to pressure, had no significant differences for both groups evaluated.

Nardi Junior and Bertolini (2010) have used a similar procedure to evaluate the pain thresholds to cold and to pressure, as well as for the evaluation of cold pain intensity. They observed, for the control group, a trend similar to that found in the present study, only for the cold pain intensity, and reported a significant increase when compared the first evaluation with the one performed 1 hour later.

Piovesan et al. (2001) showed that the reproduction of thresholds for painful perception is higher in asymptomatic individuals than in disease carriers, partially due to the continuous nociceptive modifications experienced by the individuals carriers of recurrent painful syndromes, whereas the thresholds of painful perception can oscillate, during the crises.

The evaluation of the pressure pain threshold is dependent on the evaluator technique, but also on the capacity of the people assessed to provide verbal indication coherent to their painful thresholds (CHESTERTON et al. 2007). In the present study it was used as sample, healthy volunteers, without history of pain or some alterations in the sensitivity or cognitive, which could thus undermine the results found during the evaluations. However, the evaluators were previously trained, as to techniques of evaluation.

By assessing the use of neural mobilization in healthy individuals, Parreira et al. (2009) have found increase in movement amplitude by applying the elevation test of extended leg after the application of

neural mobilization for the median nerve. This fact can be attributed to the central nervous system continuity, demonstrating that the application of a tensile load can reflect on other segment. Thus, a hypothesis that seeks to justify the use of neural mobilization, as a form of treatment, is that the use of neural mobilization for three long peripheral nerves could produce interferences to each other and in adjacent structures.

Oliveira Junior and Teixeira (2007) reported that besides being object for evaluation and diagnosis, the mobilization of the central nervous system also improved the movement amplitude, and was effective for reducing algias. Besides, the authors mentioned that 3 minutes of mobilization, which can progress according to the treatment, had been enough to obtain positive results. For that reason, the time of neural mobilization used in this research was in accordance with the mean time described in the literature.

Wolny et al. (2010), assessing sensory deficits of upper limbs in patients, after cerebral vascular accident, at final stage of treatment, observed that for the group of proprioceptive neuromuscular facilitation associated to the neural mobilization, for median and radial nerves, the results have been better than for the group of only proprioceptive neuromuscular facilitation or conventional therapy, concluding that this type of therapy produced better results on the sensory deficits.

Bertolini et al. (2009), using an experimental model of compression of sciatic nerve, concluded that the neural mobilization, as a form of therapy, was effective to reduce the sciatic pain in rats. On the other hand, for Scrimshaw and Maher (2001), there were no clear evidences that the post-operative of the lumbar spine surgery should include the protocol of the nervous system mobilization for sciatic nerve and lumbosacral region, whereas compared with the control group there were no significant differences in the improvement of the pain and morbidities.

One of the main characteristics of the central sensitization in individuals with musculoskeletal pain is a reduction in its pain threshold to pressure, which in most cases represents a primary hyperalgesia due to the sensitization of nociceptors of the injured area (NIJS et al., 2010). Thus, studies that use symptomatic samples could have, more easily, significant results for techniques of treatment, such as the neural mobilization used in this research, because such individuals have alterations of the pain threshold previously to the procedure.

However, Krouwel et al. (2010) investigated the hyperalgesic effects in healthy individuals, after 3 sessions of mobilization of the lumbar spine, in 3 distinct days with intervals of 48 hours, and observed an increased pain threshold by pressure. In this case the justificative for the positive response in healthy individuals would be that the interventions were performed during more days, which could imply in summation of effects, not observed in the present study, since the neural mobilization was performed in a single day, being the previous or the subsequent session used only as placebo; and according to Nee and Butler (2006) the learning by the patients about the neurobiological mechanisms of the movement, can ease performing the therapeutic.

In the study of Ellis and Hing (2008), it was recognized the difficulty for the criteria of inclusion in systematic reviews in respect of neural mobilization, which makes the studies clinically heterogeneous, since were observed studies with diverse injuries and different types of protocols, besides some studies have blinded their evaluators while others did not, which can alter the research reliability, making difficult the analysis of the method effectiveness. In addition, differences among the sequences, intervals and quantity of mechanical load applied to specific nervous segments, could influence the results during the performance of neurodynamic tests (NEE et al., 2010).

Again, it was highlighted the existing controversy in literature, regarding the effects of neural mobilization, with some indications of positive results in the altered initial conditions of the pain thresholds, thus, it is suggested that further studies should focus on evaluating these individuals' pain, and also provide more subsidies to understand the cause of the possible effects of the neural mobilization.

Conclusion

In conclusion, the neural mobilization had no influence on the pain threshold to pressure and to cold, and on the cold pain intensity, for asymptomatic individuals.

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