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EFFICACY OF INTERFERENTIAL THERAPY ON MECHANICAL PAIN THRESHOLD, MAXIMAL TORQUE AND CREATINE KINASE ACTIVITY AFTER ECCENTRIC EXERCISE IN HUMAN QUADRICEPS

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SUMMARY

This study examined the interferential current (IC) acute effect on mechanical pain threshold (MPT), eccentric peak torque (EPT) and creatine kinase (CK) activity after delayed onset muscle soreness (DOMS) induction by eccentric exercise in human quadriceps. Forty-one physically active healthy male volunteers aged 18-33 years were randomly assigned to one of two experimental groups: Interferential Current (IC; n=21) or Placebo (PL; n=20) group. Both groups performed a bout of 100 isokinetic eccentric maximal voluntary contractions (10 sets of 10 repetitions) at an angular velocity of 1.05 rad.s-1 (60°.s-1) to induce DOMS. On the next day, volunteers received either an IC or a placebo-IC treatment. IC was applied for 30 minutes (4 KHz frequency; 125 μs pulse duration; 80-150 Hz bursts). MPT, EPT and CK activity were measured at four different time intervals: prior to induction of DOMS, immediately following DOMS induction, on the next day after DOMS induction, and immediately after the IC application. Both groups showed an increase in CK levels and a reduction in EPT and in MPT after exercise. After IC treatment only the IC group showed a significant increase in MPT with no changes in EPT and CK activity. IC was effective in increasing quadriceps MPT after eccentric exercise, with no effect on EPT and CK activity.

INTRODUCTION

Eccentric exercise is commonly used in sport practice especially in desacceleration movements; however, it usually produces delayed onset muscle soreness (DOMS) [1,2,3]. Among the main acute effects of eccentric exercise are: soreness and muscular pain, blood serum muscular proteins increase and a reduction in muscular strength [4,5,6]. IC has been used in DOMS treatment and it is defined as the transcutaneous application of two alternating medium frequency electrical currents usually between 4000 and 4100Hz that are amplitude modulated to create a low frequency for therapeutic purposes. Although eccentric exercise is commonly used in sport practice, only few studies evaluated the effect of IC in exercise symptoms of the elbow flexor muscles: Schmitz et al. [7] found a significant decrease in perceived pain scores across treatment groups after IC therapy using low or high frequencies; Minder et al. [8] demonstrated no significant differences between treatment (placebo and IC) groups in perceived pain using similar parameters. Our previous study evaluated the hamstrings muscles and found pain reduction after IC application [9]. Thus, results in the literature are controversial and there is a gap in the literature with respect to the IC efficacy in DOMS treatment. As eccentric exercises are very common in sports, the rapid reversion of exercise symptoms in athletes is essential for both function restoration and regain of sports performance [3]. Therefore, the aim of this study was to examine the interferential therapy efficacy on mechanical pain threshold (MPT), eccentric peak torque (EPT) and creatine kinase (CK) activity after DOMS induction by quadriceps eccentric exercise in humans.

METHODS

Forty-one healthy male volunteers aged 18-33 years (mean=24.0; SD=3.7) were recruited and randomly assigned to one of two experimental groups: Interferential Current group (IC) (n=21) or Placebo group (PL) (n=20). Both groups underwent an eccentric exercise protocol aimed at inducing muscle soreness. On the next day, volunteers returned to the laboratory for the IC or placebo treatment. Participants were physically active for at least 3 months prior to their participation in the study. They were instructed to not ingest any medication for at least 48 hours prior to data collection and to not perform any exhausting and/or eccentric exercise. All variables were measured in four moments: prior to DOMS induction (PRE), immediately following DOMS induction (0h POST), on the day after the induction (24hs POST) and immediately after the IC application (IC POST). The following variables were analyzed: painful sensitivity through the MPT, quadriceps EPT and CK activity as a marker of muscle damage. A handheld analogic pressure algometer with 0.9 cm diameter head (Pain Diagnostic & Treatment Inc., Great Neck - NY, USA) was used for MPT measurements (0-20 Kgf, 0.1 Kgf divisions). Participants were instructed to say ‘stop’ at the precise moment they felt the pressure turned into a painful sensation. Values for each participant were taken as the amount of force (Kgf) required to eliciting a painful sensation. The algometer was used at 40% of the femur distal length in the anterior region of the thigh on each test [9]. Eccentric torque measurements were obtained using a Biodex System 3 isokinetic dynamometer (Biodex Medical System, Shirley - NY, USA). Volunteers were instructed to

perform maximal force in all contractions (non-dominant lower limb). The eccentric torque was assessed at an angular velocity of 60°.s-1 through a 50° range of motion. Two-minute rest between contractions was observed and the peak torque value between three contractions was considered the participants maximal eccentric torque. Blood samples (10ml) were collected from an antecubital vein before each test by a trained professional. Blood was allowed to clot and then the samples were kept on ice until centrifugation at 3000 rpm for 15 min at 4°C [10]. Samples were stored at -60°C until the analysis of serum CK. CK activity was measured by spectrophotometric enzymatic assays using a standard laboratory kit (Labtest Diagnóstica S.A., Lagoa Santa, Brazil). To induce DOMS participants were positioned on the dynamometer and were instructed to perform a bout of 100 isokinetic eccentric maximal voluntary contractions at an angular velocity of 60°.s-1 through a 50° range of motion. The eccentric actions were performed as 10 sets of 10 repetitions with three minutes rest between sets [9]. IC treatment (4 KHz frequency; 125 µs pulse duration; 80-150 Hz bursts) was applied 24 hours after DOMS induction for 30 minutes using a Chattanooga interferential unit (2738K Intellect Transport® Combo; Vista, CA - USA) and two carbon rubber electrodes (5 cm x 9 cm / 2" x 3.5"). One electrode was positioned 2 cm above the point where MPT was measured and the other one was placed 2 cm below the same reference point. The IC intensity was increased until the participant reported a 'strong but comfortable' sensation. For the PL group, the procedures were similar to the IC group, however, no current was delivered [9]. A two-way ANOVA (group x test) and a Holm-Sidak post-hoc test were used to compare MPT, IPT and CK activity values. All analyses were performed with an alpha level of $p<0.05$ (SPSS 17.0).

RESULTS AND DISCUSSION

There were significant differences for MPT between tests ($p<0.001$) but not between groups ($p=0.441$). MPT values also did not show group by test interaction ($p=0.300$). The comparison between groups in each test showed significant difference only on IC POST test ($p=0.048$) (Figure 1A). In the first three tests both groups were similar for MPT, which was expected considering that both received the same intervention until the third test. The exercise was effective in increasing painful sensitivity for both groups in the expected period. The placebo treatment did not influence the results of the IC POST test; however, significant differences demonstrated that the use of the IC led to a decrease in the painful sensitivity in the IC group. Significant differences for torque were observed between tests ($p<0.001$) but not between groups ($p=0.128$). Also, EPT values did not show group by test interaction ($p=0.917$), demonstrating similar behavior between IC and PL groups. The comparison between groups in each test did not show significant differences at any test. (Figure 1B). Eccentric exercise was effective in reducing torque after the induction of soreness and such decrease was maintained up to the last test, even after IC or PL application. Significant differences between tests ($p<0.001$) but not between groups ($p=0.258$) were observed for CK activity. Also, values did not show group by test interaction ($p=0.878$). The comparison between groups in each test did not show significant differences at any test. Exercise was effective in increasing CK activity 24 hours after the induction of soreness for both groups and such decrease was maintained up to the last test, even after IC or PL application. Altogether, the MPT, EPT and CK activity results show that even with the decreased painful sensitivity, torque values and CK levels did not change after IC application. This fact strengthens the idea that the analgesic electric currents commonly used in therapy do not deal with the cause of injury, they only restrain the painful sensation probably through the gates of pain mechanisms [11] and through the action of endogenous opioids [12] depending on the used parameters.

CONCLUSIONS

IC was effective in increasing quadriceps muscles MPT after eccentric exercise, notwithstanding that the EPT and CK activity did not change after the use of the electrical current.

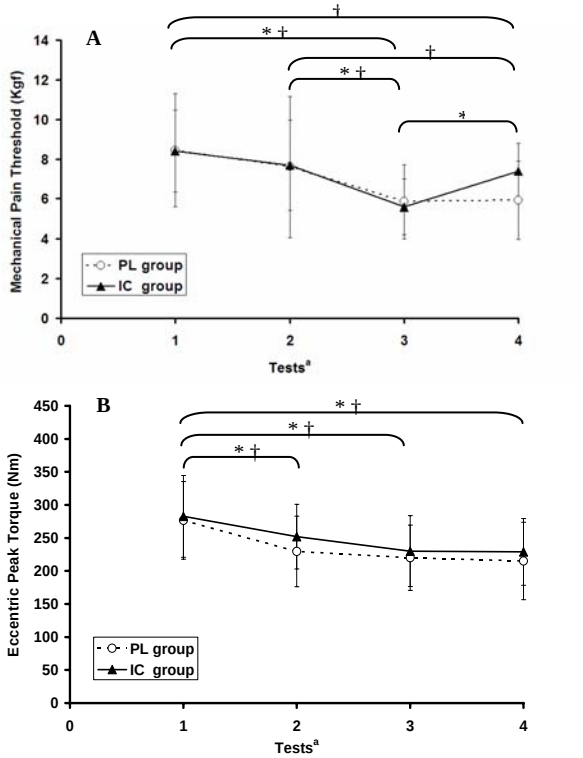

Figure 1: Results for IC (n=21) and PL (n=20) groups (mean and SD values). A: Mechanical Pain Threshold. B: Eccentric Peak Torque. Tests: 1 = Pre-exercise; 2 = 0h Post-exercise; 3 = 24h Post-exercise; 4 = IC Treatment Post-exercise. * $p<0.05$ for IC group; † $p<0.05$ for PL group.

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