EFFECTS OF PULSED ELECTROMAGNETIC FIELD (PEMF) ON LACTATE REMOVAL CAPACITY AFTER AN EXHAUSTIVE REPEATED SPRINT PROTOCOL

Pedro Sardinha Leonardo Lopes Martins[1]
Pedro Augusto Inacio[2]
Heloísa Ferreira de Almeida [1]
Paulo Ricardo França[3]
Luara Alves Faria[4]
Patrícia Sardinha Leonardo[5]
Rodrigo Alvaro Lopes-Martins[6]
Alberto Souza Sá Filho[7]

1 Discente do curso de Medicina, Universidade Evangélica de Goiás.
2 Discente do PPGMHR, Universidade Evangélica de Goiás.
3 Discente do PPGCFFT, Universidade Evangélica de Goiás
4 Discente do Curso de Fisioterapia, Universidade Evangélica de Goiás.
5 Docente do PPGCFFT e PPGMHR, Universidade Evangélica de Goiás
6 Docente do Curso de Ciências Biológicas, Universidade Evangélica de Goiás
7 Docente do Curso de Educação Física, Universidade Evangélica de Goiás

ABSTRACT

Introduction: Pulsed electromagnetic field (PEMF) stimulation has gained attention in health and performance sciences, being used to assist muscle recovery. **Objectives**: To evaluate the efficacy of PEMF in accelerating lactate removal in participants after an exhaustive sprint running protocol. **Methods**: Four participants of both sexes completed two visits. Lactate measurements were taken at baseline, immediately after exercise, and at 5, 10, 15, and 30 minutes post-exercise. The protocol consisted of ten 75-meter sprints with 30-second intervals. In one condition, PEMF was applied to accelerate muscle recovery; in the other, recovery was passive (rest). **Results**: Lactate peaked 5 minutes post-exercise. Both conditions showed a reduction in lactate concentrations, but the control group had higher mean values (83%) compared to the PEMF group (76%). Paired t-tests showed no statistical significance at immediate (p=0.0592), 15 minutes (p=0.0833), and 30 minutes (p=0.0784) post-exercise. **Conclusion**: PEMF did not demonstrate improved lactate removal at the evaluated time points; however, the results suggest that a larger sample size may achieve statistical significance.

Keywords: PEMF; Lactate; Muscle recovery; Sprint

INTRODUCTION

Pulsed electromagnetic field (PEMF) stimulation is a tool widely used in physiotherapy and rehabilitation (Bogataj, 1995; Samuels et al., 2019). This strategy has gained attention in both health and performance contexts. Its mechanism is based on promoting depolarization of the cell plasma membrane, opening ion channels—particularly voltage-dependent calcium channels—generating an action potential and, consequently, muscle contraction (Leonardo et al., 2023). The contraction pattern can be powerful tetanic contractions or light submaximal contractions, which can aid muscle recovery.

According to Dupuy et al. (2018), in their systematic review, massage techniques are more effective at reducing delayed onset muscle soreness (DOMS) and perceived fatigue compared to other methods, including conventional electrostimulation and cryotherapy. However, to our knowledge, no studies have used PEMF to analyze recovery, which could, through light/moderate activation, accelerate the restoration of acid-base balance and reduce fatigue perception after exhaustive tasks.

Therefore, this study aimed to evaluate the efficacy of PEMF as an active recovery strategy to induce faster lactate removal in recreationally trained individuals subjected to an exhaustive sprint running protocol.

MATERIALS AND METHODS

Sample

Four physically active participants of both sexes were invited. Inclusion criteria: at least 1 year of training, regular aerobic and high-intensity strength exercise, no use of substances affecting recovery. Exclusion criteria: prior injuries, low aerobic fitness.

Study Design

Two visits were conducted. Lactate levels were measured at baseline, immediately post-exercise, and at 5, 10, 15, and 30 minutes post-exercise. The exercise protocol consisted of ten maximum 75-meter sprints with 30-second intervals. In one condition, PEMF was applied to accelerate recovery; in the other, participants underwent passive recovery (lying down at rest).

PROCEDURES

Exercise Protocol

The exercise protocol began with a 5-minute light warm-up (self-selected by participants). On a semi-professional track, participants were positioned on the start line (without starting blocks) for repeated sprints. The 75-meter course was straight and marked with cones. Three evaluators measured performance at specific points: a) start line, b) midline, c) finish line. Participants started at a whistle signal and performed repeated maximal sprints, verbally encouraged to achieve maximum effort.

PEMF Procedure

The PEMF device used was the portable Supramaximus (Adoxy™). The PEMF procedure lasted 30 minutes over both gastrocnemius muscles. Magnetic flux density ranged between 10–15% (of a total of 7.5 Tesla per applicator) at a submaximal frequency of 5 Hz. Participants lay supine on a table near the track during the procedure.

Lactate Measurement

Lactate was measured at: a) baseline, b) immediately after exercise, c) 5 min post-exercise, d) 10 min post-exercise, e) 15 min post-exercise, f) 30 min post-exercise. Blood was collected from the earlobe by a trained evaluator, discarding the first drop. The device was recalibrated for each participant.

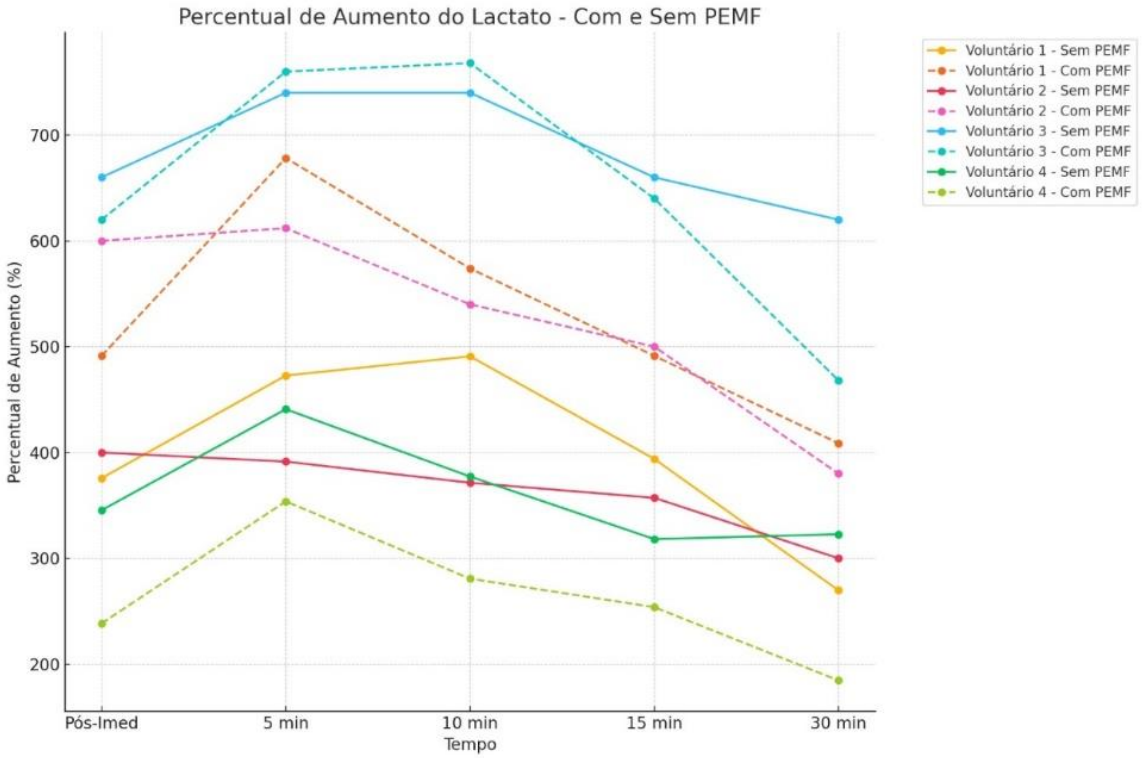
Statistical Analysis

Data were presented as mean ± standard deviation. Paired t-tests compared experimental conditions. A significance level of $p = 0.05$ was adopted.

RESULTS

For both groups (control and PEMF), lactate peaked 5 minutes post-exercise (values were relativized to this peak). Lactate levels decreased over time in both groups. However, the control group had higher mean values (83%) compared to the PEMF group (76%), suggesting a potential initial advantage from active recovery. Paired t-tests revealed no statistical significance at immediate ($p=0.0592$), 15 min ($p=0.0833$), and 30 min ($p=0.0784$) post-exercise. Figure 1 shows lactate concentration behavior.

Figura 1. Comportamento individual da concentração de lactato



CONCLUSION

Despite the observed trend toward reduction, PEMF was not able to improve lactate removal responses at any of the evaluated time points. Expanding the sample size is suggested for further insights and potential results.

Acknowledgments

To CNPq – Undergraduate Research Grant for Pedro Sardinha Leonardo Lopes Martins; Research Productivity Grant 1B for Professor Rodrigo Alvaro B. Lopes Martins**.**

REFERENCES

BOGATAJ U, G. N. K. M. A. R. M. M. **The Rehabilitation of Gait in Patients With Hemiplegia: A Comparison Between Conventional Therapy and ~ultich-me1 Functional Electrical Stimulation Therapy**. [s.l: s.n.].

DUPUY, O. et al. An evidence-based approach for choosing post-exercise recovery techniques to reduce markers of muscle damage, Soreness, fatigue, and inflammation: A systematic review with meta-analysis. **Frontiers in Physiology**, v. 9, n. APR, 26 abr. 2018.

LEONARDO, P. S. et al. Applications of Pulsed Electromagnetic Field Therapy in Skeletal-Muscle System: An Integrative Review. **Manual Therapy, Posturology & Rehabilitation Journal**, v. 21, p. 1–11, 2 fev. 2023.

SAMUELS, J. B. et al. Safety and Efficacy of a Non-Invasive High-Intensity Focused

Electromagnetic Field (HIFEM) Device for Treatment of Urinary Incontinence and Enhancement of Quality of Life. **Lasers in Surgery and Medicine**, v. 51, n. 9, p. 760–766, 1 nov. 2019.