Effects of Electrical Muscle Stimulation (EMS) and Active Recovery on Blood Lactate Levels

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Abstract

Electrical muscle stimulation (EMS) is a method of muscle recovery used by athletes before, during, and after competition. Active recovery is arguably the most popular recovery technique after intense exercise because of how much it reduces lactate levels in the blood. Few studies have analyzed the effects of EMS and active recovery on blood lactate levels in swimmers, and none have been found on the combination of the two. Therefore, there is an insufficient amount of information linking the two methods together for the purpose of maximizing blood lactate reduction. This study sought to analyze the effects that EMS and active recovery have on Division 1 collegiate swimmers' blood lactate levels specifically in their quadriceps muscles. Participants completed two sets of seven 200-yard swims separated by a week, with the intensity of each swim gradually increasing until the last two which are maximum effort. Following the final swim, each participant completed the EMS and active recovery protocol. Blood samples were taken after each swim and following recovery protocol to analyze lactate levels. It was hypothesized that the combination of the two methods would lower lactate in the blood faster than only utilizing active recovery or EMS.

Keywords: EMS, active recovery, swim, blood lactate

Introduction

- Competitive swimming requires proper muscle recovery to attain elite status (McArdle, Katch, & Katch, 2015).
- Lactate production increases during anaerobic exercise due to the body's need to maintain energy (McArdle et al., 2015).
- Lactate levels decrease during active recovery, or when performing at 60-65% of relative maximum heart rate (Neric, Beam, Brown, & Wiersma, 2009).
- Most swimmers warm-down after racing as a form of active recovery to help lower blood lactate levels (Vescovi, Falenchuk, & Wells, 2010).
- The purpose of this study was to determine if the combination of EMS and active recovery affects blood lactate levels more than active recovery.

Methods

Participants

- Twelve male and 12 female collegiate swimmers with an average age of 20 years old
- At least six years of swimming experience with 15-20 hours of training per week

Research Design

- Seven 200-yard swims at an increasing intensity with the last two at maximum effort
- Blood samples obtained from quadriceps before the first 200 and after each subsequent swim
- Each participant was randomly assigned a recovery protocol

Active Recovery	Active Recovery & EMS
20 minutes of active recovery with blood samples every five minutes	10 minutes of active recovery followed by 10 minutes of EMS with blood samples every five minutes

Data Analysis

- A paired t-test was used to see if there was a significant statistical difference between active recovery and combined recovery.
- Descriptive statistics plots were used to explore intermediate lactate levels throughout the test.
- This helped track the increase and decrease in lactate levels throughout exercise intensity and recovery.

Timeline of Blood Sample Collection (Exercise)

Before the start of exercise	After the 1st swim at 75% of max	After the 2nd swim at 80% of max	After the 3rd swim at 85% of max
After the 4th swim at 90% of max	After the 5th swim at 95% of max	After the 6th swim at 100% of max	After the final swim at 100% of max

Timeline of Blood Sample Collection (Recovery)

5 minutes into recovery	10 minutes through total recovery	15 minutes through total recovery	After 20 total minutes of recovery

Active Recovery | EMS

Active Recovery

Summary & Conclusion

- EMS has been shown to reduce soreness and improve range of motion (ROM) and strength in subjects who suffered from delayed-onset muscle soreness (DOMS) by almost 25% (Butterfield et al., 1996).
- This research could help to better understand the relationship between EMS and active recovery and how they can more efficiently decrease lactate levels in the blood.
- This research could be vital to conduct this research for the purpose of optimizing one's athletic abilities, especially in swimmers.

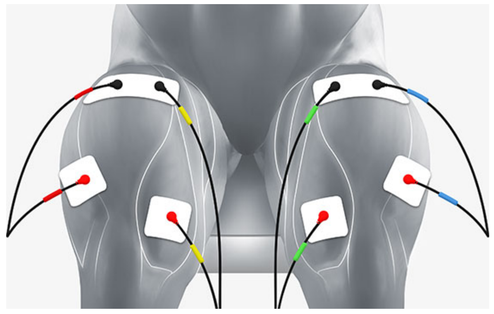

Figure 1: EMS electrode placement on quadriceps

Acknowledgements

- Austin Reames
- David Mintz
- Dr. Jeffrey Hartman
- Gardner-Webb's Men and Women's Swim Team
- Gardner-Webb University Exercise Science Program
- Kevin Plewniak

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