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# Mitochondrial Oxidative Function Degrades Within 30-Minutes Following Blunt Injury in Skeletal Muscle

NATA RESEARCH & EDUCATION FOUNDATION

## GRANT INFORMATION SUMMARY

### PRACTICAL SIGNIFICANCE

Clinicians are most likely to succeed in limiting secondary injury following trauma if we begin cold treatments in the first 15-30 minutes after blunt injury and continue treatments over at least the first 5-hours.

### STUDY BACKGROUND

Recovering from injury depends partly on the total quantity of injury. Less injury equates to less healing time. The total amount of injury includes the initial damage, known as primary injury, and additional secondary injury from inflammation and the loss of blood supply. We can't alter primary injury after the fact. However, we can greatly limit secondary injury by using cryotherapy. Our 'window of opportunity' for acute cryotherapy was unknown because we did not know the timeline for the progression of secondary injury. The purpose of this study was to identify the early timeline for secondary injury following musculoskeletal trauma.

### OBJECTIVE

To describe the timeline for secondary injury following blunt trauma in an effort to identify a 'window of opportunity' to initiate acute injury treatments.

### DESIGN AND SETTING

In an animal model, a uniform blunt contusion to the right triceps surae was caused using a dropped-weight method while the left limb was used as an uninjured control. Following injury, secondary injury was measured at 15-minute intervals ranging from immediately post-injury up to 5-hours post-injury. Data were analyzed using a repeated measures 2 X 21 (injury status X time-point) factorial ANOVA.

### SUBJECTS

168 anesthetized male Sprague-Dawley rats (250-275g). Eight animals were analyzed at each of the 21 time-points representing the first 5-hours following injury.

### MEASUREMENTS

Secondary injury, indicated by the loss of energy producing capacity of the muscle tissue was measured. Energy producing capacity was measured by flux through oxidative phosphorylation. This involved a colorimic assay for enzymatic activity of cytochrome c oxidase where triphenyl tetrazolium chloride (TTC) is reduced to triphenyl formazan (TF).

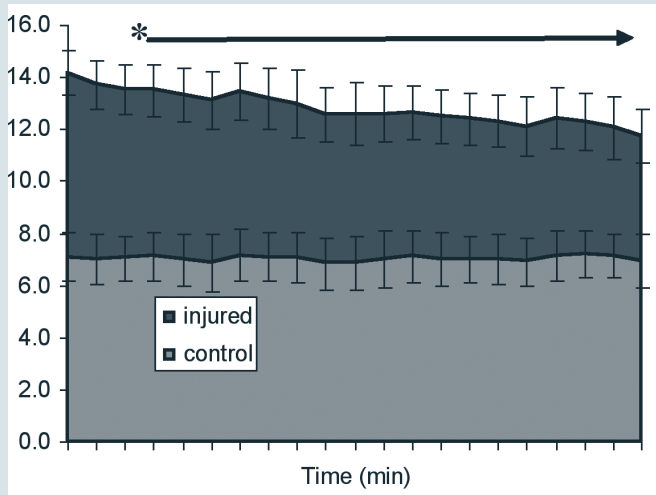


Figure 1. Loss of aerobic energy production (cytochrome oxidase activity) across the first 5 hours following contusion injury

## RESULTS

In the first 30-minutes after injury, TTC reduction rates for controls ( $7.1 \pm 0.9 \mu\text{g}\cdot\text{mg}^{-1}\cdot\text{hr}^{-1}$ ) did not differ from injured tissues ( $6.8 \pm 1.2 \mu\text{g}\cdot\text{mg}^{-1}\cdot\text{hr}^{-1}$ ). After 30-minutes, statistical differences between controls and injured tissues became evident ( $P = 0.04$ ). The loss of energy production for the injured tissues was linear from the 30-minute point until the final time-point at 5-hours when the TTC reduction had declined by roughly 30% to  $4.8 \pm 1.0 \mu\text{g}\cdot\text{mg}^{-1}\cdot\text{hr}^{-1}$ .

## CONCLUSIONS

Secondary injury is a slowly developing problem that becomes evident somewhere between 15 and 30 minutes post-injury and continues to worsen across at least the first 5 hours and probably longer. We are most likely to succeed in limiting secondary injury if we begin cold treatments within the first 15-30 minutes and continue them at least through the first 5 hours.

## Publication and Presentation List:

The following abstract was presented at the 2004 NATA conference in Baltimore, MD and published in the *Journal of Athletic Training*.

Merrick M, Loss of Mitochondrial Oxidative Function Following Blunt Injury in Skeletal Muscle, *Journal of Athletic Training* 39(2):S33, 2004

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