Accelerated Recovery of Muscle Function in Baseball Pitchers Using Post-Game Phase Change Material Cooling

Michael J. Mullaney1,2 Susan Y. Kwiecien1 Andrew Fink2 Malachy P. McHugh, FACSM1

1Nicholas Institute of Sports Medicine and Athletic Trauma, Lenox Hill Hospital, New York, NY. 2Mullaney & Associates Physical Therapy, Matawan, NJ.

METHODS

PURPOSE
No studies have documented recovery of strength in baseball pitchers nor interventions to accelerate recovery strength on the days after a pitching performance. The objectives of this study were to (1) document indices of recovery following a pitching performance, and (2) determine if recovery can be accelerated by providing prolonged post-game phase change material (PCM) cooling to the shoulder.

METHODS: Shoulder strength, pain and plasma creatine kinase (CK) levels were measured in 11 college baseball pitchers 48 h prior to a game, and 12 h and 36 h afterwards. Players were randomized to wearing PCM cooling packs (15 ºC) within a compression shirt for 3 h post game (PCM treatment), versus no treatment (control) and received the opposite post-game treatment the week later (randomized order of design). Strength in internal rotation (IR), external rotation (ER) and empty can test (EC) was assessed using a hand-held dynamometer. Pitchers threw 45 pitches on each occasion. Effect of PCM cooling on strength, pain and CK was assessed with repeated measures analysis of variance.

RESULTS: There was IR strength loss in the control condition (15% at 12 h, 11% at 36 h, P<.01) but no strength loss in the PCM condition (<1% at 12 h and 36 h; Treatment effect P=.06, Treatment by Time P=.214). Similarly, there was ER strength loss in the control condition (14% at 12 h, 11% at 36 h, P<.01) but less strength loss in the PCM condition (8% at 12 h, 7% at 36 h, Treatment effect P=.01, Treatment by Time P=.17). PCM had no effect on ER strength protection (Time effect P=.904, Treatment effect P=.036, Treatment by Time interaction P=.214). Strength loss, pain and elevated CK were evident 12 days after a baseball pitching performance. PCM cooling packs provide a practical means of delivering prolonged post-game cooling after pitchers have departed the training room.

INTRODUCTION

The problem
Considering the significance of pitching to success in baseball, and the importance placed on the number of days between starts, it is surprising that there is a dearth of research on recovery in pitchers. The research on recovery on the days after a pitching performance is limited to a few studies with small samples (6-10 subjects) (Potasek et al 1992; Yanagawa et al 2003a; Yang et al 2016).

Despite the fact that post-game icing of the shoulder and elbow has been in common practice for years there is a lack of supporting science specific to recovery in baseball pitchers. The goal of post-exercise cryotherapy interventions is to reduce the proliferation of tissue disruption. Two limitations of post-exercise icing are (1) the thermal discomfort and (2) the limited treatment duration due to risk of cold-induced injury. Repeated ice treatments may be more beneficial than a single treatment but in practice are inconvenient as the athlete must remain in the training room.

Recently post-exercise cooling using phase change material (PCM) cooling packs worn inside compression shorts has shown to accelerate recovery after eccentric exercise in recreational athletes (Kawasaki et al 2016) and after games in professional soccer players (Clifford et al 2018). The PCM packs in these studies froze at 15ºC and maintained this temperature for at least three hours. These packs provide marked reductions in intramuscular temperature (Kawasaki et al 2016) and allow the athlete to leave the training room while the treatment continues. Thus, the combination of safety and practicality make PCM cooling an attractive recovery intervention for athletes.

PURPOSE AND HYPOTHESIS

The purposes of this study were twofold. The first purpose was to examine the indices of recovery following baseball pitching, specifically examining strength recovery since only one prior small sample study has documented strength recovery in pitchers (Yanagawa et alib et al 2008). The second purpose was to examine the effectiveness of post-game PCM cooling on indices of recovery in pitchers. Based on prior work (Kawasaki et al 2016; Clifford et al 2018) it was hypothesized that PCM cooling would accelerate recovery.

EXPERIMENTAL DESIGN

Testing Pre Game (day before pitching), 1 Day Post Pitching, 2 Days Post pitching. Pitchers randomly assigned to receive PCM cooling packs versus no treatment post game.

PROCEDURE

Immediately following pitching, 2 PCM packs “frozen” at 15ºC (Glacier Tek LLC, Minneapolis, MN) were placed inside a compression shirt. One PCM pack was oriented on the anterior shoulder with the other on the posterior shoulder. A third pack, made of a nylon and filled with flexible PCM microphases (PureTemp LLC, Minneapolis, MN), was placed over the medial elbow, covering the flexor mass of the forearm held with a compression sleeve (Musetech, TN). The shoulder packs weighed 1.7 lb each; the elbow pack weighed 1.5 lb.

STATISTICS

Effect of postgame PCM cooling on strength, soreness and CK levels was assessed using treatment (PCM vs. control) by time (Pre, Day 1 post, Day 2 post) analysis of variance with repeated measures for time and treatment as a between subjects factor since not all pitchers had both treatments with matching numbers of pitchers.

RESULTS

Data were collected in the NCAA sanctioned fall season (September) and the NCAA sanctioned presession (January/February). All pitchers were on a prescribed number of innings for a given outing and threw a minimum of 45 pitches to a maximum of 90 pitches, depending on the stage of their progression established by the coaching staff.

PCM 23 Games 60:16 Pitches
CONTROL 24 Games 62:17 Pitches

** Elbow PCM was only applied in Jan/Feb games (11, 13 controls games)

CK CHANGES

Shoulder soreness for PCM cooling and control conditions (9-10 scale) 

PCM Cooling

Day 1 Post 6.19 ± 2.29

Day 2 Post 6.87 ± 3.16

Control

Day 1 Post 6.23 ± 2.90

Day 2 Post 7.13 ± 4.08

Time effect P<0.001: *significant effect of time

Treatment effect P>0.085: **significantly greater than Pre Game P<0.05. Means±SD

SORENESS CHANGES

Elbow soreness for PCM cooling and control conditions (9-10 scale) 

PCM Cooling

Day 1 Post 0.5 ± 1.2

Day 2 Post 0 ± 0.6

Control

Day 1 Post 0 ± 0.6

Day 2 Post 0 ± 0.6

Time effect P<0.001: *significant effect of time

Treatment effect P=0.134, Treatment by Time P=0.26: **significantly greater than Pre Game P<0.05. Means±SD

CONCLUSION

This is the first study to document impairments in muscle function on the days following baseball pitching, and the first study showing a novel intervention that accelerates recovery of muscle function in baseball pitchers. The results indicate that significant muscle damage occurs in collegiate level pitchers after throwing and average of 60 pitches and recovery is incomplete two days after pitching. Prolonged PCM cooling accelerated recovery of strength but did not impact soreness or CK responses. The effect of PCM cooling of the medial elbow and forearm on grip strength recovery is very encouraging considering the role the wrist flexors play in dynamic stability of the elbow.

Clinical Relevance: PCM cooling packs placed in compression garments provide a practical means of delivering prolonged post-game cooling to baseball pitchers after they have departed the training room.