THE ROLE OF CORE BODY TEMPERATURE ON LACTATE PRODUCTION

Heller C,1 Grahn D,1 Cao V,1 Choi A,2

Background: Blood lactate studies indicate a close association between lactate threshold and fatigue. That observation led to the common concept that fatigue was caused by a build-up of lactate when individuals exceeded their aerobic capacity. The concept of lactate production causing fatigue has been disproven. Rather than lactate causing fatigue, we propose that mechanisms of fatigue result in lactate production. One of those fatigue mechanisms is limitation of ATP production in response to hyperthermia. This adaptation might be due to the inactivation of pyruvate kinase at high temperatures. If that hypothesis is correct, lactate threshold should also be temperature sensitive.

Purpose: We evaluated effects of core body temperature on lactate threshold and production of lactate. The hypothesis was that rise in core body temperature hastens fatigue during exercise, and a manifestation of this fatigue mechanism is a rise in lactate production.

Study Design: Crossover Paired Tests.

Methods: Two studies were performed. In study one, 12 college age subjects (3 females, 9 males) performed incremental graded exercise on a treadmill (SciFit). Core body temperatures (Tes) were measured with self-inserted esophageal thermocouples (Mallinckrodt Medical). Each subject completed two tests, one starting at a Tes of 37°C and one starting at a Tes of 38°C, with the order of the two tests randomized. Starting T es was achieved by resting in a 45°C environment until the target Tes was reached. Speed of the treadmill was 3.5 mph and 0% incline, then raised 2% every 3 minutes until volitional stop. Blood lactate (Nova Biomedical) was measured at every change in workload. Lactate threshold was determined as the workload when blood lactate reached 4.0 mmol/L. We hypothesized that the 38°C tests would reach lactate threshold sooner and at a lower workload. In cross-over study two, 14 subjects (5 females, 9 males) randomly completed three trials. In one trial, the subjects, dressed in summer workout attire, simply rested at room temperature for 60 minutes. In trial two, dressed in summer attire, they rested at 45°C for 60 minutes. In trial three, subjects dressed in Personal Protective Equipment (PPE) rested at 45°C for 60 minutes. All subjects performed a five minute treadmill walk at 60% of their calculated maximal workload at the end of the 60 minute rest period. We hypothesized that only individuals with a higher starting core temperature would show a rise in blood lactate levels post-intervention.

Results: In the first study, the 38°C group reached lactate threshold with an average of 220 Watts of work, while the 37°C group reached lactate threshold with an average of 263 Watts. This 43 watts difference was significant (p<0.001). In the second study, subjects in trials 1 and 2 showed no increase in Tes or blood lactate at the end of the rest period or treadmill challenge. In trial 3, subjects showed an increase in Tes to 38.8°C at the end of the rest, but no increase in blood lactate. However, after the treadmill challenge, the subjects in trial 3 showed a more than doubling of blood lactate (p<0.001). The lactate response was only seen in response to a mild exercise challenge in hyperthermic subjects, but hyperthermia alone did not affect their blood lactate.

Discussion/Conclusion: A state of elevated core temperature impairs the ability of subjects to respond to exercise challenges without a significant rise in blood lactate. Effective management of core body temperature may prolong sustainable efforts in training and competition before the body reaches lactate threshold.

Presenting Author:
Andy Choi – achoi94402@gmail.com

1Stanford University, 2Choi Sports Rehab