Lactic acid and exercise performance: culprit or friend?

Cairns SP. Sports Med. 2006; 36(4):279-91.

Institute of Sport and Recreation Research New Zealand, Faculty of Health and Environmental Sciences, Auckland University of Technology, Auckland, New Zealand. simeon.cairns@aut.ac.nz.

This article critically discusses whether accumulation of lactic acid, or in reality lactate and/or hydrogen (H+) ions, is a major cause of skeletal muscle fatigue, i.e. decline of muscle force or power output leading to impaired exercise performance. There exists a long history of studies on the effects of increased lactate/H+ concentrations in muscle or plasma on contractile performance of skeletal muscle. Evidence suggesting that lactate/H+ is a culprit has been based on correlation-type studies, which reveal close temporal relationships between intramuscular lactate or H+ accumulation and the decline of force during fatiguing stimulation in frog, rodent or human muscle. In addition, an induced acidosis can impair muscle contractility in non-fatigued humans or in isolated muscle preparations, and several mechanisms to explain such effects have been provided. However, a number of recent high-profile papers have seriously challenged the 'lactic acid hypothesis'. In the 1990s, these findings mainly involved diminished negative effects of an induced acidosis in skinned or intact muscle fibres, at higher more physiological experimental temperatures. In the early 2000s, it was conclusively shown that lactate has little detrimental effect on mechanically skinned fibres activated by artificial stimulation. Perhaps more remarkably, there are now several reports of protective effects of lactate exposure or induced acidosis on potassium-depressed muscle contractions in isolated rodent muscles. In addition, sodium-lactate exposure can attenuate severe fatigue in rat muscle stimulated in situ, and sodium lactate ingestion can increase time to exhaustion during sprinting in humans. **Taken together, these latest findings have led to the idea that lactate/H+ is ergogenic during exercise. It should not be taken as fact that lactic acid is the deviant that impairs exercise performance.** Experiments on isolated muscle suggest that acidosis has little detrimental effect or may even improve muscle performance during high-intensity exercise. In contrast, induced acidosis can exacerbate fatigue during whole-body dynamic exercise and alkalosis can improve exercise performance in events lasting 1-10 minutes. To reconcile the findings from isolated muscle fibres through to whole-body exercise, it is hypothesised that a severe plasma acidosis in humans might impair exercise performance by causing a reduced CNS drive to muscle.