IS THERE A COMMON DETERMINANT OF FATIGUE DURING HIGH-INTENSITY EXERCISE?

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The Critical Power test was first introduced by Monod and Scherrer [3] and requires a series of exercise trials to exhaustion, each at different but fixed power outputs. When work performed (kJ) is plotted against time to exhaustion (s), a strong linear relationship between the two variables emerges. The y-intercept has been proposed to represent a muscular energy reserve that is exhausted at fatigue. The critical power model therefore predicts that fatigue is due to the depletion of a fixed, critical energy store in the muscle; however, this has not been experimentally tested.

Recognising that reduced exercise tolerance is an important feature of ageing and many disease states, the purpose of this study was to critically address possible mechanisms that might contribute to fatigue during whole-body exercise. Six well-trained triathletes (mass: 77.4 +/- 13.6 kg; VO2max: 59.8 +/- 5.8 mL/kg/min) visited the laboratory six times, over a four-week period. At the first visit, subjects performed an incremental test to exhaustion on a cycle ergometer. On subsequent days, they performed one familiarisation until fatigue at 100% VO2max and another at 120% VO2max. In the final three sessions, in a random order, subjects performed constant-load exercise tests at 93, 100 and 120% of VO2max until fatigue. Biopsies were taken at rest and at the point of fatigue for each of these three tests. Electromyographic (EMG) activity of vastus medialis and biceps femoris muscles was also recorded during the constant-load exercise tests. Consistent with previous research, there was a strong linear relationship between work performed and time to fatigue for each subject (R2>0.99). Contrary to previous suggestions, subjects did not always fatigue at the same percentage of VO2max (103 vs 99 vs 96% VO2max; P<0.05). In contrast to the predictions of the critical power model, estimates of anaerobic energy contribution at fatigue were significantly different between the predictive trials. In all cases, the estimated anaerobic energy contribution at fatigue was greater than that predicted by the model raising questions about the validity of the y-intercept as an estimate of anaerobic work capacity. There was a significant negative correlation between estimated anaerobic energy expenditure and final pH (r=0.72; P<0.05). Final pH was significantly lower following exercise to fatigue at 120% of VO2max compared to the other 2 conditions (6.57 vs 6.61 vs 6.69). Our results suggest that athletes do not fatigue at a critical pH. Rather, it appears that final pH is related to the anaerobic contribution prior to fatigue caused by other mechanisms. This result may help to explain why individuals have been reported to fatigue at different pH levels [2] and why pH at fatigue is decreased following training [1].