INTRODUCTION

Oxygen uptake kinetics are determined by computation of the time constant, or ’τ’ (’tau’), from VO2 data during square-wave work. In an incremental (ramp) test, presuming a linear increase of VO2 with increasing intensity (dVO2 / dt = const, for the intensity range below the anaerobic threshold), tau can be estimated from the time delay (τ=Δt) needed to reach the VO2 that corresponds to the steady-state VO2 (VO2ss) at the same intensity (Whipp et al., 1981). Accordingly, we estimated tau in trained sprinters from: 1) single treadmill step tests (with no steady-state) and VO2ss, and 2) two step tests with different speed increments, without utilization of VO2ss.

METHODS

24 sprint runners (100-400m) completed 3 incremental treadmill tests to exhaustion with increase in running speed of: 1 km/h each ½ min (T05), 1 km/h each min (T1), and 2 km/h each 4 min (SS). Breath-by-breath VO2 data were averaged to 30 s, and centered to the corresponding running speeds for T05 and T1. The VO2ss values at 8, 10 and 12 km/h were defined as the average VO2 values in the 4th minute of respective stages in the SS test, and were corrected to account for the VO2 difference between ramp and step protocols. The time constants (Δt) were determined from linear regression parameters derived from the VO2/running speed relationship in SS, T05 and T1. The analysis was performed within the aerobic speed range (8-12 km/h). The significance of differences between Δt were determined from 1) SS–T1, 2) SS–T05, and 3) T1–T05 test data (p<.05).

RESULTS AND DISCUSSION

The VO2 kinetics, as estimated from Δt determined from SS–T05, SS–T1 and T1–T05 data did not differ significantly (49.2±21.0 s, 51.7±37.1 s, and 46.7±29.1 s, respectively; p>0.05), and were somewhat slower in T1 and T05 with increasing speed. The per step increase of intensity in T05 (1kmh/30s) is twofold the increase in T1 (1kmh/60s). Therefore, for a certain VO2, the Δt between T1 and T05 tests should be equal to Δt between T1 and SS, enabling estimation of τ and VO2ss. Indeed, the average error of VO2ss and Δt estimated from the time delay between T1 and T05 was practically irrelevant (0.1-0.3 ml/min/kg, or 3-5 s). The average Δt values of sprint runners were significantly higher compared to tau values measured directly from square-wave tests in previous studies, and approx. 15-20 s higher than the values determined with the same methodology in endurance runners(Sentija et al, 2012). The high Δt values as measures of VO2 kinetics of both studies, may be explained by the delay time needed for transportation of blood from working muscles to the lungs (~ 10-20 s). As in endurance runners, high individual variability (many values outside of the physiological range for τ, reflecting accumulated effects of high biological variability and technical errors for repeated measurements), precludes the use of this methodology as a reliable procedure for individual determination of VO2 kinetics.

REFERENCES

Whipp BJ et al (1981). J Appl Physiol 50(1):217-21

Sentija D, Vucetic V (2012). ECSS, 556-7