Comparison of the Lactate Pro and the YSI 1500
Sport Blood Lactate Analyzers
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To determine the agreement, reliability, and linearity of the Lactate Pro with the YSI 1500 Sport lactate analyzer, seven male and five female volunteers performed a discontinuous incremental exercise test at discrete percentages of their maximum aerobic power on a cycle ergometer. Five blood samples were collected for each subject, one after each of five increasing workloads. Agreement was evaluated by comparing, in parallel, measurements from the Lactate Pro and the YSI 1500 using Bland-Altman plots. Reliability was determined by performing 10 repeated assays on blood collected at 160 W and 370 W in a randomly selected subject. Strength of association was determined by performing linear regression analysis of the measures obtained from both analyzers. Bland-Altman analysis revealed that blood lactate concentrations from the Lactate Pro were 0.5 ± 1.0 mM (mean ± SD) higher than the YSI 1500 with the limits of agreement being 0.2 to 0.7 mM. Coefficients of variation from blood collected at 80 W and 370 W were 7.1% and 8.9%, respectively. The linear regression equation was Lactate Pro = 1.067(YSI 1500) + 0.036 ($R^2 = 0.967$). In conclusion, the Lactate Pro is reliable and has sufficient agreement and linearity with the YSI 1500 for use in submaximal research and athletic testing.

key words: comparison, testing, lactate, bicycling

Introduction

In 1886, the measurement of blood lactate (BLa) concentrations by Gaglio required up to 200 mL of blood and several days for analysis (Aden et al., 1994; Noordally & Vincent, 1999; Slomovitz et al., 1998). The advances in technology since then have resulted in improvement in both the time and the volume of blood required to analyze lactate concentrations. The development of completely portable, hand-held lactate analyzers has allowed for lactate testing to escape the domain of the laboratory and enter into training and competition venues. The Lactate Pro is an example of one of these new generation lactate analyzers.

The use of BLa as a parameter for testing in coaching and research settings requires an instrument that is both valid and reliable (Bishop & Martino, 1993). A portable, battery-powered, and user-friendly BLa analyzer allows for the immediate testing of BLa concentrations both at training and competition venues (Fell et al., 1998). Prior to being incorporated into use, any new measurement technique needs to be validated in order to determine whether the instrument is actually measuring what it was designed to measure.

The KDK Corporation (Kyoto, Japan) has recently introduced the Lactate Pro blood lactate test meter, which is a completely portable whole BLa analyzer. Several hand-held and/or portable blood
lactate analyzers have been evaluated and deemed accurate and reliable for use in sport testing laboratories, training and competition venues, hospital emergency departments, and intensive care units (Aduen et al., 1994; Bishop & Martino, 1993; Brinkert et al., 1999; Noordally & Vincent, 1999; Slomovitz et al., 1998; Weil et al., 1986).

There have been three recent studies that have evaluated the Lactate Pro. Medbo, Mamen, Holt Olsen, and Evertsen (2000) examined the Lactate Pro versus two YSI 1500s and found moderate agreement (slopes of the regression lines were equal to 0.668 and 0.758) between both models. Neither of the two other studies (McNaughton et al., 2002; Pyne et al., 2000) compared the Lactate Pro to the YSI 1500, although Pyne et al. (2000) used another YSI model (2300 Stat) in their comparison. The YSI 1500 has been used extensively over several years in this laboratory having been previously and repeatedly examined in comparison with established methodologies (i.e., Sigma colorimetric L-lactate method, Kit 735) with regression analyses results always greater than 0.95 ($r^2$). However, it was felt that further study into the reliability of the Lactate Pro and its agreement and linearity with the YSI 1500 was warranted. Therefore, the purpose of this study was to determine the reliability of the Lactate Pro and its strength of association with the YSI 1500 Sport lactate analyzer. It was hypothesized that there would be no significant differences between the BLa concentrations obtained from both analyzers.

Methods

Subjects

Measurements were made in seven male (age 27.9 ± 4.3 (mean ± SD) years, body mass 76.9 ± 7.5 kg, height 177.4 ± 3.4 cm, VO$_2$max 54.4 ± 7.0 mL·kg$^{-1}$·min$^{-1}$) and five female (age 25.0 ± 6.7 years, body mass 69.3 ± 2.5 kg, height 172.8 ± 3.1 cm, VO$_2$max 46.9 ± 3.4 mL·kg$^{-1}$·min$^{-1}$) trained volunteers after reading and providing written informed consent that was approved by the Ethics Committee of the Faculty of Kinesiology at the University of Calgary.

Apparatus

The Lactate Pro is a hand-held, battery powered test meter with a liquid crystal display, a built-in thermo-sensor, and a strip inlet for insertion of check strips, calibration strips, and test strips. The check strips are inserted prior to use to ensure that the test meter is operating properly. The thermo-sensor automatically compensates for temperature and the test meter can be calibrated automatically by inserting a calibration strip. Chemical test strips that analyze BLa concentrations ranging from 0.8 to 23.3 mM are used following calibration and require only 5 µL of whole blood, which can be analyzed in 60 seconds. The reaction principle of the chemical strips has been described elsewhere (Shimojo et al., 1993).

The reference analyzer used for this evaluation was the YSI 1500 Sport (YSI Incorporated,