

Comparison of Interstitial Fluid pH, PCO₂, PO₂ with Venous Blood Values During Repetitive Handgrip Exercise

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We evaluated the use of a small, fiber optic sensor to measure pH, PCO₂ and PO₂ from forearm muscle interstitial fluid (IF) during handgrip dynamometry. **PURPOSE:**

Compare pH, PCO₂ and PO₂ values obtained from venous blood with those from the IF of the flexor digitorum superficialis (FDS) during three levels of exercise intensity.

METHODS: Six subjects (5M/1F), average age 29±5 yrs, participated in the study. A venous catheter was placed in the retrograde direction in the antecubital space and a fiber optic sensor (Paratrend, Diametrics Medical, Inc.) was placed through a 22 G catheter into the FDS muscle under ultrasound guidance. After a 45 min rest period, subjects performed three 5-min bouts of repetitive handgrip exercise (2s contraction/1 s relaxation) at attempted levels of 15%, 30% and 45% of maximal voluntary contraction. The order of the exercise bouts was random with the second and third bouts started after blood lactate had returned to baseline. Venous blood was sampled every minute during exercise and analyzed with an I-Stat CG-4+ cartridge, while IF fiber optic sensor measurements were obtained every 2 s. Change from pre-exercise baseline to end of exercise was computed for pH, PCO₂ and PO₂. Blood and IF values were compared with a paired t-test. **RESULTS:** Baseline values for pH, PCO₂ and PO₂ were 7.37±0.02, 46±4 mm Hg, and 36±6 mm Hg respectively in blood and 7.39±0.02, 44±6 mm Hg, and 35±14 mm Hg in IF. Average changes over all exercise levels are noted in the Table below. For each parameter the exercise-induced change was at least twice as great in IF as in blood. In blood and IF, pH and PCO₂ increases were directly related to exercise intensity. Change in venous PO₂ was unrelated to exercise intensity, while IF PO₂ decreased with increases in exercise intensity. **CONCLUSIONS:** Measurement of IF pH, PCO₂ and PO₂ is more sensitive to exercise intensity than measurement of the same parameters in venous blood and provides continuous assessment during and after exercise.

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Average change in parameter from baseline to end exercise

	pH*	PCO ₂ * (mm Hg)	PO ₂ * (mm Hg)
venous blood	-0.10±0.06	20±11	-10±6
Interstitial fluid	-0.22±0.18	50±42	-21±12

* p < 0.05 venous compared to IF