NIRS-Derived Tissue Oxygen Saturation and Hydrogen Ion Concentration following Bed Rest

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Long-term bed rest (BR), a model of spaceflight, results in a decrease in aerobic capacity and altered submaximal exercise responses. The strongest BR-induced effects on exercise appear to be centrally-mediated, but longer BR durations may result in peripheral adaptations (e.g., decreased mitochondrial and capillary density) which are likely to influence exercise responses. **PURPOSE**: To measure tissue oxygen saturation (SO_2) and hydrogen ion concentration ($[H^+]$) in the vastus lateralis (VL) using near infrared spectroscopy (NIRS) during cycle ergometry before and after ≥ 30 d of BR. **METHODS**: Eight subjects performed a graded exercise test on a cycle erogmeter to volitional fatigue 7 d before (pre-BR) and at the end or 1 day after BR (post-BR). NIRS spectra were collected from a sensor adhered to the skin overlying the VL. Oxygen consumption (VO_2) was measured by open circuit spirometry. Blood volume (BV) was measured before and after BR using the carbon monoxide rebreathing technique. Changes in pre- and post-BR SO_2 and $[H^+]$ data were compared using mixed model analyses. BV and peak exercise data were compared using paired *t*-tests. **RESULTS**: BV (pre-BR: 4.3 ± 0.3, post-BR: 3.7 ± 0.2 L, mean ± SE, p=.01) and peak VO_2 (pre-BR: 1.98 ± 0.24, post-BR: 1.48 ± 0.21 L/min, p<.01) were reduced after BR. As expected, SO_2 decreased with exercise before and after BR. However, SO_2 was lower post compared with pre-BR throughout exercise, including at peak exercise (pre-BR: 50± 3, post-BR: 43 ± 4%, p=.01). After BR, $[H^+]$ was higher at the start of exercise and did not increase at the same rate as pre-BR. Peak $[H^+]$ was not different from pre to post-BR (pre-BR: 36 ± 2; post-BR: 38 ± 2 nmol/L). **CONCLUSIONS**: Lower SO_2 during exercise suggests that oxygen extraction in the VL is higher after BR, perhaps due to lower circulating blood volume. The higher $[H^+]$ after BR suggests a greater reliance upon glycolysis during submaximal exercise, although $[H^+]$ at peak exercise was unchanged. Taken together, these data suggest that longer duration BR induces a number of changes that result in peripheral adaptations which contribute to cardiovascular and muscular deconditioning as measured by NIRS-derived SO_2 and $[H^+]$ in the VL and may contribute to lower post-BR exercise tolerance. *Supported by the National Space Biomedical Research Institute through NASA NCC 9-58*