Development of a Time Efficient Protocol for Cross-Limb Comparisons of Muscle Mitochondrial Capacity Using NIRS

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The non-invasive determination of muscle oxidative capacity via Near Infrared Spectroscopy (NIRS) typically involves voluntary contraction of a single limb and requires as many as 22 brief ischemic occlusions per measurement. This limits the number of oxidative capacity measurements that can be completed in a given test session and also makes cross-limb muscle comparisons challenging. **PURPOSE:** To establish the efficacy of a recently developed protocol that utilizes fewer (i.e. 6) ischemic occlusions combined with surface electrical stimulation (E-stim) in both limbs simultaneously. **METHODS:** The test employs 2 upper thigh cuffs and 2 NIRS sensors placed directly over the vastus lateralis (VL) muscles (supine position) or the semi-tendinosis (ST) muscles (prone position). Metabolic rate is temporarily increased via E-stim pads placed above and below each NIRS sensor. A standard 6Hz frequency is employed using a pre-modulation setting, with the intensity (mV) increased sufficient to raise metabolic rate (≥ 3 fold), but within the tolerance of each participant. The mitochondrial capacity protocol involves 4 separate sets of 30 sec of E-stim followed by 6 x 5 sec cuff inflation/5 sec cuff deflation cycles. Analysis consists of calculating oxygenation recovery rate constants (Tc) for each muscle (i.e., 4 repeated measurements per muscle, per limb) using a customized software program. **RESULTS:** In preliminary tests of moderately active younger adults, Tc ranged from 24 to 44 sec in the VL and 32 to 53 sec in the ST. Variability of repeated tests (CV%) averaged <10% (range 6.2-17.2%) in both muscles. Metabolic rate increased from pre- (slope = -0.011) to post- (slope = -0.018) stimulation. **CONCLUSION:** This bilateral E-stim protocol is time efficient and should facilitate cross-limb comparisons of muscle mitochondrial capacity.