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Using Near Infrared Spectroscopy to Access Muscle Post-exercise Oxygen Debt

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Post-exercise muscle oxygenation recovery, measured by near infrared spectroscopy, reflects a balance between oxygen supply and oxygen consumption within the muscle. PURPOSE: This study examined the differences between forearm muscle oxygen recovery kinetics after ischemia and after ischemia with exercise to determine the oxygen debt associated with exercise. METHODS: Three men and two women (26 to 52 years) performed a 6 minute (min) blood flow occlusion only trial and two occlusion trials with 30 second (s) and 2 mins of maximal static handgrip exercise respectively (5s work/rest cycle). Continuous wave near infrared spectroscopy was used to measure the flexor digitorum superficialis percent oxygen saturation throughout all three trials. A one-way repeated measures ANOVA was used to determine differences between trials with significance set at 0.05. RESULTS: There were significant differences between all trials ($p<0.001$) for the percent oxygen saturation area under the curve during 3 min of recovery. The occlusion only condition had the greatest area (20,781±2,116 %-s) followed by occlusion with 30s exercise (19,263±2,201 %-s) and occlusion with 2 min exercise (17,601±1,523 %-s). Compared to the occlusion only trial, the percentage of oxygen debt for 30s of handgrip exercise was 7.4±2.7% and 15.2±1.5% for 2 min of handgrip exercise ($p<0.001$). CONCLUSION: These results demonstrate that near infrared spectroscopy can be used to determine post-exercise oxygen debt from muscle oxygen saturation recovery kinetics. Oxygen debt is associated with the degree of muscle anaerobic metabolism required during exercise. Further study into the application of near infrared spectroscopy to access muscle oxygen debt and anaerobic metabolism for both athletic and clinical populations is suggested.