

114.36

A single bout of exercise is followed by a prolonged decrease in the interstitial glucose concentration in skeletal muscle

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The present study was performed to test the hypothesis that the interstitial glucose concentration in human skeletal muscle is decreased for a prolonged period following a single bout of exercise, while blood flow is normalized. The interstitial concentration of glucose, lactate, pyruvate and urea was monitored in six healthy individuals during 8 hours following a 2-hour one-leg exercise session by microdialysis at low perfusion flow rate. Simultaneously the blood flow was measured by the microdialysis ethanol technique. The blood and control leg interstitial glucose concentration was stable during the experiment averaging 5.71 ± 0.11 and 4.1 ± 0.3 mM, respectively (mean \pm SEM). In contrast, the interstitial glucose concentration in the exercise leg was markedly decreased, averaging 1.9 ± 0.5 mM, during the first 5.5 hours following exercise ($p < 0.01$), after which it returned towards normal values. Muscle blood flow, measured as the ethanol outflow-to-inflow ratio, did not change significantly over time in the control or exercise leg and did not differ significantly between the two legs. In conclusion, the interstitial glucose concentration is markedly decreased for several hours following a single exercise session. The decreased interstitial glucose concentration may serve to limit the post-exercise muscle glucose uptake to a rate compatible with normal blood glucose levels and may also be speculated to have a positive long-term health implication by augmenting muscle insulin sensitivity. The research was supported by the Swedish Research Council and the Swedish National Centre for Research in Sports.

114.37

Resistance training-induced apoptotic signaling in rat skeletal muscle

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The significance of programmed cell death is not well established in post mitotic tissues, such as skeletal muscle. Moreover, it is not clear whether apoptotic signaling contributes to training-induced skeletal muscle hypertrophy. Therefore, this study investigated the effect of resistance training with stretch-shortening contractions on apoptotic markers in young rat skeletal muscle. The left common peroneal nerve was stimulated at 120 Hz to maximally activate the dorsi flexor muscles in young male (3 mo old) Fisher344XBrown rats ($n=6$), while the right limb served as intra-animal control. Animals were exposed to 14 training sessions of 80 repetitions/session over a four and a half-week exposure period. The animals were sacrificed 24 hours following the last exposure and the tibialis anterior (TA) muscles were removed for protein analysis. Muscle wet weight was 17% (11.9-23.4%) greater in the experimental as compared to the control TA muscle. The anti-apoptotic Bcl2 protein level was significantly ($p=0.033$) increased by 28.7%, while the pro-apoptotic Bax protein content remained unchanged in experimental compared to control muscles after the training period. Moreover, the Bcl2/Bax ratio, an indicator of apoptotic status, was elevated by 107.4%. Additionally, the level of pro-apoptotic AIF protein, which is thought to play a role in caspase independent signaling, was significantly decreased ($p=0.046$) by 51.7% in experimental as compared to control muscles. In conclusion, it appears that apoptotic signaling contributes to training-induced hypertrophy in skeletal muscle of young animals, by down regulation of pro- and up regulation of anti-apoptotic proteins. Supported by grants from NIH R01AG021530 and NIOSH.

114.38

Local effect of insulin and vanadate in insulin-resistant human skeletal muscle: influence of a single bout of exercise

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The present study tested the hypothesis that a single bout of exercise augments the local effect of insulin and the insulin-mimetic trace element vanadate on the interstitial glucose concentration in insulin-resistant human skeletal muscle. Eight insulin-resistant obese male

subjects performed one-legged cycle exercise for two hours. Two hours later, microdialysis catheters were inserted in the quadriceps femoris muscle. Four catheters, two in each leg, were perfused at a low flow rate, $0.2 \mu\text{l}/\text{min}$, whereas four other catheters were perfused at $1.33 \mu\text{l}/\text{min}$. After an equilibration period, the perfusion medium was supplemented with 100 mM sodium metavanadate in two of the low-flow catheters (one in each leg) and with 14 mU/ml insulin in two of the high-flow catheters (one in each leg). The remaining catheters served as controls. In response to insulin or vanadate, there was a marked decrease in the glucose concentration of the interstitial space ($p < 0.01$). In the vanadate catheters, the decrease was similar in both legs, whereas insulin tended ($p < 0.09$) to have a larger effect in the exercised (-32.1%) than in the rested leg (-19.8%). The insulin effect in healthy muscle has been reported earlier (-30.3%; Int J Biol Macromolecules 28, 69, 2000). It is concluded that a single bout of exercise normalizes the insulin effect on the interstitial glucose concentration in insulin-resistant human skeletal muscle. The effect of vanadate (which is not decreased in insulin-resistant human skeletal muscle) was not augmented by exercise. The research was supported by the Swedish Research Council and the Swedish National Centre for Research in Sports.

OXYGEN TRANSPORT AND DELIVERY (115.1-115.11)

115.1

Gender Differences in Muscle Metabolism during Ischemic Exercise
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This study investigated gender differences in muscle metabolism during forearm ischemic exercise. Ten males and ten females (ages 18-30) performed an isotonic arm exercise under three conditions: control, blood pressure cuff placed above their right elbow inflated to 80mm Hg, and with the cuff inflated to 120mm Hg. Muscle oxygen saturation (StO₂), blood volume and water absorbance of the right extensor carpi radialis were measured using near-infrared spectroscopy (NIRS). Males had a 0.4% greater decrease in StO₂ compared to females in the control trial. This difference enlarged to 13.3% in the 80mm Hg trial and 18.9% in the 120mm Hg trial and was statistically significant ($P < 0.05$). Males had a 0.5% and 11.8% greater decrease in blood volume compared to females in the control and 120mm Hg trials respectively. However, in the 80mm Hg trial, females had a 32.2% greater increase in blood volume compared to males ($P < 0.05$). In terms of water absorbance, females had a greater increase compared to males of 2.8%, 11.2%, and 12.2% in the control, 80mm Hg, and 120mm Hg trials respectively. These results demonstrate that men showed greater decrease in StO₂ than women during venous and arterial occlusion due to less blood volume in the exercising muscle. The greater water absorbance increases displayed by women in the venous and arterial occlusion trials implies greater water extravasation, resulting in increased swelling in women.

115.2

Direct measurement of oxygen saturation distribution of hemoglobin in in vitro micro capillary

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Axial and radial oxygen saturation distributions of hemoglobin (Hb) have been measured for solutions flowing through a novel *in vitro* artificial capillary. The capillary was cast in 125um-thick silicone rubber film. The capillary itself is ~5mm long and had a 25um-diameter lumen which is connected on one side to a Hb reservoir and on the other to a syringe pump. The Hb solution (2~4mM heme) was pulled through the capillary by the syringe pump at flow rates of 2.2~22ul/hr. Air or N₂ gas was blown across the surface of the capillary. The capillary was set on a microscope stage, and a Xe lamp was placed under the capillary. Transmitted light intensity was measured using a 12bit-CCD detector (Hamamatsu C8484, Japan) through a x32 objective at 417nm and 430nm using optical filters. Oxygen saturation distributions were measured at a resolution of 0.2x1.4um rectangular area. The residence times required to reach 50% saturation of Hb for O₂ uptake and release were 0.14s and 1.6s, respectively, and independent of flow rate. The experimental data fit well to simulations, which assume that the axial

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