Determinants of Fatigue in the Biceps Brachii During Blood Flow Restriction Training

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Training loads of 60% - 80% of maximum are traditionally recommended for increasing muscular strength. Lifting lighter loads (~20% of 1RM) with concomitant blood flow restriction (BFR) can also increase muscle strength. It is unknown if adaptation with BFR is limited to the muscle or also due to changes in the nervous system. We examined changes in the output of the motor cortex and the muscle with stimulation, when subjects perform 1.) Training with light loads, 2.) Training with light loads with BFR, and 3.) Training with moderate loads. 5 subjects completed three training sessions with the elbow flexor muscles. Maximal strength was measured before and after each training session. Voluntary activation was tested with cortical stimulation (TMS) and with electrical stimulation of the biceps during additional MVCs. Subjects trained with a block of 4 isometric contractions at 20% MVC (120s, 60s, 60s, 60s durations) or at 60% MVC (40s, 20s, 20s, 20s durations). Fatigue (% decrease in MVC after training) was similar between 20% with BFR and 60% conditions (18.6% and 16%) and less in the 20% without BFR condition (9.7%). Cortical voluntary activation decreased similarly between the 20% BFR and 60% conditions (-3.6% and -3.3%) and showed less change with 20% without BFR (-1.8%). Alternatively, with electrical stimulation of the muscle, both 20% training conditions showed a decline in voluntary activation (-3.1% and -5.15), while voluntary activation increased by 8% after the 60% condition. Similar levels of fatigue occur at different contraction intensities when BFR is applied during the lighter contraction. Both 20% with BFR and 60% loading causes deficits in cortical activation, though the limiting factor in the 20% BFR condition is a decrease in activation of the muscle directly, while in the 60% contraction it is due to an inability to drive the motorneuron pool sufficiently.