Blood Flow Restriction Augments Muscle Excitation During Submaximal Running Bouts

Sean M. Lubiak, Christopher E. Proppe, Paola M. Rivera, Niriham Shah, Nihar Patel, Anuj Prajapati, Ethan C. Hill

University of Central Florida

Background

The application of blood flow restriction (BFR) during bouts of low-intensity aerobic exercise can facilitate robust cardiovascular responses (1,2,3). There is, however, a lack of available information which has examined the aerobic intensities that are enhanced or attenuated with BFR. Thus, the purpose of this investigation was to examine the acute effects of BFR on neuromuscular function during submaximal running.

Methods

Twelve (21.4 ± 2 years, 176.1 ± 8.1 cm, 83 ± 13.1 kg) aerobically trained men visited the laboratory on two separate occasions. On the first visit, a customized RAMP protocol was used to determine peak running speed which started at 6 miles per hour and increased by 0.1 mile per hour every 12 seconds until failure. On the subsequent visit, participants randomly performed four, three-minute running bouts at 70%, 80%, and 90% of peak running speed with BFR and 100% of peak running speed without BFR. Each bout was separated by 5 minutes of rest. Surface electromyography (sEMG) was assessed from the vastus lateralis (VL) and vastus medialis (VM) muscles and normalized to a pre running unilateral maximal voluntary isometric contraction of the leg extensors. All neuromuscular parameters (sEMG amplitude [AMP] and mean power frequency [MPF]) were measured from the right leg and assessed every 60 seconds during each running bout using separate 4 [Condition (70%, 80%, 90%, 100%)] x 3 [Time (every 60 seconds)] repeated measures ANOVAs.

References

Institute of Exercise Physiology and Rehabilitation Science
UNIVERSITY OF CENTRAL FLORIDA

sEMG AMP responses were similar for the VL and VM when running with and without BFR, while sEMG MPF was only similar for the VL, but not the VM

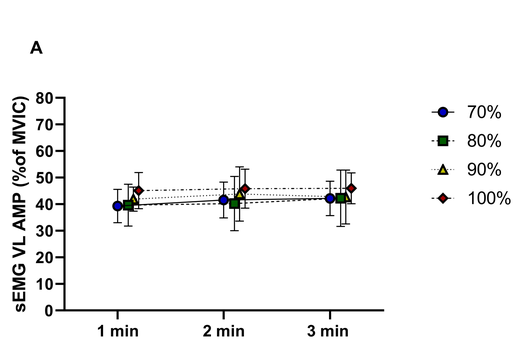

Figure A: Surface electromyography vastus lateralis amplitude responses across Time and between Conditions, expressed as a percentage of a maximal voluntary isometric contraction.

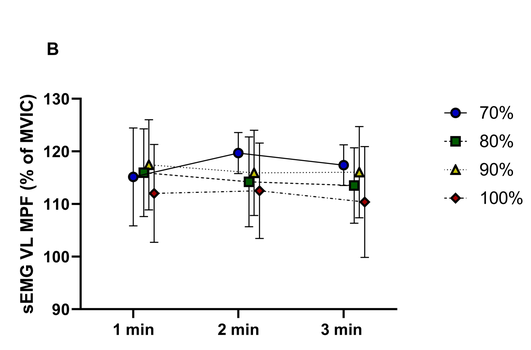

Figure B: Surface electromyography vastus lateralis mean power frequency responses across Time and between Conditions, expressed as a percentage of a maximal voluntary isometric contraction.

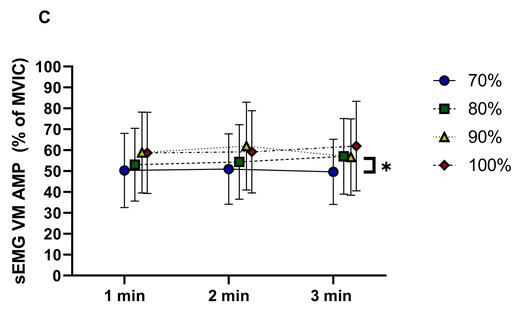

Figure C: Surface electromyography vastus medialis amplitude responses across Time and between Conditions, expressed as a percentage of a maximal voluntary isometric contraction. * denotes a significantly (p<0.05) greater response for the 90% relative to the 70% and 80% submaximal running bouts with blood flow restriction.

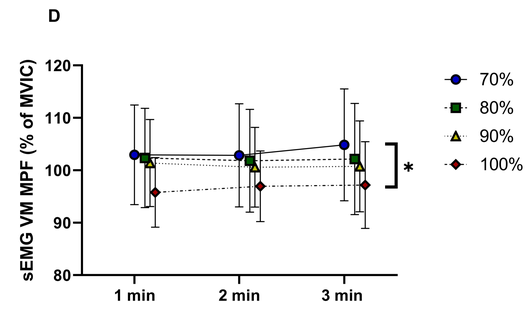

Figure D: Surface electromyography vastus medialis mean power frequency responses across Time and between Conditions, expressed as a percentage of a maximal voluntary isometric contraction. * denotes a significantly (p<0.05) greater response for the 70% submaximal running bout with blood flow restriction relative to the 100% maximal running bout without.

Results

There were no significant (p=0.158-0.514) interactions for sEMG AMP or sEMG MPF of the VL or VM, but there were significant (p<0.001; p=0.029) main effects for Condition for the VM. Specifically, collapsed across Time, VM sEMG AMP was greater during the 90% (55.46 ± 25.9%) condition compared to the 70% (46.57 ± 23.41%) and 80% (50.5 ± 24%) conditions (p=0.002; p=0.029). Additionally, VM sEMG MPF was greater during the 70% (105.15 ± 15.05%) condition than the 100% (97.58 ± 11.12%) condition (p=0.043).

Conclusions

During the running bouts, there were condition specific neuromuscular responses for the VM, but not the VL. In general, however, all submaximal running bouts provoked a similar magnitude of muscle excitation (as assessed by sEMG AMP) as maximal running without BFR. For sEMG MPF, which reflects motor unit action potential conduction velocity, the differences between 70% and 100% may reflect a lower magnitude of metabolite buildup and/or production during the 70% condition, but this didn't affect the muscle excitation responses between conditions.

Practical Applications

The application of BFR during submaximal running may provide a neuromuscular training stimulus similar to those achieved during maximal running without BFR. Thus, coaches and/or practitioners may consider reducing the intensity (e.g., running speed) of some training sessions when combined with BFR without compromising the acute neuromuscular responses provoked by rigorous training. Some muscles, however, may be more sensitive to changes in running speed and future work is warranted to better understand this relationship.