The impact of blood flow restrictive exercise on endothelial function

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Abstract

Blood flow restriction exercise (BFRE) is the occlusion of blood flow during resistance exercise to elicit enhanced skeletal muscle hypertrophy while lifting lower weight compared to standard resistance training. Research has shown BFRE with low intensity resistance training to elicit similar results in skeletal muscle hypertrophy when compared to higher intensity resistance exercise. Although BFRE demonstrates similar levels of skeletal muscle hypertrophy, no research has examined the effects of BFR exercise on brachial artery endothelial function which has been demonstrated to be closely linked to coronary artery endothelial function and thus predisposition to developing atherosclerosis. Due to the effect on endothelial function, this type of training modality may not be suitable for individuals with cardiovascular disease (CVD) or those at a greater risk for developing CVD. The purpose of this study is to examine the effects of blood flow restriction exercise on endothelial function. Subjects in the experimental group were 9 healthy males, ages 23.4±1.1years, BMI 27.6±1.0 kg/m^2 and the control group were 3 healthy males, ages 22.7±1.0 years, BMI 29.7±3.2kg/m^2; regularly participate in resistance training exercises at least 2 times per week. Subjects performed 3 sets of bicep curls at 30% of their 1 repetition maximum to failure or a set repetition with or without a blood pressure cuff at 80% arterial occlusion pressure. Endothelial function was assessed by flow mediated dilation performed before, 10 min. after, and one hour post bicep curl. These data indicate BFR exercise does not alter endothelial function in healthy males. There is a significant effect of time in brachial artery diameter at the 10min time point post BFRE/resistance exercise (RE) in both the experimental and control group. Future studies will be aimed at examining plasma markers of vascular dysregulation, such as endothelin-1 and vascular cell adhesion molecule in response to BFR to determine potential mechanisms for the blunted flow mediated dilation. Future studies should also aim to increase the control sample size.

Introduction

- ACSM guidelines recommend resistance training at 70% of 1 rep max[1]
- Blood flow restriction exercise has shown similar increases in strength and hypertrophy at lower intensities
- Recently, some suggests BFR in clinical populations who may not be able to lift heavy weights
- Little is known about the effects on the vasculature

Figure 1: Example of blood flow restriction exercise

Methods

Nine and three healthy males (experimental, and control group, respectively), participating in at least 2 days/wk of resistance training participated in the study. In the first study visit, the subject's total occlusion pressure of the brachial artery was found (only in experimental group), followed by a 1RM bicep curl measurement.

In the second study visit, the subject's initial baseline FMD was measured. Experimental subjects then completed 3 sets to failure of bicep curls at 30% of their 1 rep max with or without a blood pressure cuff inflated on their right arm to 80% occlusion pressure. Control subjects then completed 3 sets to an average rep, from experimental group, of bicep curls at 30% of their 1 RM. Within 10 minutes post exercise, a second FMD was taken. A 3rd FMD was taken 1 hour post exercise. A two-way repeated measures ANOVA was used to analyze the data.

Flow Mediated Dilation (FMD)

- Assesses endothelial function via ultrasound of the brachial artery
- Measures vessel diameter and velocity before and after 5 min cuff inflation to 250 mmHg

Figure 2: Example of Flow Mediated Dilation protocol

Table 1. Mean and Standard Error of Participants

Subjects	1RM (lb.)	Total Occlusion (mmHg)	Age (years)	BMI (kg/m^2)
Experimental	47.2±1.7	139.6±3.5	23.4±1.1	27.6±1.0
Control	46.7±2.9		22.7±1.0	29.7±3.2

Results

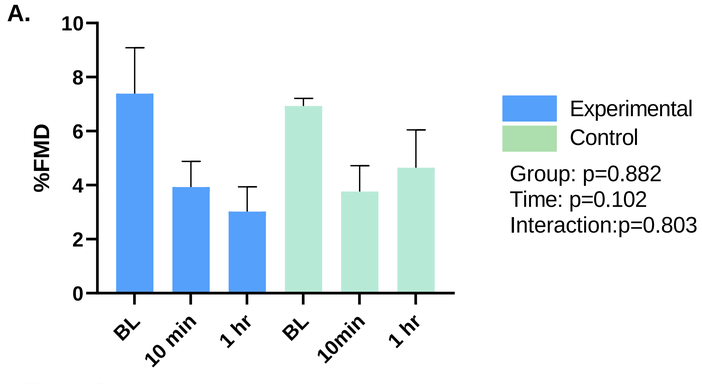
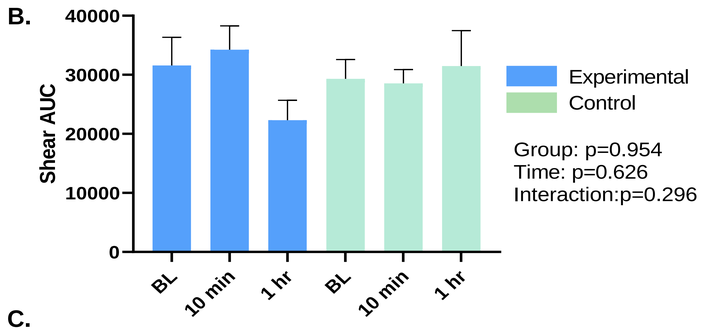


Figure 3: Illustrates the results of flow mediated dilation in the brachial artery performed at baseline, 10 minutes post exercise, and 1 hour post exercise. **A**. Average %FMD

Results, cont.



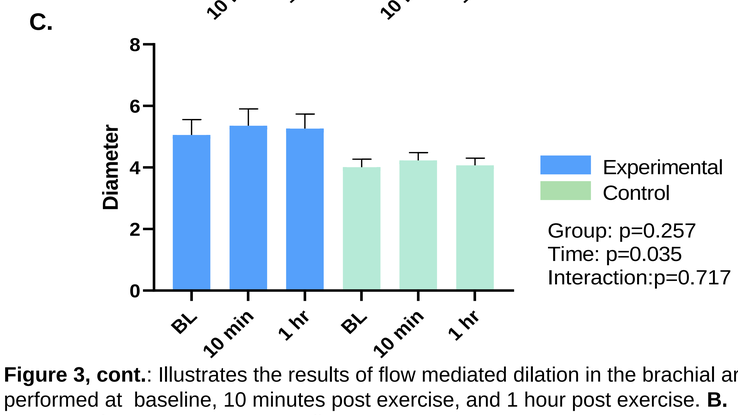


Figure 3, cont.: Illustrates the results of flow mediated dilation in the brachial artery performed at baseline, 10 minutes post exercise, and 1 hour post exercise. **B.** Average Shear AUC **C**. Average diameter

Summary

- No change in %FMD or shear AUC was found in the blood flow restriction exercise or resistance exercise group
- Mean diameter showed a significant effect of time ($p<.05$) at 10 min post

Conclusion

These early preliminary data indicates blood flow restriction exercise and resistance exercise does not alter flow mediated dilation, however we did find a significant interaction effect ($p=.035$) of brachial artery mean diameter in both groups at the 10 min post BFRE/RE.

Future Directions

- Increase sample size
- Explore plasma markers of vascular heath following BFR exercise
- Expand to female population

References

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