Perceptual responses to blood flow restriction resistance exercise

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Introduction: Light-load resistance exercise (20-30% 1 repetition maximum [1 RM]) in combination with blood flow restriction (BFR) has been shown to increase strength and muscle mass greater than light-load resistance exercise without BFR. In addition, these adaptations may be as great as those achieved with traditional heavy-load resistance exercise (≥65% 1 RM) (Takarada *et al.*, 2000). However, several investigations have observed greater elevations in ratings of perceived exertion and pain during lower body BFR resistance exercise compared with light-load non-BFR resistance exercise (Loenneke *et al.*, 2010). Furthermore, despite the use of light-loads, results from our laboratory (unpublished), and others, have revealed that BFR resistance exercise significantly elevates ratings of delayed onset muscle soreness (DOMS) (Umbel *et al.*, 2009). While the majority of previous studies have observed these perceptual responses as a result of lower body BFR resistance exercise, relatively little is known about the perceptual responses to upper body BFR resistance exercise. Therefore, the aim of the present study was to examine the timing and magnitude of DOMS in response to unilateral bicep curl BFR strength exercise in comparison with more traditional resistance exercise methods (*i.e.* utilizing heavy and light loads). While in addition, examining ratings of perceived exertion (RPE) for each exercise trial. A secondary aim was to compare these perceptual responses between two separate BFR exercise protocols. It was hypothesized that the perceptual responses to unilateral elbow flexion exercise would be greatest during heavy-load resistance exercise and lowest with light-load resistance exercise, with perceptual responses to BFR resistance exercise residing between these two more traditional exercise techniques.

Methods: Healthy males (n=17, 23 ± 0.7 years, 179.7 ± 2.0 cm, 71.5 ± 2.4 kg) completed a balanced, randomized cross over study comprising four strength exercise trials, with one undertaken each week across four weeks. The four trials were heavy load (HL; 80% 1 RM), light-load (LL; 20% 1 RM), and two BFR trials in combination with LL; Continuous BFR (BFR-C) and Intermittent BFR (BFR-I). In all trials, participants performed four sets of unilateral (dominant arm) elbow flexion exercise (*i.e.* a standard dumbbell bicep curl). RPE were taken pre- and five minutes post-exercise, while participants provided ratings of DOMS for seven days post-exercise using a 100 mm visual analogue scale where 0 mm represents “no soreness” and 100 mm represents “very, very sore”.

Results: Mean elbow flexion 1 RM strength was 18.2 ± 0.8 kg. The mean pressure used during BFR was 93 ± 2 mmHg and 141 ± 3 mmHg for BFR-C and BFR-I, respectively. Baseline measures were not different between trials. However, RPE was significantly higher following both HL and BFR-I when compared with both LL and BFR-C ($P < 0.01$). No differences were noted between HL and BFR-I, and similarly between LL and BFR-C. DOMS increased from baseline to 24 h post exercise following LL, BFR-C, and BFR-I ($P < 0.01$). At which point DOMS was also greater for BFR-I when compared with HL, with a trend to being greater than HL ($P = 0.07$) and LL ($P = 0.08$) at 48 h. DOMS remained significantly elevated at 48 h post exercise for BFR-C and BFR-I ($P < 0.01$), but not LL. In addition, DOMS ratings were elevated at 48 h post exercise in HL compared with baseline ($P < 0.05$). At 72 h post exercise DOMS was not different from baseline in all trials despite a trend for DOMS being greater in BFR-I compared to LL ($P = 0.07$).

Discussion: The findings suggest that unilateral elbow flexion resistance exercise with a high cuff pressure (*i.e.*, BFR-I) induces similar perceptual responses to HL resistance exercise, which may limit its potential use in some clinical populations. However, when a lower pressure was used (*i.e.*, BFR-C) session RPEs and DOMS is similar were more similar to LL resistance exercise. Therefore, it is recommended that lower cuff pressures with continuous application of BFR be utilized during resistance exercise, as we demonstrate this method to be more tolerable, and is a more typical method to produce gains in strength and muscle mass.

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