The effects of Isometric Exercise Training on Artery Dimensions and Blood Flow in Middle-aged Men

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Introduction

Previous isometric training studies reporting reductions in resting blood pressure have not explored whether there are concomitant changes in resting artery dimensions and blood flow. Furthermore, the influence of isometric training intensity on these adaptations has not been investigated. Therefore, the purpose of this study was to explore whether training-induced reductions in resting blood pressure are associated with concomitant changes in the vasculature of the trained and untrained limbs and to establish if these adaptations were intensity dependent.

Methods

Subjects undertook an 8 week training programme consisting of 4x2 min bilateral-leg isometric contractions 3 x per week (Wiles *et al.*, 2010). Two groups exercised at intensities equivalent to 70% (n=10) or 85% (n=10) of their peak heart rate ($\%HR_{peak}$; as established in a prior incremental test), and a third group acted as controls (n=10). Resting systolic (SBP), mean arterial (MAP) and diastolic (DBP) blood pressure was measured at baseline and post-training. Artery diameter and mean blood flow (brachial and femoral) were also measured at rest using Doppler ultrasound. Analysis of variance was used to determine whether post-training measures were significantly different to baseline. Also, baseline values were used as a covariate to account for initial resting blood pressure values.

Results

There were significant reductions in resting SBP (-10.8±7.9 mmHg) and MAP (-4.7±6.8 mmHg) in the 85%T group post-training and concomitant significant increases in resting femoral mean artery diameter (FMAD; 1.0±0.4 mm) and femoral mean blood velocity (FMBV; 0.68±0.83 cm/s), which resulted in increased femoral artery blood flow (FABF; 82.06±31.92 ml/min). There were no significant changes in brachial artery measures after training. Furthermore, there were no significant changes in any resting measure in the 70%T or control group.

Discussion

This study shows that the reductions in resting SBP and MAP observed after isometric training are associated with concomitant increases in resting artery dimensions and blood flow, but these changes were restricted to the trained limbs. This suggests that the vascular adaptations were localised. Furthermore, these adaptations seem to be training-intensity dependent, as they were not observed in the 70%T training group. These findings could be explained by reduced resting vascular tone, enhanced endothelium-dependent function or by vascular remodelling. The stimulus for such adaptations may arise from changes in availability/activity of nitric oxide as a result of sheer stresses during isometric exercise (McGowan *et al*. 2007). Exactly how these sheer stresses occur during isometric exercise and how they might be related to isometric training intensity would be deserving of future study.

McGowan CL, Levy AS, McCartney N, MacDonald MJ. (2007). Clin. Sci. 112, 403-409.

Wiles JD, Coleman DA, Swaine IL. (2010). Eur. J. Appl. Physiol. 108, 419-428.