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Brachial flow-mediated dilatation response to acute different upper body training postures in lean inactive vs. lean active men

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Abstract *Background:* Resistance training postures trigger different results on endothelial function: however, the acute effect of resistance training on upper body muscle in active and inactive persons is inconclusive. The present study aimed to investigate the acute effects of 2 different types of upper body training (bench press training and lat pull down training) on flow-mediated dilation (FMD), and to compare the effects between lean inactive men (LI) and lean active men (LA).
Methods: LI ($n = 16$) and LA ($n = 16$) men undertook 2 upper body training postures at 60% of 1 repetition maximum (RM), 15 repetitions a set for 3 sets. Before and after immediate training, the biological data, FMD data, and blood pressure data were collected.
Results: Both the LI and LA groups showed similar results at the baseline of biological data, including carotid intima media thickness data ($P > 0.05$), while the higher muscular strength was observed in the LA group. Significantly higher shear rate and blood pressure after training were observed in both groups ($P < 0.05$); however the magnitude of increment in blood pressure was greater in LI group. FMD was significantly increased in the LA group following bench press training while it decreased in the LI group following lat pull down training ($P < 0.05$).
Conclusion: Higher fitness status can acutely protect against the undesirable effects on vascular function following resistance training. In active persons, we suggest performing both the bench press and lat pull down trainings, without any limitations. In contrast for inactive persons, the bench press is recommended at the beginning of training for protection against decreased FMD. After vascular adaptation, lat pull down training might be added in order to strengthen upper body muscles.

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Introduction

Endothelial cells are simple squamous monolayer cells that line the inside of the lumen of blood vessels in a mosaic pattern. These cells have a crucial responsibility for maintaining vascular homeostasis, especially, the balance of vasodilators and vasoconstrictors.[1] Thus, any imbalance can lead to endothelial dysfunction which can cause the development of cardiovascular diseases, i.e., atherosclerosis, coronary artery disease, and arterial hypertension.[2,3] To enhance endothelial function, several strategies have been recommended, including antihypertensive therapy, cholesterol decreasing drugs, exercise training, and other methods involving the reduction of cardiovascular risk factors. Specifically, exercise training that affects vascular function has been widely investigated for improving the deterioration of endothelial function.

The most common method for evaluating endothelial function in exercise training is by flow-mediated dilatation (FMD), which is a non-invasive method that represents the change of diameter via the activation of blood flow.[4–6] Higher FMD in humans is related with lower vascular risk and stage of hypertension.[7] Aerobic exercise has shown an increment of FMD in both acute and chronic effects in active subjects.[8,9] In contrast, some studies have reported conflicting results concerning the acute effects in sedentary subjects.[8] It is possible that the variation of the baseline of vascular risk factors and health status in individuals might be an important factor associated with the change of FMD.

The acute effects of FMD following resistance training were inconclusive, especially when researchers focused on different training postures.[10,11] Our previous studies reported the acute effects of different abdominal types of training on FMD in untrained sedentary subjects.[10,11] We found that FMD was acutely improved after 3 sets of crunch training, with no change in side-crunch training and plank 30 s training, and a decrease in both leg raise and plank 60 s training. These results encourage the inactive subjects to select proper postures that might not impair FMD at the beginning of training. Nonetheless, there is no concrete evidence regarding the acute effects of resistance training on other body regions, especially the upper body region. The purpose of this study was to investigate the acute effects of the different types of upper body training (bench press training and lat pull down training) on FMD. These effects were compared between lean inactive and lean active male subjects. Our working hypothesis was that the different upper training postures would yield variable results in both exercise status groups.

Methods

Participants

Thirty-two lean young male subjects, active (n = 16) and inactive (n = 16), were recruited from Srinakharinwirot University, Nakhon Nayok, Thailand. The lean inactive (LI) group was characterized by no exercise training in the past 6 months. The lean active (LA) group had experience in resistance training program for a minimum of 3 times per week for at least 6 months, but no aerobic training program, or an aerobic program but of less than 1 time per week. All participants were aged between 18 and 22 years, with a body mass index (BMI) of 18.5–24.9 kg/m^2, were nonsmokers, and free from known cardiovascular diseases. The study was approved by the Ethics Committee of Srinakharinwirot University, Thailand and written consent was obtained from all participants.

Exercise intervention

Participants performed bench press training on a Smith machine (Smith machine FW-161, Johnson Health Tech Co., Ltd) and standard lat pull down training on a cable system (Johnson SU-152, Johnson Health Tech Co., Ltd). For bench press training, participants started in the supine position on the bench, gripping the bar, then lowered the bar to their chest at nipple level. Participants began the first repetition by pushing the bar until they achieved full elbow extension, and then lowered the bar to the starting position. The distance between both hand grips was calculated by 165% biacromial breadth (the distance between acromion processes × 1.65). For lat pull down training, participants started in a seated position on the bench with their thighs attached to the machine. They used a pronated grip on the bar. Participants began the first repetition by pulling the bar downward to chin level, and then slightly extended their elbows and shoulders until fully extended to the starting position. The distance between both hand grips was equal to the distance of the outside of the distal end of the metacarpal to the seventh cervical vertebra.

In both the bench press and lat pull down trainings, participants were instructed to perform 2 s for the concentric phase and 2 s for the eccentric phase which was controlled by a metronome. Each type of training involved training at 60% of 1 repetition maximum (RM), 15 repetitions a set for 3 sets, with 1 min to rest between each set.

Study design

Both the LA and LI groups undertook two upper body training postures, the bench press and lat pull down, using weight machines. Training session was separated by at least 72 h. Twenty-four hours prior to each session, the participants were asked to refrain from vigorous physical activities and caffeine. At the first training session, both the LA and LI groups performed two trials in a randomized order, either the bench press or lat pull down training. The remaining upper body training posture was undertaken by participants at the second training session. Participants in both groups were instructed about the training and permitted to practice a week prior to their first session. At each training session, all the participants had their biological data, blood pressure data, FMD data, and intima media thickness (IMT) of the common carotid artery data measured. After the completion of training, all of the above biological data were repeated immediately.