Isometric strength training increases acetylcholine-induced relaxation in ovariectomized female rats

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Introduction
The endothelium plays an important role in the regulation of vascular tone via synthesis of various vasoactive substances, such as nitric oxide (NO). Ovariectomized rats develop a typical endothelial dysfunction resembling that observed in postmenopausal women. They have a markedly reduced relaxant response to acetylcholine (ACh), an endothelium and (NO)-dependent relaxant agent (1). Exercise training has been shown to improve NO-dependent vasodilation in animals, in part, due to increased release of NO by the endothelial NOS (2). The majority of previous studies have been performed using endurance exercises, and no information exists about effects of isometric training.

So, the purpose of this study was to investigate whether a progressive isometric strength training protects against endothelial dysfunction induced by estrogens deficiency in female rats, and to compare training exercise with 17β-estradiol administration effects.

Methods
Twenty-four female Sprague-Dawley rats (4 weeks old) were subjected to a bilateral ovariectomy (OVX rats). Eight sham operated animals (Sham OVX rats) served as control. Three weeks after surgery, animals were randomly assigned to one of the four treatment groups during 14 weeks as follows: 1) sedentary control group receiving subcutaneous (s.c.) daily injection of 17β-estradiol 20 µg/kg in 100 µl of a mixture of DMSO (0.2 %) and NaCl (99.8 %)(OVX SED17β; n=8); 2) sedentary control group receiving daily vehicle s.c. (OVX SED; n=8); 3) isometric strength training group receiving daily vehicle s.c. (OVX ISO; n=8); 4) sedentary sham operated group (Sham OVX; n=8). Exercised animals were subjected to a progressive isometric strength training (3) every morning, 5 days per week. Endothelium response was evaluated with cumulative concentrations of ACh (10⁻¹⁰–10⁻⁵ M) in aortic rings precontracted with norepinephrine (10⁻⁷ M). Results are expressed as means ± SEM.

Results
The concentrations-response curves for ACh (fig 1) demonstrated that ACh-induced relaxation was enhanced in aortic rings obtained from the OVX ISO group, as evidenced by the highest pD2 value of Ach compared to OVX SED and SHAM OVX groups (Table 1). 17β-estradiol treatment increased endothelium-mediated relaxation in OVX SED17β compared to OVX SED rats (Table 1), however exercise training significantly improved endothelial function with a greater extend as compared to 17β-estradiol.

Discussion/Conclusion
Our findings showed that isometric strength training succeeded in improving endothelial function in ovariectomized female rats. Exercise training enhanced endothelium-dependent dilation, which contributes to the benefit of regular exercise in preventing cardiovascular diseases.

References