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USE OF ARTIFICIAL GRAVITY TO AUGMENT ANKLE-BRACHIAL INDICES

Abstract

Introduction: Peripheral arterial disease (PAD) is mainly caused by atherosclerosis and is characterized by decreased circulation, lower blood pressure, and insufficient tissue perfusion in the lower extremities. The hemodynamics of standing and altered gravity environments have been well studied relative to arm blood pressures, but are less well understood for ankle pressures. Since regional blood pressure depends, in part, on the gravitational pressure gradient, we hypothesized that artificial gravity exposure on a short-arm centrifuge with the center of rotation above the head would increase blood pressure in the lower extremities more than in the upper extremities.

Methods: Cardiovascular parameters for twelve healthy subjects (4 females, 8 males; 26 +/- 1 years, weight 70 +/- 3 kg, height 177 +/- 2 cm) were measured during exposure to supine short-arm centrifugation at the Man-Vehicle Lab (Massachusetts Institute of Technology) at 20, 25, and 30 revolutions per minute (rpm), corresponding to centripetal accelerations of 0.94 Gz, 1.47 Gz and 2.11 Gz at the foot level, respectively. Supine and standing blood pressures were also evaluated before and after centrifugation.

Results: Systolic ankle blood pressure significantly increased at all levels of centrifugation. Ankle-brachial indices (the most widely non-invasive parameter used to evaluate patients with PAD), defined as the ratio of systolic ankle to arm blood pressures increased significantly from 1.17 +/- 0.03 to 1.58 +/- 0.03 at 0.94 Gz ($p<0.005$), 1.74 +/- 0.02 at 1.47 Gz ($p<0.005$) and 1.89 +/- 0.06 at 2.11 Gz ($p<0.005$). Systolic arm blood pressure significantly increased at 2.11 Gz, but heart rate did not change significantly. All supine parameters returned to normal after cessation of centrifugation. There were however more prominent blood pressure (but not heart rate) responses to standing after exposure to centrifugation.

Conclusions: We demonstrated that short-radius centrifugation leads to an increase in ankle-brachial indices. These findings could have potential implications for the treatment of patients with PAD.