
**INTRODUCTION.** Changes in blood volume during space flight are thought to contribute to decrements in cardiovascular function. The purpose of this study was to determine whether gender affects red cell mass and plasma volume during a short exposure to simulated microgravity, and whether gender differences in orthostatic tolerance during bed rest are influenced by these variables.

**METHODS.** Twenty men (21.9 ± 4.3 yrs, STD) and 12 women (26.1 ± 2.8 yrs, STD) were studied before bed rest and on day 3 of bed rest. The study was a blinded, randomized, cross-over design. Subjects were evaluated in the supine position with intravascular volume maintained at near-pre-flight levels for the duration of bed rest.

**RESULTS.** Men had significantly lower plasma volume and red cell mass at rest than women. In men, plasma volume decreased by 14.6% (p = 0.01), and red cell mass decreased by 17.7% (p = 0.01), but not significantly in women. The decreases were significantly greater in men than women. There were no gender differences in changes in total blood volume.

**CONCLUSIONS.** The decreases in plasma volume and red cell mass were greater in men compared to women. The decrease in total blood volume was similar for men and women. These findings may have implications for the design of future space missions.

INTRODUCTION. Hindlimb denervation produces alterations in skeletal muscle and bone similar to those observed in animals exposed to microgravity. The objective of this experiment was to determine the effects of dobutamine, a beta agonist, on the cardiovascular and skeletal muscle systems in hindlimbs of rats. METHODS. Adult male Sprague-Dawley rats (n = 14) underwent unilateral sciatic nerve section on the right hindlimb. After surgery, rats were randomly assigned to either control saline (SAL) or dobutamine (DOB) treatment groups. Each animal received two intraperitoneal injections per day, given approximately one hour apart, for 11 of the 12 days. Bone mineral density (BMD) and the proximal load (PPL) and (PPL) of the tibia from both the innervated (INN) and denervated (DENERV) hindlimbs of each rat were measured by a bone densitometer (SP-2 Lunar). Muscle weights of the soleus (SOL) and plantaris (PLT) and citrate synthase (CS) enzyme levels of the SOL muscle were examined. RESULTS. ANOVA and Tukey's post hoc tests (p < 0.05) indicated a significant reduction in wet weight of the SOL and PLT muscles in the DENERV SAL group compared with their INNERV counterparts. BMC of the PLT and PPL of the tibia and CS levels of the SOL were also significantly reduced in the DENERV animals that received SAL. Although animals which received DOB treatment did have decreases in muscle mass, BMC and CS in the DENERV hindlimb, these decreases were not significant when tested against their INNERV values. DOB treatment appeared to be most effective in bone, where the decrease in BMC produced by DENERV in SAL animals was almost entirely eliminated in rats receiving the drug. CONCLUSION. These data indicate that DOB is able to effectively attenuate alterations in muscle and bone which are induced by hindlimb denervation. This information suggests that DOB may be effective as a countermeasure for some of the deconditioning life changes which result from exposure to a microgravity environment.

CHANGES IN LEFT VENTRICULAR FUNCTION AS DETERMINED BY THE MULTI-WIRE GAMMA CAMERA AT NEAR PRESYCORPICAL LEVELS OF LOWER BODY NEGATIVE PRESSURE. • K. Fisken, • S. Fortney, • R. Muthyap, 2. Lacy, • KRUG Life Sciences, • NASA Johnson Space Center, • University of Arizona Space Research Association and • Baylor College of Medicine.

At presyncope levels of lower body negative pressure (LBNP), we have frequently observed echocardiographic respiratory variations due to changes in cardiac position and/or shape, but could be indicative of altered myocardial function. To further investigate this, we evaluated cardiac function using a nuclear imaging technique in 24 human subjects maintained for 60 minutes in supine rest and near the end of a presyncope-limiting LBNP exposure (LBNP averaged 65 ± 3 mmHg at 70 s). Cardiac function parameters were obtained using a Multi-Wire Gamma Camera following an intravenous bolus injection of 30-50 mCi of 153Talentium. Manual blood pressures and electrocardiograms were obtained throughout the 3-minute graded LBNP protocol. Between rest and injection during LBNP, heart rate increased (P < 0.001) from 67 ± 3 bpm to 99 ± 9 bpm, systolic blood pressure decreased (P < 0.01) from 119 ± 3 mmHg to 107 ± 3 mmHg and left ventricular ejection fraction (EF) decreased (P < 0.001) from 0.65 ± 0.02 to 0.48 ± 0.02. During LBNP, ST segment depression of at least 0.5 mm occurred in 7 subjects. Subjects with ST segment depression had greater reductions in EF (P < 0.05) than subjects without ST depression (0.65 ± 0.02 vs. 0.48 ± 0.02), but also tolerated greater levels (P < 0.05) of negative pressure (88 ± 6 mmHg vs. 69 ± 5 mmHg). There was a significant relationship between presyncope LBNP levels and EF (r = 0.50, P < 0.05). These findings suggest there may be a decrease in systolic myocardial function at high levels of LBNP.

EFFECT OF LBNP ON CEREBRAL CIRCULATION. T. Iino1, • K. Yoshimoto1, • Y. Niiyama1, • S. Sekiguchi2, • Y. Yumikura3, • A. Miyamoto4, and A. Fujita5. 1.Dept of Neurosurgery, Tokyo Police Hospital, Fujime, 218-0041, Chiyoda-Ku, Tokyo, 102 Japan, 3 Dept of Hygiene, Nihon Univ School of Medicine, and 4National Space Agency, Japan of 205.

INTRODUCTION. The purpose of our study is to determine the effects of lower body negative pressure (LBNP) on cerebral circulation. METHODS. Oxygenation and hemodynamics of the brain were measured continuously and invasively in eight cases which were exposed to 30 mm Hg LBNP for 25 min by using a carotid doppler, a transcranial doppler, a cuvette laser doppler, and a near infrared spectroscopy. RESULTS. The carotid blood flow and the mean velocity of the middle cerebral artery decreased in all cases, even though the systemic blood pressures were well maintained. Oxygenation of the measured homogoblin and cerebral blood volume of the brain typically increased while deoxygenated homogoblin showed variable small changes. CONCLUSION. The constricts of the carotid doppler and the transcranial doppler indicate that the cerebral blood flow might decrease during LBNP. From the increase of oxygenated homogoblin and cerebral blood volume, it is suggested that the dilation of the cerebral vessels occurs at the arterial side. Taken together, it can be said that exposure to moderate LBNP typically produces a decrease of the cerebral blood flow with a compensatory vasodilatation at the arterial side of the brain.

ASSESSMENT OF CEREBRAL BLOOD FLOW BY TRANSCRANIAL DOPPLER METHOD DURING gz ACCELERATION IN HUMAN. G. OSSARD, J.-F. CLERB*, F. MELCHOR, A. RONCIN, J. SELVAZ. Laboratoire de Medicine Aerospatiale, Centre d’Essais en Vol, P 91228 Brestely sur Cabe Cedex; France.

INTRODUCTION. Limit of human tolerance to +Gz acceleration is attributed to cerebral perfusion failure. A study using transcranial Doppler (TCD) was conducted in order to evaluate changes in cerebral blood flow (CBF) under +Gz stress. METHOD. 9 relaxed volunteers were exposed to 30 sec +Gz pulse, 2 or 3 +Gz in one subject. CBF changes were assessed by transcranial Doppler recording of middle cerebral artery (MCA) blood flow velocity. Arterial pressure (head level) was monitored with a continuous non-invasive method (Finapres 3300). From these data, mean cerebral artery perfusion pressure was computed. RESULTS. Mean blood flow velocity (MBFV) was significantly decreased during +Gz onset and during 2 and 4 +Gz plateau. MBFV was 6.2 ± 1.7 cm/s compared to 7.5 ± 2.0 cm/s at +Gz. Three main intolerance cases were observed, each having transient decrease in extended blood flow back in MCA. DISCUSSION. The sensitivity of TCD method is adequate to evaluate small variations of CBF at +Gz. The method shows that CBF is insufficient at certain 5 +Gz profiles, explaining intolerance symptoms.