EVALUATION OF LBNP AS COUNTERMEASURE TO CARDIAC DECONDITIONING. K. Yajima(1), M. Isogashi(1), A. Miyama(2), M. Ito(1), K. Hihara(1), T. Nakazato(2), S. Yumikura(2), M. Doi(2) and C. Sekine(1, 2). 1) Nihon University, Tokyo, Japan, 2) NASDA.

METHODS: To evaluate the effects of LBNP as a countermeasure for cardiac deconditioning in space, seven young male volunteers were admitted to the hospital and experienced 6-degree head-down tilt (HDT) for 3 days. Passive 60-degree head-up tilt (HUT) was performed before and after HDT. Four volunteers received 30 mmHg LBNP for 3 minutes to induce fluid shift to the lower body twice a day (every morning and afternoon) during HDT for 3 days, while 3 of 7 volunteers (the control group) did not receive LBNP. Continuous blood pressure monitoring, heart rate, and impedance plethysmogram were measured during the HUT test before and after HDT. RESULTS: One volunteer became presyncpe during the first LBNP and also became presyncpe again during the HUT test after HDT. The other LBNP volunteers (3 out of 4) did not show undesirable conditions. One volunteer of control group was not presyncpe during the HUT test before HDT. However, he did not become presyncpe during the HUT test after HDT. CONCLUSION: 30 mmHg LBNP loading for 3 minutes twice a day did not seem to prevent cardiac deconditioning induced by 2 days of 6-degree HDT.

DISUSE OSTEOPOROSIS: CHANGES IN BIOCHEMICAL PARAMETERS DURING AND FOLLOWING SIMULATED MICROGRAVITY OF DIFFERENT DURATION. K. Lohn*, DLR Cologne, Germany; S.R. Mohler*, F. Powers*, T. Hargraver, Wright State University, Dayton, OH.

A limiting factor for prolonged human exposure to microgravity is the loss of bone mass. Immobilization and bed rest have proved to be useful models for earth based simulation of weightlossess effects. To further understand biochemical bone parameters we observed over a period of 120 days in 15 healthy male volunteers, divided into three groups. Group I (5 subjects) experienced 3 weeks, Group II (5 subjects) 1 week of horizontal bed rest. Group III (5 subjects) served as ambulatory control group. All bed rest subjects received a Ca balanced individual diet and were kept under close supervision in a hospital. Blood and urine samples were collected throughout the bed rest periods and during follow up (15 weeks).

RESULTS: Serum and 24 urine parameters of Group I showed changes that resembled the typical bone loss pattern of disuse osteoporosis (slight increase of Serum Ca, increase of osteocalcin, decrease of serum PTH, increase of urinary Ca and Hydroxyproline). Group II showed similar trends, however, changes were not significant compared to base line.

CONCLUSION: A bed rest period of more than 1 week appears to be necessary to show significant biochemical changes due to immobilization.

ENHANCED GAMMA COMPUTED TOMOGRAPHY FOR BONE DENSITY MEASUREMENT IN SHORT TERM BED REST SUBJECTS. W. S. Powers*, S. R. Mohler*, A. Lohn, T. Hargraver, N. Tomita, Wright State University, Dayton, Ohio 45401.

INTRODUCTION. Prolonged space flight may produce bone density loss of sufficient magnitude to adversely impact extended duration space travel. Trabecular bone density change which occurs early in space flight has not been adequately measured due to the limited accuracy of prior measuring devices. METHODS. The OsseoQuant gamma computed tomography device, with 0.5% change in trabecular bone density detection ability, was used to characterize changes in the bone density of healthy male bed rest subjects. Three groups of five subjects received monthly measurements of trabecular bone density of the distal radius and distal tibia. Five had three weeks bed rest, five had one week bed rest, and five were controls.

RESULTS. Trabecular bone density changes in the bed rest groups approached 1%. There was an unexpected rise in trabecular bone density of both bed rest groups in the first week of bed rest, followed by a decline in bone density during the bed rest period. CONCLUSION. The initial rise in trabecular bone density at the onset of bed rest may represent a new finding. The OsseoQuant could be used to measure changes in bone density in connection with current space shuttle missions.


INTRODUCTION. Saline loading (SL) within hours of reentry is currently used as a countermeasure against postflight orthostatic hypotension in astronauts. However, its effects on blood volume expansion is not quantified or its effects on orthostatic tolerance is not proven marginal at best. The purposes of the present study were: 1) to quantify the effects of SL on plasma volume and orthostatic tolerance following exposure to simulated microgravity and 2) to compare these effects with the use of a pharmacological fluid expander, hydroxyethyl starch (HES). METHODS: eleven men (30-45 yr) underwent a 15-min stand test before and immediately after 7 days of head down (BD) bed rest. Five of the subjects ingested SI (8 g salt tablets with 1 liter of water) 2 hr before standing at the end of bed rest while the other 6 subjects received 0.2 mg oral doses of F at 0600 and 2000 hours the day before and 0800 hours the day subject got out of bed (i.e. 2 hr before standing). Plasma volume (PV) was measured before BR, on day 7 of BR and after the final SI and F treatments just before the post-BR stand test. Blood pressure and heart rate was measured continuously during the stand tests. RESULTS. BR decreased from 43.7 ± 3.9 ml/kg to 35.9 ± 1.1 ml/kg (-11.8%, P<0.05). Following SL, PV remained at 39.1 ± 1.8 ml/kg, while F returned PV to 39.1 ± 1.6 ml/kg. The post-BR stand test was completed without syncope symptoms by only 2 of 7 subjects but by all 5 subjects after SI.

CONCLUSIONS. SI may be ineffective in restoring PV to preflight levels and may provide inadequate protection against postflight orthostatic hypotension. In contrast, F may provide a promising countermeasure if it can be shown that the incidence of syncope following exposure to simulated microgravity in the present study.

THE SPATIAL DISORIENTATION TRAINING SYSTEM BUILT IN AIR FORCE CHINA. Liu Jie, Institute of Aviation Medicine, Beijing, P.R. China.

INTRODUCTION. To reduce the incidence of the Spatial Disorientation (SD) accidents a 3D training System was built in AF of China. METHODS. This System consist of a), Education, through which the pilots should acquire adequate knowledge about the SD, its etiology, manifestation and the methods for coping with it b), Ground-Based training, through which allow the pilots to safely experience the SD simulated by Barony chair and Otolitho stimulator and to acquire adequate skill for coping with the SD by Visuo-Instrument Orientation ; c), In-Flight Training, trough which allow the pilots to acquire the factual skills of identifying SD (preferably for type 3D). It is built by a series of flight maneuvers to simulate the training aircraft and to acquire the skill of maintaining current spatial orientation to prevent disorientational conflict and the skill of developing (optimal control strategies for recovery from unusual atttitudes. RESULTS. Design of the system, which is based on ten thousands pilots are trained for overall training program. After training, the SD incidence is reduced from 81.4% to 13.3%, the recovery brings SD per every 100 h-flight is reduced from 8.5% to 0.1%, the recovery time of SD per every 100 h-flight is reduced from 9.9 to 2.6, the averaged flying hours of SD fatal accident per one year is reduced from 1.6 case (1988-1994, before training) to 0.4 case (1985-1999, after training).

CONCLUSION. This 3D training System is realizable and effective for avoiding SD fatal accident.

INTRODUCTION. Combat Edge (CE) is a new anti-G system permitting the use of F-15 and F-16 seat-back angles which are higher than standard seatback angles in simulator sickness, as measured by self-report, postural, and visual tests. A standardized scoring technique was developed which facilitates comparison between simulators and a factor analysis revealed three distinct factor clusters corresponding to ocularmotor, visual-vestibular, and neurovegetative systems. METHOD. Four simulators were examined in the present experiment. Two "aerobatic" moving-base simulators (2F114 and 2F143) for the A-10 and a fixed-wing simulator (2F121) for the H-60 helicopter. RESULTS. The simulator employing CR1 infinity stalls and the other two were dove projection simulators. The 2F143 was a fixed base. Approximately 100 acre was observed in each simulator. CONCLUSION. Simulator sickness was found in all simulators when total scores were taken into account, with the highest incidence in the helicopter simulators.

SKELETAL MUSCLE RESPONSES TO UNLOADING IN HUMANS. G. Dudley, P. Tresco, B. Hatger, A. Adams & P. Buchanan*. NASA & Biospace Corp, Kennedy Space Center, FL 32899, Karolinska Institute, S10401, Stockholm, Sweden.

INTRODUCTION. This study examined the effects of unloading on skeletal muscle structure. METHODS. Eight subjects walked on crutches for six weeks with a 10 cm elevated sole on the right shoe. This removed weight bearing by the lower limbs and biopsies of the left m. vastus lateralis (VL) were used to study muscle structure. RESULTS. Unloading decreased (P<.005) muscle cross-sectional area (CSA) of the knee extensors. In addition, both lower limbs and biopsies of the left m. vastus lateralis (VL) were used to study muscle structure. RESULTS. Unloading decreased (P<.005) muscle cross-sectional area (CSA) of the knee extensors. In addition, both lower limbs and biopsies of the left m. vastus lateralis (VL) were used to study muscle structure. SUMMARY. The results suggest that decreases in skeletal muscle CSA are determined by the relative change in impact loading history because atrophy was about 1/2 faster in extensor than flexor muscles. The 10 cm concern is that muscle function, at least at 70% in fast as compared to slow muscles or fibers, and 3) does not decrease cross-sectional or multi-joint function. They also suggest that the atrophic responses to unloading reported for other species are not necessarily similar to changes in highly-trained humans.

Supported by a NASA grant administered under contract NASA10 11624.