**BLOOD SUBSTITUTION AND PROPOSED HYPOTHESI:


**INTRODUCTION.** The use of hypothermia as a metabolic suppressor has been widely accepted. However, limitations of its surgical application and the unavailability of one effective inotropic drug negated the widespread use of this technique. To determine if it is possible to extend the duration and depth of hypothermic procedures, a novel technique was developed and applied in conjunction with complete blood substitution, using an aqueous blood substitute in a dog model. METHODS. Nineteen adult mongrel dogs were anesthetized and cannulated for intracardiac oxygenation, followed by complete blood substitution. The heart started at 19°C and spontaneous respiration was maintained. Results indicated that hypothermic procedures could be extended to 3-4 hrs., without significant ischemic injury. This technique may open new avenues for therapeutic intervention through prolonged suppression of cerebral metabolic activity.

**CONCLUSION.** Third order polynomials in hemoglobin and hematocrit were added to PREDICT all the other variables of the four groups. A total of 15 variables were identified and solved as they occurred. Quality of tracings was acceptable and heart rates during flight maneuvers were closely related to the intensity of flight loads. Noticeable hemodynamic changes occurring during performing the Q-G and the L-1 maneuvers were matched with each other. The increase of HE, CO, Plasm, and CVO and the rise of blood pressure and these parameters are of help for further investigation on the mechanism of blood pressure rising in G-6 maneuvers.

**STUDIES ON RESPIRATORY SENSATION FOR DEFINING ACCEPTABLE LEVELS OF ADDED RESISTANCE FROM RESPIRATORY APPARATUS. LI FAN ZHANG, R.L. BARGSTE, Aerospace Physiology, Fourth Medical University, Xian, 710002, P.R.China.

**INTRODUCTION.** The aim was to carry on a more systematic study of the sensory magnitude and its relationship with various kinds of added resistance, particularly the combined loads with different inspiratory vs. expiratory load ratios. METHODS. A new kind of category scale, the Multiple Evaluation System (MES) based on a fuzzy set category judgement model was used to assess the acceptability of respiratory resistance load. The equivalent respiratory sensation contours of 2, 3, and 4 JND (Just Noticeable Difference) steps above basal level, respectively, were determined. RESULTS. The intensity of the total added resistance was kept constant, the perceived magnitudes assessed by MES were dependent under rest as well as physical activity of light to moderate degree. The responses are obtained and are of practical significance in defining the permissible levels of added resistance of protective respiratory equipment.

**INDIRECT MEASUREMENT OF EYE-LEVEL BLOOD PRESSURE (BP) DURING +Gz LOADING USING OCCULARISCOPE (OCC) METHOD. K. ONO, S. YAGURA, I. KORAYASHI, H. KUMAZAWA, and H. KAWAGUCHI. J. Aerospace Medical Laboratory, JSASJ, Shizuoka-cho, Tachikawa-shi, Tokyo, 190, JAPAN. 2. Dept. of Physiology, Koyln Univ., Shinkawa, Mitaka-shi, Tokyo, 181, JAPAN.

**INTRODUCTION.** A (T+S) r (SETIME) method was developed to measure the blood pressure during +Gz load. We applied this device to the black out monitoring system (BOMS) during +Gz, METHODS. The device consisted of electro-photo-sensor for the detection of the velocity of arterial blood flow and superficial arterial pulsation. Special shaped rubber cuff mounted in a hood band which press the artery. From the oscillation curve of pulse wave and cuff pressure applied to the artery, systolic, diastolic and mean arterial pressures were calculated. The subjects equipped with the device (T+S) r (RSP) were seated and loaded level +Gz (2.3, 4.5 for 20sec with GORE, 0.1G for GORE). For the black out monitor, pulse wave from upper arm under constant cuff pressure (20-40mmHg) was continuously recorded. RESULTS. The disappearance of the arterial pulsation and occurrence of ocular symptoms (gray out and black out) was examined. REsults. During low level of G loads (2-3 G with GORE, eye-level and mean arterial pressure and constant level. Upon the exposure to 4 to 5 G, BP showed sharp decrease and its relationship with the disappearance of the arterial pulsation well corresponded to the occurrence of ocular symptoms. Results suggested a possibility of non-invasive BP measurement in space flight environment. An alternative new device to BOMS of advanced fighter aircraft.

**USE OF THE HOLTER MONITOR DURING FLYING OPERATIONS. B.D. BARKER*, G. GREY+. Canadian Forces, CFB Moose Jaw, Bushnell Park, Stell, Canada. SOH ONG.**

**INTRODUCTION.** Centrifugal cardiac evaluation of aircrew is limited to the +Gz environment and only partially simulates the physiological stressors of the operational cockpit. This study evaluated the use of the Holter monitor as an assessment tool during actual flying operations. A secondary aim involved a comparison study of heart rate and blood pressure trends in student pilots who fly under various flight conditions. METHODS. A single blind study matched a group of student pilots with the following 2 groups: G-z maneuvering group and the non-manoeuvring group. The Holter monitor and flow identical missions involving timed maneuvers ranging from -1G to +5G. Technical problems involving use of the Holter monitor during flight maneuvers were identified and solved as they occurred. Quality of tracings were assessed and heart rates during flight maneuvers identified. Comparison was made between heart rates between groups during each maneuver, respiratory parameters were used as an assessment tool when used in the operational cockpit. Differences in cardiac performance noted during this study are reflective of differences in training and experience.

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INTRODUCTION. Especially the cardiovascular systems are affected by positive radial acceleration (PARA) and hypergravity, increased in the levels of stress hormone occurred and secretion of renin from the kidney depends on the blood flow through the glomerulus. ANP released from the atria has vasodilator and diuretic effects. The secretion of ANP usually depends on changes of intracardiac volume. This study was to investigate the changes of secretion of ANP and PRA under the positive acceleration effect.

METHODS. The subjects included 14 subjects of Korean Air Force Academy and 7 pilots. The cardiac profile was a +6Gz for 30 secs. Blood sampling was performed before and after exposure to accelerated gravity.

RESULTS. An increase of ANP was recorded in 2 cases when PRA decreased in 7 cases. Measurements of ANP and PRA levels were analyzed by radioimmunoassay. CONCLUSION. PRA response to PARA was clearly observed, but the ANP response was not significant.

EFFECTS OF 3 WEEKS CENTRIFUGAL ACCELERATION IN RATS. M. Sudoh, H. Waki*, Y. Honda†, S. Iwama and H. Sakii.

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INTRODUCTION. This study was performed to clarify the effects of gravity on physiological parameters in rats exposed to 3 weeks centrifugal acceleration. METHODS. The Wistar rats were exposed to either 1G, 1.6G and 3G (n=each) centrifugal acceleration for 3weeks. RESULTS. A complete hypergravity, a centrifuge having an annular radius of 1.3m was used. RESULTS. During this period, daily changes in body weight, urine volume, food intake, water intake and urinary excretion of creatinine were measured. In addition, water balance was determined by urine volume and water intake. Body weights in groups 1.6G and 3G decreased by 7% on the 2nd day and by 14% on the 5th day, respectively. They, however, recovered to the pre-exposure control level by the end of the experiment. Food intakes in groups 1.6G and 3G decreased by 68% and 78% on the 1st day, respectively, and recovered to the pre-exposure level on the 2nd day. Thereafter, they remained unchanged. Water intakes in groups 1.6G and 3G decreased by 62% and 98% on the 1st day, respectively, and returned to the pre-exposure level on the 3rd day. CONCLUSION. It is suggested that body weight and daily intake of food and water decrease in response to acclimation to hypergravity and that the rate of decrease is influenced by the intensity of gravity.

EFFICIENCY OF CONTINUOUS BLOOD PRESSURE MONITORING DURING LBNP TEST. S. Yamakura1), K. Sekiguchi*1), T. Mawatari1), K. Enomoto2), R. Maruy2), N. Yamaguchi2), and K. Yamaura2).

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PURPOSE AND METHOD: To evaluate the efficiency of continuous blood pressure (BP) monitoring during the LBPN test, the continuous BP monitoring system (Finapres) was used on 30 mmHg LBPN tests. The cases of presyncope episodes in the Finapres and LBPN (n=26) were compared with the intermittent (1-minute interval) hemodynamic impedance cardiography monitoring and 2-minute interval BP monitoring. RESULTS. Neither 1-minute nor 2-minute interval BP monitoring could indicate the immediate hemodynamic response during the presyncope episode. However, continuous BP monitoring showed a remarkable difference between BP and HR during the presyncope episode. The average duration from the beginning of BP decrease to the LBPN termination was 39.5 sec. Conclusions. Continuous (beat-by-beat) BP monitoring is necessary.

SPECTRAL COMPONENTS OF HUMAN CAROTID ARTERY VASCULAR RESPONSES TO STEP CHANGES IN LOWER BODY NEGATIVE PRESSURE (LBNP) BEFORE AND AFTER 22 HR OF 6° HEAD DOWN BED REST. C.F. Knopp, J.M. Evans, E. Grande, C.D. Murphy, A.P. Panuwattan, Center for Biomedical Engineering, University of Kentucky. Lexington, KY 40506.

Changes in autonomic outflow to peripheral organs during the development of head down bed rest (HDBR) have been hypothesized. Recent studies have indicated that spectral analysis provides an indirect assessment of these changes. Eight male subjects were studied before and after 22 hours of 6° head down bed rest plus Lasix (40 mg/m2). Cardiovascular autoregulatory technique were determined for heart rate (HR), arterial pressure (AP), Finapres radial arterial blood flow (RR), and radial pulse transit time (RPTT). Spectra were obtained from 2.5 minute segments during control, LBNP (30, 50, 70, 90, -50 mmHg) and recovery. Heart rate (HR) spectral power in the low frequency range (LF) was significantly decreased in the low frequency range (LF) of the LF+HF (0.04 to .18 Hz) range, increased AP power in the high frequency range (HF) associated with increased arterial blood flow (RR) and radial pulse transit time (RPTT) and were associated with increased AP power in the high frequency range and decreased AP power in the low frequency range. Since spectral power of AP/AP in the high frequency range has been shown to be sensitive to sympathetically mediated regulation and power in the low and mid frequency ranges indicate a sympathetic or parasympathetic mixture, then both bedrest and LBNPreduced sympathetic activity and the low frequency range toward sympathetic regulation of HR. The interpretation of the spectral content of AP and RR with respect to their autonomic origins remains unclear. Supported by NASA NAG 8289.

CHRONIC CATECHOLAMINE ADMINISTRATION INDUCES DOSE DEPENDENT CHANGES IN SKELETAL MUSCLE MYOIN ISOZYMES AND FIBER TYPES DURING HINDLIMB SUSPENSION. C. Gilg*, A.J. Merola, W.M. Sherman, G. Winsor, D. Danile. Wake Forest University School of Medicine, Winston-Salem, NC 27109. USA.

INTRODUCTION. Several dosages of GP-2 (GP-2), a new and very potent synthetic catecholamines, were tested to determine the minimum effective dose capable of significantly altering skeletal muscle myosin isoforms and fiber types. METHODS. Adult male Sprague-Dawley rats (n=56) were randomly assigned to one of seven treatment groups. Rats assigned to the control (CON) group were not exposed to suspension. All other rats were suspended using the Morrey-Hilton tail suspension method and were given injections of either saline (SAL) or one of five dosages of GP-2 (0.02, 0.04, 0.08, 0.10 μg/kg). Each animal received two intraperitoneal injections per day, given approximately one hour apart, for 12 of the 14 days. Fiber types of the soleus (SOL) and gastrocnemius (GAST) muscles and myosin isozone profiles of the GAST were determined by histochemical techniques and by gel electrophoresis, respectively. RESULTS. ANOVA and Tukey's post hoc tests (p<0.05) indicated a significantly lower percent slow twitch fibers (% ST FIB) in the suspended SAL (SUS/SAL) vs SAL/CON. This was achieved by treatment by 5% ST FIB) in the GAST, the % of slow myosin (1% SM1) in the GAST of the SUS/10 group did indicate that the % 10 μg/kg dose was effective in suppressing the suspension induced decrease in the % SM1 while the other doses were not. Despite some differences in group comparisons between % ST FIB and % SM1 in the GAST, there was a significant correlation between these two measures (r=.56). CONCLUSION. Overall, the data indicated that incremental increases in GP-2 resulted in graded dose response increases in % ST FIB and % SM1 and graded attenuation of detrimental skeletal muscle changes produced by conditions which stimulate weightlessness in rats.