Abstracts of Current Aviation Medicine Literature

I. ACCELERATION PHYSIOLOGY

1. Lower body negative pressure box for +Gz simulation in the upright seated position.

M. T. LATEGOLA & C. G. TRENT. *Aviat. Space Environ. Med.* 50 : 1182–1184, 1979.

The cost of purchasing and operating a human centrifuge is substantial. Lower body negative pressure(LBNP) is considered an acceptable experimental substitute for the +Gz stress of the centrifuge. Since civil aviation pilots are usually subjected to +Gz stress in an upright seated position, an upright seated version of the supine LBNP box was developed. In this version, a negative pressure of –40 torr is considered the equivalent of a 2 +Gz stress. This box has successfully withstood a test pressure of –120 torr. Pedal ergometry within the box is easily accomplished. The box was anthropometrically engineered to accommodate a human height range of 160–195 cm. Locating the box within an altitude chamber allows the application of LBNP at any level of chamber altitude. The total cost of fabrication is approximately $500.

2. Radiographic comparison of human lung shape during normal gravity and weightlessness.

D. B. MICHELS, P. J. FRIEDMAN & J. B. WEST. *J. Appl. Physiol.: Respirat. Environ. Exercise Physiol.* 47 : 851–857, 1979.

Human lung shape was measured during zero gravity (OG) to decide whether the normal vertical regional differences in ventilation are due directly to distortion of the elastic lung by its own weight, or instead, due indirectly to the effect of gravity on the shape of the rib cage and diaphragm. This was important because we previously established that weightlessness virtually abolishes the normal topographical inequality of ventilation (J. Appl. Physiol: Respirat. Environ. Exercise Physiol, 45 : 987-998, 1978). Chest radiographs were made after 10s of a weightless flight trajectory aboard a NASA-Ames Research Center Learje in both posterior-anterior and left lateral projections on five seated volunteers at residual volume functional residual capacity, and total lung capacity. Lung shape was assessed by measuring lung heights and widths in upper, middle, and lower lung regions. We found no significant differences between any of the normal gravity (1G) and OG measurements, although there was a slight tendency for the lung to become shorter and wider at OG (mean changes generally less than 3% or about 0.5 cm). By contrast, Grassino et. al. (J.Appl. Physiol. 39 : 997-1003, 1975) found no change in the vertical distribution of ventilation after voluntarily changing lung dimensions by more than 1 cm, by moving the abdomen in or out. We conclude that gravity produces topographical distribution of ventilation in the upright human lung by distorting the elastic lung tissue within the chest rather than by altering the shape of the rib cage and diaphragm.

3. Reproducibility of +Gz tolerance testing.

J. E. WHINNERY & W. G. JACKSON, Jr. *Aviat. Space Environ. Med.* 50 : 825-828, 1979.

The +Gz tolerance of USAF aircrewmen undergoing medical evaluation has been tested at the USAF School of Aerospace Medicine since 1973. For various reasons, the test protocol can usually be carried out only once on these patients. Accurate determination of the +Gz tolerance of aircrewmen who fly high performance fighter aircraft is very important in assuring aeromedical safety, since loss of consciousnes as a result of exceeding a pilot's G tolerance may result in loss of life and loss of aircraft. It is, therefore, necessary to estimate the variability associated with each profile of the test so that a more accurate assessment of +Gz tolerance can be made. Multiple repeat medical evaluation test protocols were performed on 17 centrifuge acceleration panel members. The standard

deviations in the +Gz measurements for the four centrifuge profiles were GOR(1) = 0.38 Gz, ROR = 0.22 Gz, GOR(2) = 0.34 Gz, and GOR(S) = 0.39 Gz. A statistically significant learning effect, which increases +Gz tolerance, was observed in both experienced and inexperieeced subjects. Knowledge of the variability associated with each test profile will allow a more accurate definition of an individual +Gz tolerance when only a single centrifuge test protocol can be performed. In addition, possible future use of this centrifuge protocol in the selection of individuals with above— or below-average +Gz tolerance is facilitated with an accurate assessment of the variability associated with the test.

II. CLINICAL AVIATION MEDICINE

4. Carotid sinus hyper sensitivity in patients presenting with syncope.

A. B. DAVIS, M. R. STEPHENS & A. G. DAVIS. *Brit. Heart J.* 42 : 583-586, 1979.

23 patients (ages 44 to 81) presenting with syncope vertigo, or transient amnesia were studied. In these patients massage of carotid sinus produced significant bradycardia. Electrophysiological study of ten most severely symptomatic patients was undertaken. The studies included measurement of intracardiac conduction times and corrected sinus node recovery times, as well as with carotid sinus massage before and after atropine. The only detectable abnormality in five of this group was asystole produced by carotid sinus massage, the other five had, in addition, evidence of either sinoatrial disease or an intracardiac conduction defect. Cardiac pacing in these ten patients completely abolished their symptoms. In a control group of 52 asymptomatic patients (ages 36 to 87), an abnormal response to carotid sinus massage was uncommon (2%).

5. Occurrence and reproducibility of exercise induced ventricular ectopy in normal subjects.

B. EKBOLM, L. H. HARTLEY & W. C. DAY *Amer. J. Cardiol.* 43 : 35-40, 1979.

The prevalence of ventricular ectopy was determined during gymnasium exercise in 389 normal men and 58 normal women. Ventricular ectopy was detected in 35 percent of men and 14 percent of women. Prevalence increased with age from 18 percent positive response in men under 30 to 50 percent over 50 years; men had more ectopy than women at each decade of life. Cigarette smoking, coffee drinking and regular physical activity had no significant impact on the prevalence of ventricular ectopy. The prevalence of ventricular ectopy increased from 15 percent at heart rates of less than 120 beats/min to 50 percent at a rate of more than 150 beats/min. Ventricular ectopy occurred 25 times more frequently during exercise than during the recovery period. At similar heart rates, the prevalence level of positive tests (both exercise and recovery period) were the same during running or during ergometric exercises. The prevalence of ventricular ectopy was not significantly different in patients after myocardial infarction than in normal periods matched for age and heart rate (42 and 36 percent, respectively).

6. Adaptation in human subjects to the effects of inhaled ozone after repeated exposure.

B. P. FARRELL, H. D. KERR, T. J. KULLE, L. R. SAUDER & J. L. YOUNG. *Am. Rev. Respir. Dis.* 119 : 725-730, 1979.

Single exposures to low concentrations of ozone (0.4 to 0.5 ppm) have resulted in decrements in forced vital capacity and specific airway conductance. To establish whether adaptation might occur with repeated exposure, 14 normal human subjects were exposed on 5 consecutive days to 0.4 ppm of ozone for 3 hours per day in an environmental chamber. Measurements of forced vital capacity and specific airway conductance obtained after exposure to ozone were compared to corresponding control values obtained during the previous week, when the same subjects breathed filtered air in the environmental chamber for 3 hours per day on 5 consecutive days at the same time of day. The forced vital capacity was significantly lower than the control value on the first 3 days of exposure to ozone, but there was no significant difference on the fourth and fifth days. Specific airway conductance was significantly lower than the control value on the first and second days of exposure to ozone; no significant difference was noted on the third, fourth, or final day. All subjects were symptomatic on the first and second days of exposure to ozone. Symptoms resolved thereafter, with only one subject remaining symptomatic on the final day of exposure to ozone.

7. Sickle cell trait and the aviator.

R. B. RAYMAN. *Aviat. Space Environ. Med.* 50 : 1170–1172, 1979.

Sickle cell trait (SCT) for years has been a controversial disorder within the aerospace medicine community. Some authorities consider SCT to be an entirely benign condition without particular significance, at least to moderate altitudes. Others are in disagreement and consider it a serious enough threat that flying duties should be precluded for all individuals with this disorder. These issues are addressed by reviewing SCT, its relationship to altitude, and its risk to aviation. The author concludes that flying organisations must establish their own policy on flying status for individuals with SCT based upon mission peculiarities and the assessment of risk inherent in that mission.

8. Problems of Impedance Cardiography.

K. SAKAMOTO, K. MUTO, H. KANAI & M. LIZUKA. *Med. Biol. Eng. & Comput.* 17 : 697–709, 1979.

Various electrical-impedance methods have been proposed for the measurement of haemodynamic parameters noninvasively. For example, an impedance method is proposed for the measurement of cardiac output from the skin surface and is called Impedance Cardiography. However, there are many problems in the application of the impedance technique for the noninvasive measurement of haemodynamic parameters. One of them is the complicated structure of organs in the body. Another is the anomalous electrical properties of tissues. For these reasons, it is very difficult to obtain exact information about haemodynamics from the waveforms measured by the impedance cardiograph, in spite of the fact that the waveforms include much useful information. We can get useful information, if the relationships between the waveforms and the biomedical events in the subject are understood. In this paper, the relationships between the waveforms and the circulation of the blood are discussed both theoretically and experimentally. The effects of the complicated structure of the organs and the anomalous electrical properties of tissues upon the waveforms are also discussed both theoretically and experimentally. For the analysis of the waveforms, it is very important to discuss (a) equipotential lines and potential distribution on the thorax, (b) the impedance or admittance between a pair of electrodes, (c) impedance or admittance changes due to blood circulation, (d) waveforms due to the pulsatile blood flow and (e) the effects of the complicated structure of organs upon the waveforms. From the results, it is concluded that :

(a) the waveforms measured by an impedance cardiograph are affected not only by the change of blood volume in the aorta but also by that in various organs such as the heart and lungs.

(b) the impedance measured by a pair of small electrodes separated by a short distance gives useful information about the region in the vicinity of the electrodes,

(c) much valuable information will be available, if the relationships between the measurement results and the pulsatile blood flow are understood, and

(d) by choosing an appropriate electrode arrangement, we may get much useful information about the blood circulation in the organs we want to investigate.

III. ENVIRONMENTAL, AVIATION AND EXERCISE PHYSIOLOGY

9. Heat tolerance and aging.

B. L. DRINKWATER & S. M. HORVATH *Med. Sci. Sports.* 11 : 49–55, 1979.

Although children and older adults appear more susceptible to heat stress, the mechanisms responsible for their lower tolerance are not fully understood. Many studies dealing with the effect of age on temperature regulation have concluded that an inadequate sweating response is primarily responsible for the low tolerance of children and the elderly to exercise in the heat. However, the dependence of core temperature on relative exercise intensity and sweat rate on absolute exercise intensity makes it difficult to avoid the confounding effects of exercise on thermoregulation when aerobic power (Vo_2max) varies across age groups. When 38 non-acclimatized females, ages 12 to 68 years, exercised at 30-35% Vo_2max in the heat, the degree of cardiovascular stability was the primary predictor of tolerance time. Age was not a significant predictor. However, it were more likely to be at risk. For children this risk was associated with the instability of an immature cardiovascular system; for older women, a marked decrement in aerobic power.

Sweat rate added significantly to the prediction of tolerance time for all subjects regardless of age. Whether the decrease in responsiveness of sweating noted for some older individuals is an age related change or a reflection of their lower fitness levels is not known.

10. Effect on performance of cycling deep body temperature between 37.0 and 37.6° C.

T. M. GIBSON & J. R. ALLAN. *Aviat. Space Environ. Med.* 50 : 935–938, 1979.

Previous experiments showed that performance of a pursuit rotor task is worse during heating than during cooling at deep body temperatures of 37.9–38.5°C. Performance of the same task and of a manikin task has now been studied in a similar experiment while core temperature was cycled between 37. 0 and 37.6°C. No change in performance was observed between heating and cooling. It is concluded that decrements in performance during heating only develop above a critical absolute level of deep body temperature. The critical level of deep body temperature, above which performance of the rotary pursuit task is degraded, is 37. 6–37. 9°C, and this can be related to affective thermal sensation.

11. Effects of preexercise feedings on endurance performance.

C. FOSTER, D. L. COSTILL & W. J. FINK. *Med. Sci. Sports.* 11 : 1–5, 1979.

Eight male and eight female students were studied during exercise to exhaustion on a bicycle ergometer at 80 and 100% of Vo_2max following the ingestion of water (W), 75 g of glucose (G) or a liquid meal (M) (10g protein, 12.5g fat, 15g CHO). When compared to the endurance ride (80% Vo_2max) in the W treament, endurance performance time was reduced by 19% ($p<.05$) (53.2 to 43.2 min) as a result of the preexercise glucose feeding (Trial G). No differance in performance at 80% Vo_2 max was found between the W and M trials. The preexercise feedings had no effect on exercise time to exhaustion at 100% Vo_2 max, though most of the subjects demonstrated a transient decline in serum glucose (<3.5mM). After 30–40 min of exercise, however, serum glucose returned to normal and was seldom low at the time of exhaustion. Serum free fatty acids (FFA) were depressed throughout the G trial. The results of these experiments indicate impaired lipid mobilization following CHO ingestion. The present data support our earlier findings which demonstrate that glucose feedings 30–45 minutes before endurance exercise increase the rate of CHO oxidation and impede the mobilisation of FFA, thereby reducing exercise time to exhaustion.

12. Cardiac response to whole-body heating.

M. A. B. FREY & R. A. KENNEY. *Aviat. Space Environ. Med.* 50 : 387–389, 1979.

Changes in ventricular function, as described by systolic time interval analysis, have been studied during heat stress and the time course of these changes, as well as changes in heart rate, have been investigated. Seven male and female subjects, 25–35 years of age, immersed their lower legs in water 42–44°C for 30 min; their trunks and upper legs were enclosed in nonpermeable plastic to prevent evaporative heat loss. Total beat interval (R–R), left ventricular ejection time (LVET), pre-ejection period (PEP), arterial blood pressure, and oral temperature were monitored periodically during heating and ecovery (post-heating) periods. The stress induced significant ($P<0.05$) decreases in R–R and LVET by 5 min of heating which continued decreasing throughout the 30-min heating period. Heart rate accelerated from 72 up to 97 beats/min. LVET's during heat stress were shorter than those at similar resting heart rates. R-R and LVET were increased significantly by 1-min recovery but had not returned to preheating levels at 15 min. PEP, on the other hand, was not reduced until 15 min of heating, and did not start to recover until 3 min postheating, after which it reached values exceeding control. A small increase in systolic blood pressure was maintained throughout heating and remained at 15 min recovery. Oral temperature increased approximately 1°C during the heating procedure ; 50% of this was dissipated by 15 min recovery. Results are consistent with a two-stage cardiac response to heat — vagal withdrawal followed by a strong sympathetic outflow to the heart affecting both inotropic and chronotropic characteristics.

13. Ventilatory drive in acute metabolic acidosis.

S. JAVAHERI, L. HERRERO & H. KAZEMI. *J. Appl. Physiol : Respirat. Environ. Exercise Physiol.* 45 : 913–918, 1979.

Although hyperventilation is a known compensatory mechanism in metabolic acidosis, the site (s) of

H^+ chemosensitive areas mediating this phenomenon have been controversial. The increase in ventilation has been ascribed to both primary stimulation of the central chemosensitive areas (CSA) or that of peripheral arterial chemoreceptors (PCR). To study the mechanism of hyperventilation, arterial and cisternal CSF pH were measured in two groups of anesthetised, spontaneously breathing dogs during 4 hr of infusion of 0.2 N HCl with and without peripheral chemodenervation. The fall in arterial plasma [HCO_3^-] was about 10 meq/l in both groups. In 11 intact dogs the $PaCO_2$ fell from 37 to 22mm Hg and in 9 dogs with bilateral sinus nerve section and cervical vagotomy $PaCO_2$ fell from 47 to 27 mm Hg. Arterial pH in the chemo denervated animals was 7.33 at zero time, 7.18 at 1 hr and 7.20 at 4 hr with simultaneous cisternal CSF pH of 7.30, 7.33 and 7.28. The data suggest that :

(i) because $PaCO_2$ fell appropriately in both groups, peripheral chemoreceptors are not essential for hyperventilation

(ii) if increased [H^-] is the ventilatory stimulus to the central chemosensitive areas these areas are not functionally located superficially on the medulla because the cisternal CSF pH did not become acidic to stimulate ventilation and

(iii) if the ventilatory drive is central, then H^+ sensitive areas must be deeper in brain tissue and the increased blood [H^+] has rapid and ready access to these areas.

14. Cardiopulmonary readjustments in passive tilt.

S. V. MATALON & L. E. FARHI. *J. Appl. Physiol : Respirat. Environ. Exercise Physiol.* 47 : 503–507, 1979.

There is ample evidence that posture affects many cardiorespiratory variables, but the extent to which secondary reflex mechanisms complement or oppose the primary gravity effect is not clear. We have addressed ourselves to this problem by studying five normal volunteers, passively tilted from the supine to the upright position in 15° increments, in random sequence, determining cardiac output (Q), heart rate (HR), stroke volume (SV), minute and alveolar ventilation (Ve and Va), functional residual capacity (FRC), and arterial-end-tidal P_{CO_2} pressure difference. In each position, four to five measurements were obtained by noninvasive techniques. Changes in Q and in FRC were linearly related to the sine of the tilt angle, indicating that reflexes were either absent or that their net effect was proportional to the effects of gravity ; this was clearly not the case for other variables (HR, SV, Ve, Va) in which it was possible to demonstrate threshold values for the appearance of secondary changes.

15. Metabolic adrenergic changes during submaximal exercise and in the recovery period in man.

J. M. PEQUIGNOT, L. PEYRIN, M. H. MAYET & R. FLANDROIS. *J. Appl. Physiol : Respirat. Environ. Exercise Physiol.* 47 : 701–705, 1979.

The urinary excretion of dihydroxyphenylalanine (DOPA), catecholamines (CA) [dopamine (DA), norepinephrine (NE), and epinephrine (E)], their 3-0-methylated derivatives [3-0-Methyldopamine (3-MT), normetanephrine (NMN), and metanephrine (MN)], and their deaminated metabolites (dihydroxiphenylacetic acid (DOPAC) and vanilmandelic acid (VMA) was studied in six healthy men, at rest, during short-term (15 min) or exhaustive submaximal exercise, and in the 2-h postexercise recovery period. During short-term exercise only NE and VMA excretions increased, whereas in postexercise period only DA output was enhanced. Exhaustive muscular work induced a rise in NE and E excretion during the test, and an increase in DA, NE, and NMN urinary levels during postexercise recovery, while the output of deaminated matabolites was unaltered. It is concluded that both release and synthesis of CA are stimulated by submaximal exercise, which induces, in addition to NE, a specific release of DA. A possible role of NE in lipid mobilization during recovery from exhaustive muscular work is evoked. The origin and role of released DA are also discussed.

16. Development of "Sports Anemia" in physically fit men after daily sustained submaximal exercise.

M. W. RADOMSKI, B. H. SABISTON & P. ISOARD. *Aviat. Space Environ. Med.* 51 : 41—45, 1980.

Hematological changes were studied in physically fit young soldiers who marched 35 km/d for 6 d,

working at 35% of their Vo_2 max. Four days of marching produced decreases in numbers of erythrocytes (RBC) and in hematocrit (Hct). This "sports anemia" persisted beyond day 6 into the post-march period and was accompanied by decreases in hemoglobin (Hb), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and mean corpuscular volume (MCV). The latter decrease was attributed to a preferential destruction of large RBC. The post-march period was characterized by an early (2 d) recovery of RBC numbers, Hct, and MCV, and a persistent (4 d) decrease in Hb, MCH, and MCHC. This pattern, characteristic of hypochromic macrocytosis, possibly reflects a premature release of young RBC from the bone marrow. Clearly "Sports anemia", previously reported to occur with intensive physical exercise, can also result from sustained and repetitive submaximal exercise.

17. Deconditioning-induced exercise responses as influenced by heat acclimation.

E. SHVARTZ, A. BHATTACHARYA, S. J. SPERINDE, P. J. BROCK, D. SCIARAFF, R. F. HAINES & J. E. GREENLEAF. *Aviat. Space Environ. Med.* 50 : 893–897, 1979.

Five young men were tested on a bicycle ergometer before (Test 1) and after (Test 2) 8 d of heat acclimation (exercise at 50% of Vo_2max at 39.8°C WB) and after 8 h of water immersion (Test 3). A control group of five subjects underwent a similar procedure in a temperate environment of 23.8°C. Heat acclimation resulted in the usual decreases in exercise heart rate (30 beats/min) and rectal temperature (0.6°C) and an increase in sweat rate (19%). The control group showed effects of moderate training by decreases in exercise heart rate (11 beats/min), rectal temperature (0.3°C), and sweat rate (24%). Water immersion resulted in substantial diuresis in both, despite 1800 ml of water consumed by each subject. In the acclimation group, exercise responses in Test 2 were better than in Test 1, with more adverse responses shown by the control group. The results show that heat acclimation provides an effective method to prevent the adverse effects of water-immersion deconditioning on exercise tolerance.

IV. HIGH ALTITUDE PHYSIOLOGY

18. Evidence for increased intrathoracic fluid volume in man at high altitude.

J. J. JAGEER, J. T. SYLVESTER, A. CYMERMAN, J. J. BARBERICH, J. C. DENNISTON & J. T. MAHER. *J. Appl. Physiol: Respirat. Environ. Exercise Physiol.* 47 : 670–678, 1979.

To determine if subclinical pulmonary edema occurs commonly at high altitude, 25 soldiers participated in two consecutive 72-h field exercises, the first at low altitude (200–875m) and the second at (3,000–4,300 m). Various aspects of ventilatory function and pulmonary mechanics were measured at 0, 36 and 72-h of each exercise. Based on physical examination and chest radiographs there was no evidence of pulmonary edema at high altitude. There was, however, an immediate and sustained decrease in vital capacity and transthoracic electrical impedance as well as a clockwise rotation of the transpulmonary pressure-volume curve. In contrast closing capacity and residual volume did not change immediately upon arrival at high altitude but did increase later during the exposure. These observations are consistent with an abrubt increase in thoracic intravascular fluid volume upon arrival at high altitude followed by a more gradual increase in extravascular fluid volume in the peribronchial spaces of dependent lung regions.

19. New inventory for the assessment of symptom occurrence and severity at high altitude.

J. L. KOBRICK & J. B. SAMPSON. *Aviat. Space Environ. Med.* 50 : 925–929, 1979.

A new inventory, called the Environmental Symptoms Questionnaire (ESQ), was devised to provide improved assessment of symptoms occurring during exposure to high altitude. The ESQ was field tested with 12 subjects exposed to 4300 m altitude for 4 d, and was compared with responses to the General High Altitude Questionnaire (GHAQ). Both instruments reflected significant symptom occurrence, but the ESQ was more sensitive on certain items focal to altitude conditions, and showed significant responses to items not contained in the GHAQ. Based on this test, the ESQ was judged easier to use, more sensitive, and more comprehensive for assessing medical symptoms at altitude.

20. Effect of physical training at moderate altitude/1850 m/ on hypoxic tolerance.

J. SEN GUPTA, L. MATHEW & P. M. GOPINATH. *Aviat. Space Environ. Med.* 50 : 714-716, 1979.

Effect of systematic physical training at moderate altitude (1850 m) on hypoxic tolerance was estimated on a group of young soldiers, by determining the time of useful consciousness (TUC) at a simulated altitude of 7620 m in a hypobaric chamber together with the critical flicker frequency (CFF) test. The subjects, after initial testing at Delhi (near sea level) were taken to an altitude of 1850 m and divided into two groups. One group was given systematic endurance physical training for 8 weeks, while the other group served as control. The subjects were then taken to an altitude of 3500 m and kept at that altitude for 4 weeks, after which they were brought back to Delhi and TUC was estimated again within 2 days. The results indicate that endurance physical training at moderate altitude improved hypoxic tolerance and the central nervous system activity under hypoxia.

V. HYPERBARIC MEDICINE

21. Effects of hyperbaric oxygen upon S. Aureus, Ps. Aeruginosa and C. Albicans.

G. L. BROWN, P. D. THOMSON, J. G. HILTON, M.E BROWNE AND C. H. WELLS. *Aviat. Space Environ. Med.* 50 : 717-720, 1979

Numerous in vitro investigations have reported that prolonged, continuous hyperbaric oxygen (OHP) exposure to certain bacteria and yeast is bacteriostatic. While it is tempting to attribute the lower infection rates reported in OHP-treated patients to this bacteriostatic effect, the duration and intensity of OHP exposure in these experimental studies exceeds that of normal therapeutic use. This study was designed to investigate the effects of human OHP treatment protocols upon the in vitro growth and survival of Staphylococcus aureus, Pseudomonas aeruginosa, and Candida albicans. Additional studies using antibiotic-containing culture media were conducted to investigate the possible OHP enhancement of antibiotic sensitivity. No differences were observed between the bacterial and yeast growth curves of the control and experimental group. OHP also failed to produce any measurable difference in the bactericidal effectiveness of the selected antibiotics.

22. Endotoxin protection against oxygen-induced acute and chronic lung injury.

L. FRANK, & R. J. ROBERTS. *J. Appl. Physiol : Respirat. Environ. Exercise Physiol.* 47 : 577-581, 1979.

Small dosages of endotoxin (100-500 μg/kg) provide significant protection against the acute manifestations of pulmonary O_2 toxicity and lethality. Ninety-seven percent of endotoxin-treated adult rats survived a 72-h exposure to $\geq$95% O_2 with minimal lung changes, compared to 32% of control animals ($P < 0.01$). Exposure to $\geq$95% O_2 for 7 days resulted in a 20% survival rate in untreated control rats vs 98% survival in endotoxin-treated rats ($P < 0.01$). Histological evaluation of lung from survivors revealed substantially less collagen and reticular fiber deposition in the endotoxin-treated animal lungs. Endotoxin treatment was associated with increased activity of the protectant antioxidant enzyme systems of the lung in an apparent dose-response manner. Endotoxin's protective activity against O_2 toxicity does not appear to depend on an initial toxic insult to the lung like with α-naphthylthiourea, oleic acid, or alloxan treatment. The data support a protective role for endotoxin against the acute and the more chronic manifestations of O_2-induced pulmonary injury.

23. Mycobacterium ulcerans infection : Treatment with rifampin, hyperbaric oxygenation, and heat.

R. E. KRIEG, J. H. WOLCOTT & W. M. MEYERS. *Aviat. Space Environ. Med.* 50 : 888 –892, 1979.

The effectiveness of hyperbaric oxygenation (HBO), heat and rifampin for treating mice infected with Mycobacterium ulcerans was analyzed. Four hundred mice were innoculated in hind footpads with 10^8 organisms. The seven treatment groups (50 mice each) were HBO (2.5 ATA for 1.5h, twice a day), rifampin (RIF) (20mg/kg body weight/d), heat (mice maintained at 37°C), and all combinations of the three treatments. The severity of infection in the treated mice was compared weekly for 20 weeks with that of infected controls. The most effective treatments were RIF/HEAT and RIF/HBO/HEAT. RIF/HBO/HEAT treatment was further evaluated to determine the effectiveness of treating mice at various stages of infection. Three hundred mice were inoculated in the hind footpads, and, as the infection progressed, they were separated into groups (50 mice/groups) according to the severity of infection. The treatment groups were compared to positive controls. The effectiveness of therapy was indirectly proportional to the severity of infection.

VI. PSYCHOLOGY & NEUROPSYCHIATRY

24. Combind effects of broadband noise and complex waveform vibration on cognitive performance.

C. S. HARRIS & R. W. SHOENBERGER. *Aviat. Space Environ. Med.* 51 : 1-5, 1980.

The performance of 12 subjects was measured on a Complex Counting Task during exposure to each of four experimental conditions for a duration of 31 min. Two levels of noise, 65 dBA and 100 dBA, were presented both with and without 0. 36 R. M. S. G, sum-of sines vibration. Combined 100 dBA noise and vibration produced less adverse effects than the vibration combined with 65 dBA noise. This result agrees with our previous studies using tracking tasks. However, two effects were demonstrated that had not been obtained previously. First, a clearcut adverse effect of vibration on theCounting Task was obtained. Second, an adverse effect of 100 dBA noise on the counting task was demonstrated. Previously, a 100 dBA noise was required to adversely affect tracking performance.

25. Psychophysiological monitoring of operator's emotional stress in aviation and astronautics.

P. V. SIMONOV, M. V. FROLOV & E. A. IVANOV. *Aviat. Space Environ. Med.* 51 : 46-50, 1980.

The level of emotional stress depending on the power of motivation and the estimation by the subject of the probability (possibility) of goal achievement, largely influences the operator's skill performance (that of a pilot, controller, astronaut). A decrease in the emotional tonus leads to drowsiness, lack of vigilance, missing of significant signals, and to slower reactions. The extremely high stress level disorganizes the activity, complicates it with a trend toward untimely acts and reactions to the insignificant signals (false alarms). The best methods to monitor the degree of the operator's emotional state during his skill performance are the integral estimation of the changes in heart-rate and T-peak amplitude, as well as the analysis of spectral and intonational characteristics of the human voice during radio conversation. These methods were tested on paratroopers, pilots in civil aviation, and airport controllers.

VII. AVIATION OPHTHALMOLOGY

26. Sensory illusions. The ophthalmologist's point of view.

J. P. CHEVALERAUD. *Medicine Aeronautique et Spatiale Medicine Subaquatique et Hyperbare.* 17 : 319-321, 1978.

Examples of three types of visual illusions experienced by aircraft pilots are discussed. Vestibulo-ocular illusions, which account for about 90 percent of all illusions reported, are explained by a nystagmus of vestibular origin, and are exemplified by disturbances of visual acuity during turns, the oculogyric illusion and the oculogravic illusion. Illusions of false equilibration include the visual autokinetic illusion, which was responsible for recorded dives into the ocean of aircraft flying in formation at night. Purely visual illusions, responsible for 10 percent of aircraft accidents due to disorientation are illustrated by the misinterpretation of ground lights and the poor estimation of altitudes during take off and landing due to the topography of the adjoining terrain. Recommendations for the prevention of visual illusions during flight are also presented.

27. Laser Doppler technique for measurement of eye movement.

C. E. RIVA, G. T. TIMBERTAKE & G. T. FFKE. *Applied Optics.* 18 : 2486-2490, 1979.

The spectrum of Doppler-shifted laser light scattered from the cornea was used to measure the distribution of eye speeds in human subjects while the eye followed a moving target. Speed distribution obtained by the laser Doppler technique were compared to those recorded with a double-Purkinje-image eyetracker.

28. The optical properties of smoke protective devices.

J. A. VAUGHAN, K. W. WELSH & P. G. RASMUSSEN, *FAA-AM-78-41*, 1978.

The devices tested comprised eight goggles and five fullface oxygen masks (three rigid one-piece masks and two flexible hoods). Those properties evaluated were (1) light transmission (2) Optical haze (3) prismatic deviation (4) refractive power (5) optical distortion, and (6) surface curvature. All clear transparencies met or exceeded standards for

light transmission, and all but one (an experimental hood) met the standards for optical haze. All but two of 11 devices exceeded standards for spherical refractive power. Three fullface masks and two goggles with steep surface curvatures did not meet the optical requirements for prismatic deviation. Only four of 11 devices evaluated by a photographic method attained the standard for optical distortion; however when the criterion of visible distortion was employed as outlined in the military specification, nine of the 11 devices conformed to the standard. Optical anomalies may be caused by facepiece configuration and surface curvature found in some of the smoke protective devices.

VIII. AVIATION OTOLARYNGOLOGY & VESTIBULAR PHYSIOLOGY

29. Eustachian tube function in selection of airmen.

P. GROTH, A. IVARSSON, A. NETTMARK & O. TJERNSTORM. *Aviat. Space Environ. Med.* 51 : 11-17, 1980.

A comprehensive study of Eustachian tube function in 84 aspirants accepted for flight training was made. Using a pressure chamber, both static and dynamic pressure changes, as in ascent and descent, were applied to test the tubal pressure equilibrating capacity in the sitting position. While all 84 were otologically healthy, a wide range in the pressure equalibrating capacity was found·20% could not equilibrate static over-and underpressures of 10 cm H_2O completely, 8% could not equilibrate at all during simulated descent, 3 subjects reported acute vertigo during simulated ascent in combination with high unilateral middle ear pressure. Asymmetry between ears of single subjects in pressure equilibrating capacity was also found to a large extent. It was not possible to identify subjects with poor equilibrating capacity by simple tests like Valsalva's or Toynbee's manoeuvres. The results may indicate that today's criteria for Eustachian tube function in the selection of airmen can be made more efficient.

30. Some influences of vision on susceptibility to motion sickness.

J. R. LACKNER & A. GRABIEL. *Aviat. Space. Environ. Med.* 50 : 1122–1125, 1979.

Two experiments were performed to evaluate the influence of vision on susceptibility to motion sickness during exposure to constant patterns of vestibular stimulation. The motion profile involved accelerating subjects at 20°/s² to 300°/s², maintaining them at that constant velocity for 30s, and decelerating them to a rapid stop in about 1.5 s. The number of stops tolerated by a subject before reaching the motion sickness endpoint served as his score. In experiment 1, subjects were tested twice with their eyes open and twice with their eyes blindfolded. They tolerated fewer sudden stops when permitted sight of the experimental chamber. In experiment 2, the effect of having the eyes-open or closed at different stages of the motion profile was evaluated. Having the eyes open during any stage of the test was more stressful than having the eyes closed, but this was especially true during the sudden stops. The findings are discussed in terms of their general implications for understanding a) situations in which vision alone elicits symptoms of motion sickness, and b) situations involving vestibular stimulation where vision heightens susceptibility.

IX. ERGONOMICS

31. Acquisition and analysis of electromyographic data associated with dynamic movements of the arm.

M. GANDY, S. W. JOHNSON, P. A. LYNN, G. A. L. REED & S. MILLER. *Med. Biol Eng. & Comput.* 18 : 57-64, 1979.

A standardised movement task has been developed for an investigation of normal patterns of electromyographic (e. m. g.) activity. The subject is required to turn a cranked wheel with his arm which is supported horizontally in front of him. The movement is standardised by positioning the subject using anatomical landmarks and is defined by a single parameter, the angle of the wheel. The present report describes the acquisition and processing of e. m. g. signals from a group of arm and trunk muscles and shows that characteristic patterns of e. m. g. activity in relation to the position of the wheel can be defined. Further processing by computer may be used to obtain simple parameters for the comparison of patterns. Two normal subjects were tested in a number of sessions to demonstrate the repeatability of the processing techniques and results from a group of 20 normal subjects used to define average patterns. Preliminary results from stroke patients show significant departures from these normal patterns.

32. Frequency and amplitude analysis of the EMG during exercise on the bicycle ergometer.

P. S. PETROFSKY. *Eur. J. Appl. Physiol.* 41 : 1-15, 1979

The surface EMG was recorded from above the quadriceps muscle in 3 male subjects during bicycle ergometry at work loads between 20 and 100% of the VO_2max to measure the EMG amplitude (RMS) and frequency (assessed from the center frequency of the power spectra) during this type of work. During brief (3 min) bouts of work the RMS amplitude of the EMG was linearly related to the work load ; the center frequency of the EMG power spectra was the same at all work loads examined. In contrast, during sustained bouts of work maintained for 80 min at 20 and 40% of the VO_2 max, the RMS amplitude of the EMG remained constant while the center frequency initially increased for the first 20 min of work and then progressively decreased as the work continued. When work loads of 60, 80 and 100% of the VO_2max were sustained to fatigue, the RMS amplitude continually increased while the EMG frequency decreased from the beginning to the end of the work periods. The results of this study showed that the EMG is a complex wavefrom, being influenced not only by fatigue, but to even a larger extent in many cases, the temperature of the exercising muscles. Therefore, although muscular fatigue caused an increase in the RMS amplitude and decrease in the center frequency, the increase in muscle temperature associated with the work opposed these changes by causing a reduction in the RMS amplitude and an increase in the center frequency.