

Abstracts of Current Aviation Medicine Literature

I ACCELERATION PHYSIOLOGY

1 Neck Muscle Resistance to Head Impact

The role of neck muscles in the body's response to the "whiplash" type of motion which occurs during frontal impact has been studied. This type of motion was simulated by a sudden backward pull of a subject's head. Head and neck response to low-level acceleration has been researched by recording the externally applied force, the head accelerations in the median sagittal plane, and the electrical activity in the sternomastoid muscle (EMG) as functions of time. The resultant acceleration-time curve and recorded EMG have been analysed, with numerical values of applied resistance to the external force recorded. An analog computer model was built incorporating resistance developed by two main variables; (1) the elasticity coefficient; (2) the active damping factor. Together, these two variables, combined with a resistance function, enable us to measure the resistance of the head/neck response. Using this model, variations in magnitude of these two components were studied under six varying conditions of impact, (1) length of warning time; (2) type of instruction given to the subject; (3) amount of previous experience on the part of the subject in similar situations; (4) anticipation of impact by the subject; (5) magnitude and kind of impact; (6) presence or absence of a preload.

[Reid, SE, G Raviv, and S F Reid, Jr. *Aviat Space Environ Med* 52 (2) : 78, 1981.]

2 Radiation and 'G' Tolerance in Rats

Male hooded rats were exposed to 2100 rad⁶⁰ Co radiation and 18h later were exposed to + Gz acceleration until heart rate was reduced to 50% of baseline rate. 'G' tolerance was 9.2% less in irradiated rats than in controls. Although small, this difference was significant at $P < 0.05$. A similar group of rats was anaesthetized 18h post-irradiation and carotid mean arterial pressures were measured. Mean arterial pressure was 122.1 torr for controls and 114.5 torr for irradiated. This difference was not significant.

[Mattson, J L, R E Cordts, and R R Deyak, Jr. *Aviat Space Environ Med*, 52 (7) : 404, 1981.]

II AIRCRAFT ACCIDENT INVESTIGATION

3. Fatal Light Aircraft Accidents in Papua New Guinea

The number of light aircraft (less than 5,700) in the developing world is small compared to those in the West, and little information on aviation accidents is readily available from developing countries. Papua New Guinea, enjoys a privileged position, since aviation was introduced early and much of the country was opened through flying. During the period of Australian trusteeship until independence in 1975, the Australian Department of Transport applied its own rigorous standards to aviation in Papua New Guinea, a policy continued by the present Civil Aviation Agency. As a result of high

supervisory controls, accurate statistics on accidents are available, from which comparisons with other countries can be made. A study has been made of fatal light aircraft accidents in Papua New Guinea. Some of the medical problems involved in accident prevention in a developing country are discussed.

[Fee, GH. *Aviat Space Environ Med*, 52 (2) : 92, 1981.]

4. Relationships between US Navy Carrier Landing Accidents and Flight Experience Parameters

Carrier arrested landing activity of all aviators flying naval attack and fighter aircraft were analyzed with aircraft accident data to determine whether statistical relationships exist between life time and recent experience variables, and accident liability. The results demonstrate that accident potential, though not statistically related to carrier landings in 30-d periods, is significantly correlated with life time experience and with landing activity in 7-d periods. The highest accident rates are associated with minimal amounts of total carrier experience. Moreover, accident liability for inexperienced carrier aviators is lowest if number of landings in 7-d periods are high.

[Borowsky, MS, J Gaynor, G, Farrell and A. Beck. *Aviat Space Environ Med*, 52 (2) : 109, 1981.]

5. Human Error in the Seventies — Reviewed and Projected through the Eighties

The USAF has had an impressive record of improvement in its accident experience during the past three decades. This has been reflected in markedly lower rates in accident experience, aircraft destroyed, and fatal accidents. As the historic experience line comes closer to the ultimate zero goal, improvement becomes more difficult. The trends during the 1970s suggest that a bottom, at least temporarily, was reached so that, unless additional effort is exerted, an actual increase rather than a continuing decline will occur. Experience does show that, regardless of future overall accident trends, the proportion of the accidents which result in fatalities will almost certainly increase. There is also a clear indication that, unless crewmen in eject-

ion-seat equipped aircraft improve their emergency perception and decision making abilities, the proportion of successes in airborne escape may not increase but could well decline still further. Accidents will almost certainly maintain the trend of being associated with inflight rather than take off or landing activities. One kind of flight mishap of particular concern remains that of USAF planes with civilian aircraft. On the basis of past experience, these kinds of accidents can continue to be anticipated. Their prevention represents a focal point of real concern. One feature of future mishaps which will become increasingly prominent will be the involvement of women crew members. Both a distressing and heartening feature of mishaps is that even a cursory review indicates that most, if not all, are preventable by the use of well-known and well-established principles of accident prevention. Improvement in the selection, training, and use of people, and improvements in hardware, both in terms of reliability and man/machine compatibility, can all lead to increased efficiency and a continuation of the historic down trend in accident losses. This defines the direction for the eighties.

[Zeller, AF. *Aviat Space Environ Med*, 52 (4) : 241, 1981.]

6. Dual Accident Pilots in Naval Aircraft

Flight activity of all aviators flying naval aircraft and aircraft accident data were analyzed to determine if pilots having pilot factor accidents early in their careers exhibit higher future accident liability than aviators who do not. The results showed that the aviators who had accidents in their first 1000h had a higher subsequent accident potential than pilots who did not. The actual number of pilots who had more than one accident was, however, relatively small, and the significance level was 0.19.

[Borowsky, MS. *Aviat Space Environ Med*, 52 (5) : 310, 1981.]

III AVIATION DENTISTRY

7. Vertigo of Dental Origin — Case Reports

Vertigo, a symptom whose aetiology and patho-

genesis is often obscure, may be caused by locally asymptomatic pathology (e.g. periapical granuloma, residual infection) in the mandible and maxillae. Three cases are presented where the confirmatory compression sign, previously described by Eidelman, was found to be positive. Removal of the suspected dental pathology resulted in rapid and permanent cure. These findings should be of interest in aviation medicine where vertigo is an important and some time extremely dangerous symptom.

[Eidelman, D. *Aviat Space Environ Med*, 52, (2) : 125, 1981.]

IV AVIATION NEUROPSYCHIATRY

8. Biofeedback Rehabilitation of Airsick Aircrew

The biofeedback treatment of 20 aircrew, disabled by chronic severe airsickness, is reported. The USAF School of Aerospace Medicine (SAM) Airsick Rehabilitation Program requires careful selection to insure high motivation and thorough medical screening to rule out intercurrent medically disqualifying conditions. Patients are trained in relaxation techniques and placed in a modified Barany Chair, capable of tilting as well as rotating. Psychological responses to motion stimulation are constantly monitored by both patient and investigators. Motion sickness is provoked, which the patient learns to control and abort through exercising autonomic control. Of 19 eligible, 16 have been returned to full flying duties.

[Levy, RA, DR Jones and EH Carlson. *Aviat Space Environ Med*, 52 (2) : 118, 1981.]

9. Psychiatric Disability of Air Force Fliers

Case reports of psychiatric disorders in flying personnel tend to be reported in diagnostic clusters. When viewed separately, these reports suggest specific patterns. When looked at collectively, psychiatric disorders in military aviators follow no specific pattern. A 5 year review of psychiatric evaluation done at the USAF School of Aerospace Medicine reveals a wide range of psychiatric diagnoses. Although aviators with psychiatric disabilities are seldom seen, a greater proportion of

this group will be grounded compared to other medical referrals. In selected cases, psychiatric treatment is highly successful. In future work, greater emphasis should be given to the identification of life stress events for the purpose of deterrence, in addition to rehabilitation through treatment.

[Corcoran, JFT. *Aviat Space Environ Med*, 52(4) : 260, 1981.]

V AVIATION OPHTHALMOLOGY

10. Visual—Vestibular Interactions : the Directional Component of Visual Background Movement.

Legibility of a head-fixed display and visual suppression of the vestibulo-ocular reflex (VOR) were found to be superior when vestibular stimuli and optokinetic stimuli were of like direction (i.e. would produce the same direction of nystagmus) and inferior when they were opposite in direction. Velocities (relating to the head) of peripheral optokinetic stimuli ranging between $-18^\circ/s$ and $+180^\circ/s$ interacted effectively with vestibular stimuli to influence visibility of a head-fixed display. This indicates that peripheral optokinetic stimulation can influence visual suppression of the VOR at velocities that far surpass effective production of optokinetic nystagmus.

[Fred E. Guedry, Jr, J, Michaelantz, Ralph M Jell, and Joel W Norman. *Aviat Space Environ Med*, 52 (5) : 304, 1981.]

11. Perception of Runway Image Shape and Approach Angle Magnitude by Pilots in Simulated Night Landing Approaches

One cue for visual judgement of glidepath angle has been referred to as form ratio. Form ratio is defined as the ratio of vertical height of the runway to width of the far end in the runway retinal image. The ability of pilots to judge form ratios was compared with the ability to judge approach angles in the night time "black hole" situation in two experiments. Responses in both static and dynamic simulated approach conditions indicated a general tendency to over-estimate form ratios and approach angles less than 3° . Intersubject and intrasubject

variability of form ratio and approach angle responses were comparable. These findings (i) do not support the utility of form ratio judgements as an aid in selecting approach angle, (ii) add to the empirical evidence of visual illusions and the danger of reliance on visual information for judgement of approach angle in the night time "black hole" situation where only runway lights are visible, and (iii) point to variability in perception of approach angle as an important part of the problem.

[Mertens, H W. *Aviat Space Environ Med*, 52 (7) : 373, 1981.]

VI AVIATION OTOLARYNGOLOGY

12. Use of Tympanometry in an Airline Medical Service

Tympanometry is a procedure in otologic medicine which enables the examiner to objectively evaluate the mobility and patency of the eardrum, the functional condition of the middle ear, and to ascertain the ventilation capability of Eustachian tube. It does this by varying the air pressure in the closed ear canal, emitting a low-frequency sound concurrently, and measuring the compliance or mobility of the eardrum on a graph. It has been found to be a very useful adjunct in the evaluation and management of the otological problems in a commercial air carrier.

[Demar, EA and Harper, R. *Aviat Space Environ Med*, 52 (3): 181, 1981.]

VII AVIATION PATHOLOGY

13. Postmortem Coronary Atherosclerosis Findings in General Aviation Accident Pilot Fatalities: 1975-77.

The autopsies of 764 pilots involved in fatal general aviation accidents during the years 1975-77 were revised to appraise the age specific prevalence of coronary atherosclerosis among the autopsied group. Of the pilots killed in aircraft accidents and autopsied during 1975-77, 51% were found to have some degree of coronary atherosclerosis ranging from minimal to severe. However, only about 5% of

the autopsied group were categorized as having severe coronary atherosclerosis. The rate per 1,000 of severe coronary atherosclerosis increased with age from 14.5 for ages less than 30, to 89.9 for ages 50 years and above; the rate nearly tripled from ages 30-39 to 40-49 (22.1 to 63.6). The prevalence of coronary atherosclerosis among this group of autopsied airmen is less than would have been expected based on the results of other recent studies.

[Booze CF, JK Pidkowitz, AW Davis, and FA Bolding. *Aviation Space Environ Med*, 52 (1) : 24, 1981.]

VIII CLINICAL AVIATION MEDICINE

14. The Effects of Tobacco on Aviation Safety

In 1976, the Federal Aviation Administration was petitioned to issue regulations that would prohibit all smoking in the cockpit during commercial flight operations and prohibit preflight smoking by flight crew members within 2h before commercial flight operations. A review of the literature was conducted to determine the effects on pilot performance of carbon monoxide (CO), nicotine, and smoking withdrawal. The records of 2,660 fatal general aviation aircraft accidents in 1973-1976 have been examined. Smoking was not identified as a causal factor but may have contributed to the cause of some of these accidents. However, compound factors were often found and dire consequences are far less likely to occur in Air commerce operations. For some, withdrawal symptoms may occur and more than offset any benefits to aviation safety that are aimed for by a ban on preflight and inflight smoking.

[Dille, JR and MK Linder. *Aviat Space Environ Med*, 52 (2): 112, 1981.]

15. The Selection of Air Traffic Control Specialists-History and Review of Contributions by the Civil Aeromedical Institute, 1960-80

For two decades, the FAA Civil Aeromedical Institute (CAMI) has explored the problems of effec-

tively selecting air traffic control specialists (ATCSs) for the FAA. The results of those efforts have contributed directly to the establishment of revised ATCS selection standards by the Civil Service Commission (CSC). Early studies on the validity of aptitude tests for predicting successful completion of Academy training led to a decision to use such tests for part of the CSC screening standard. Later studies led to the establishment of a maximum age standard of 30 years for entry into ATCS training. In addition, CAMI researchers have continuously evaluated the validity of existing standards, have examined numerous variables and alternative aptitude measures, and have provided a number of data-based recommendations in an effort to improve predicting of success in ATCS training. This paper reviews research with emphasis on aptitude screening measures, attrition, age, prior experience, education, sex, military ATCS training, and the Uniform Guidelines on Employee Selection.

[Collins, WE, Boone, JO and AD Vandeventer. *Aviat Space Environ Med*, 52 (4) : 217, 1981.]

16. Eight-Year Follow-up of Exercise Electrocardiograms in Healthy Middle-Aged Aviators

To study the prognostic capabilities of the exercise electrocardiogram (ECG) in a fit, healthy, middle-aged population, 548 members of the U.S. Navy's "1000 Aviator" cohort were exercised to 85% predicted maximum heart rate in 1969 and then followed up in 1977 for the development of clinically evident coronary artery disease (CAD). Of these subjects, 23 (4.3%) had significant ST depression during their exercise test in 1969. At the end of the 8 years follow-up period, 38 of the 448 subjects (6.9%) had developed clinically evident CAD. The sensitivity (percent of disease predicted by an abnormal test) and predictive value (percent of abnormal tests predictive of disease) of an abnormal exercise test were 15.7% and 26% respectively. The authors conclude that even in a carefully screened aviator population with a low risk for CAD, a single normal exercise ECG does not exclude the presence of latent CAD. Furthermore, in this population, a single abnormal exercise ECG should not be a dis-

qualifying defect without further work-up.

[MacIntyre, NR, JR Kunkler, RE Mitchell, A Oberman and G Graybief. *Aviat Space Environ Med*, 52(4) : 266, 1981.]

17. Evaluation of the Hewlett-Packard Ear Oximeter for Use during Routine Air Transport of Patients

The Hewlett-Packard 47201A ear oximeter was evaluated to determine the feasibility of its use aboard aircraft. At altitudes up to 2438m (8000 ft), there was no significant difference between the mean predicted percent saturation of haemoglobin and the measured percent saturation in 25 non-smokers. The accuracy of the oximeter readings on five individuals was further confirmed with a blood gas analyzer aboard the aircraft. The authors conclude that the ear oximeter is accurate and reliable for monitoring patients during flights.

[Crisik, JH, CC Yockey and RB Byrd. *Aviat Space Environ Med*, 52 (5) : 312, 1981.]

18. Identifying Borderline Hypertensives : Comparative Value of Various Blood Pressure Measurements

Ambulant male military aircrew patients (n=299) were divided into two groups based on historic evidence of normotension (N) or untreated borderline essential hypertension (BH). All patients had their blood pressure (BP) measured under various conditions and body positions. Results were analyzed to assess the capability of each BP measurement condition to assign patients correctly to their appropriate group. Clinical BP (technician-recorded) showed best sensitivity and acceptable specificity. By incorporating the results of both these measurement conditions, a predictor approximating 90% for most BH and N patients was obtained. Use of these two measurements should enable recognition of most BH patients at a single evaluation.

[Hull, DHR, Walhuis, JR Fisher, JH Triebwasser, JI Curtis, and DA McAfoose. *Aviat Space Environ Med*, 52 (7) : 399, 1981.]

19. The Military Aviator with Renal Stone Disease

Regulations currently in force governing the

flight status of military aviators with urinary calculus disease are more restrictive than necessary and result in a substantial loss of aviation manpower. Those regulations and policies currently in force are reviewed, and more liberal guidelines, designed to provide for the safe return to useful flight status of aviation personnel with renal stone episodes, are proposed.

[Lynch, D.F. Jr and W.E. Clayton. *Aviat. Space Environ. Med.*, 52 (7) : 416, 1981.]

IX ENVIRONMENTAL PHYSIOLOGY

20. Physiological and Haematologic Responses to Summer and Winter Dry Heat Acclimation

Differences between acclimation to heat at the end of winter (W) and at the end of summer (S) were studied on the same eight male volunteers. Subjects were exposed to 40°C, 30% RH for 10 consecutive days on two separate occasions approximately 5 mo apart (S and W). Daily exposures lasted 120 min: 10 min rest, 50 min walking 1.34 m. s⁻¹ on the level 10 min rest, 50 min walking. During W acclimation, rectal temperature (Tre) and heart rate (HR) decreased, sweat rate (Msw) remained unchanged and plasma volume increased. The Tre of the acclimated subjects remained higher in W and the Msw lower, than in S. It was concluded that acclimation does not totally eliminate the seasonal differences in thermoregulatory set point and sweating sensitivity. Further, acclimation to a more severe heat did not lower the thermoregulatory set point that was achieved by natural acclimation to a milder heat but affected the cardiovascular adjustment and caused greater plasma volume expansion. W acclimation caused both plasma and blood cell volume expansion, whereas S acclimation affected only plasma volume.

[Shapiro, Yair, Roger W Hubbard, Claire M Kimrough, and Kent B Pandolf. *J Appl Physiol. Respirat Environ Exercise Physiol.*, 50 (4) : 792, 1981.]

21. Metabolic Responses of Resting Man Immersed in 25.5°C and 33°C Water

This study was undertaken to determine the hormonal responses to disabling hypothermia as a result of cold water immersion. Thermally unprotected male

divers trained by the US Navy were subjected to total body immersion in water at 25.5°C and 33°C. Plasma epinephrine, norepinephrine, growth hormone and cortisol were measured. Other variables monitored included oxygen consumption, carbon dioxide production, minute ventilation, and rectal temperature. Immersion without cold stress caused suppression of plasma epinephrine without affecting plasma norepinephrine. Cold stress combined with immersion caused a significant increase in plasma norepinephrine in the absence of other indicators of a generalized stress reaction. The degree of chilling seen in this study will produce disabling hypothermia within 1-2h and may be shown initially only by an increase in plasma norepinephrine.

[Weill, AC, HC Langworthy, AR Manalaysay and RP Layton. *Aviat. Space Environ. Med.*, 52 (2) : 88, 1981.]

22. Heat Stress Impairment of Mental Performance : a Revision of Tolerance Limits

A time-related, heat stress tolerance curve for unimpaired mental performance was constructed by Wing from a summary of 15 studies. The tolerance limits, more properly described as the lower limits for heat impaired mental performance, were subsequently adopted by the National Institute for Occupational Safety and Health as the recommended standard of tolerance times for sedentary work in heat stress. Although Ramsey and Morrissey have reported a series of isodecrement curves which indicate that mental performance impairment in heat may not be a simple function, a reappraisal of the upper limit for unimpairment has not yet been advanced. The present review reevaluates results of early studies, apparently supportive of Wing's position, and proposes an alternate interpretation. Further, analysis of more recent data suggests a mental performance impairment/heat stress/relationship closely related to human thermophysiological tolerance limits.

[Hancock, PA. *Aviat. Space Environ. Med.*, 52 (3) : 177, 1981.]

23. Effects of Severe Heat Stress on Respiration and Metabolic Rate in Resting Man

The effects on metabolic gas exchange, pulmonary ventilation, respiratory rate, and end-tidal

carbon dioxide tension of increases in deep body temperature of 2°C were studied in adult male human subjects at rest. The increase in pulmonary ventilation (49%) was accompanied by a reduction in end-tidal carbon dioxide tension (17%). Heart rate rose by 85%. The increase in oxygen consumption expressed as a function of body surface area was found to be similar in all experiments (19%), irrespective of the value of the resulting oxygen consumption in the control period. There was an associated 16% increase in carbon dioxide production. The results support a hypothesis that the increase in metabolism occurring during heat stress is limited solely to that part of the metabolism defined as basal.

[Saxton C. *Aviat Space Environ Med.* (5) : 281, 1981.]

24. Haemodynamic Changes during Whole Body Surface Cooling and Lower Body Negative Pressure

Six young healthy male subjects were studied to evaluate the use of whole body surface cooling (WBSC) as an anti-orthostatic intervention. Previous studies in our laboratory have demonstrated that perfusion of an Apollo Cooling garment with 16°C water produced a significant increase in stroke volume and decrease in heart rate at rest and during lower body negative pressure (LBNP). However, optimal perfusion temperatures have not been determined. The present study examined the effects of WBSC using perfusion of water at a temperature of 10°C. This perfusion temperature produced a greater decrease in mean skin temperature (T_{sk}) than water at 16°C, -4°C drop compared to -2°C respectively. The haemodynamic effects were also more prominent with 10°C water as shown by the increase in stroke volume of 11% at rest and 35% during LBNP at -50 torr compared to control measurements at ambient temperature. Heart rates were lowered significantly (8 beats/min) and systolic arterial blood pressure was higher (8 torr). Cooling with 10°C water produced a slight increase in muscle tone, reflected by a small but significant increase (+84 ml/min) in oxygen uptake. These data suggest that WBSC is an effective nonpharma-

cologic means of controlling preload and deserves further investigation as an antiorthostatic intervention.

[Raven, PB, G Pape, WF Taylor, FA Gallney, and CG Blomqvist. *Aviat Space Environ Med.* 52(7) : 387, 1981.]

25. Personality and Inter-Subject Differences in Performance and Physiological Cost during Whole-Body Vibration

When subjects are exposed to whole-body vibration, extra effort is required to maintain pre-vibration standards of performance. Therefore the willingness of subjects to expand this effort might influence both performance and physiological cost. Willingness may be related to a personality variable-score on the locus of control scale. This hypothesis was tested in 12 subjects who performed a simulated driving task during 10 min of vertical (\pm Gz) wholebody vibration at energy levels of 0.21, 0.28 and 0.35 rmsg using a sinusoidal and a random wave form. Accuracy at a foot-controlled, compensatory tracking task, reaction time, oxygen uptake and heart rate was measured. Subjects with an 'internal' locus of control had less tracking error ($P < 0.001$) and higher heart rates ($P < 0.05$) than did subjects with an 'external' locus of control. Furthermore, both variables were significantly correlated with the locus of control scores ($r = +0.73$ and -0.66) respectively. These findings suggest that the inter-subject differences found in investigations using human subjects may be explained in part by personality differences related to locus of control.

[Webb RDG, MD Bennett, B Farnilo, SH Cole, SJ Page and WR Withey. *Ergonomics*, 24(4) : 245, 1981.]

26. Variation in Human Response to Whole-Body Vibration

Using the modified matching procedure described by Osborne and Humphreys (1973), individual sensation contours for vibration frequencies in the range 2.4 to 60 Hz were obtained from 100 subjects. In addition foot-head transmissibility ratios were obtained from each subject at each frequency, as well as EPI scores, and anthropometric data such as height,

weight and chest circumference. A wide range of individual contour shapes was obtained, the distribution of shapes being slightly skewed towards a low linearity component. When all individual variables were included in a multiple regression analysis, however, they accounted for only 37% of the variability in linearity. Implications of these findings are discussed.

[Osborne, D.J., TO Heath and P Boarer. *Ergonomics*, 24(4) : 301, 1981.]

X EXERCISE PHYSIOLOGY

27. Exercise Training Hypotension : Implications for Plasma Volume Renin and Vasopressin

To determine the function of changes in plasma volume (PV), plasma renin activity (PRA), and arginine vasopressin (AVP) in the mechanism of the reduction of resting blood pressure during exercise training, resting supine, sitting, and standing systolic (SBP) and 5th—phase diastolic (DBP) blood pressures were measured in 10 men (19—24 yr) before and after an 8-day (2h/day) training period on a cycle ergometer. The control group (5 men) exercised at 1.4 l/min (44% peak O_2 uptake (VO_2)) at 23.8°C Tdb and 50% RH and the acclimation group at 1.5 l/min (46% VO_2 max) at 39.8°C Tdb and 50%RH. After acclimation resting supine and sitting DBP decreased ($P < 0.05$) by 6 and 9 mm Hg, respectively. There were no significant changes in DBP in the controls or in SBP in either group. After training PV increased by 12.2% in controls and by 17.6% after acclimation. The resting hypotension could not be attributed to changes in resting levels of PV, AVP or PRA. However, large-decreases in PV and large increases in AVP and especially PRA during acclimation exposures suggest these responses may play a role in the chronic hypotensive responses.

[Greenleaf, J.E., D Sciaraffa, E Shvartz, LC Keil, and PJ Brock. *J Appl Physiol Respirat Environ Exercise Physiol*, 51(2) : 298, 1981]

28. Changes in the Urinary Excretion of Lactic Acid during Exercise under Hypoxic Stress.

Tread mill exercise was performed to achieve

maximal predicted heart rate at ground level and at a simulated altitude of 15000 ft in a decompression chamber. Post-exercise changes in the blood and urinary lactate were studied under these two conditions. Post-exercise values of blood lactate did not show any significant changes at altitude whereas urinary lactate (expressed as mg/25 mg creatinine) showed a significantly higher value ($P < 0.02$), as compared to that following exercise at ground level. The study showed that in a combined stressful situation of moderate hypoxia (15,000 ft) and exercise, the post exercise urinary lactate could be good indicator of hypoxic stress, with the advantage of being a noninvasive technique.

[Iyer, FM, Banerjee, PK, Ranjit Kumar and Dikshit, MB. *Ind J Med Res*, 74 : 607, 1981.]

XI HIGH ALTITUDE PHYSIOLOGY

29. Autonomic Responses of High Altitude Natives during Sojourn at Plains and on Return to Altitude

The study was conducted on 20 high altitude natives (HAN-1) 19-32 years old, to evaluate the changes in autonomic responses during their 2 months sojourn on the plains, and on return to high altitude (HA). The autonomic indices measured were heart rate (HR), blood pressure (BP), oral temperature (T_{or}), mean skin temperature (T_{sk}), respiratory rate (RR), cold pressure response (CPR), HR response to tilt at 70°, and alpha index (AI) of EEG (occipital). These indices were recorded periodically during the 2 months of their stay on the plains, and thereafter on return to altitude for a period of 1 month. For comparison, the same responses were studied on 10 lowlanders (LL) on the plains and on induction to HA along with HAN-1. The study was repeated at altitude, once on 10 HAN who had never been to the plains (HAN-II) and on 10 acclimatised lowlanders. The results suggest that the relative parasympathetic dominance observed in natives at HA showed a gradual decrease during their sojourn on the plains, probably due to the elevation in sympathetic activity. On return to high altitude, they showed further increase in sympathetic excitation, as observed in LL on acute induction, but the magnitude of this response was less in natives.

AVIATION MEDICINE

However, they showed a trend to faster return of autonomic responses to their initial level compared to LL.

[Sulvamurthy W, RK Saxena, N Krishnamurthy, and HS Nayar. *Aviat Space Environ Med*, 52 (6) : 346, 1981.]

30. Cardiac Decompression Sickness — Report and Discussion of a Case

A case of first degree atrio-ventricular block, probably representing cardiac involvement by decompression sickness is presented. The conduction defect resolved spontaneously 36h after the initiating decompression insult, and was not accompanied by any other cardiovascular changes. The contribution of a recompression treatment, which alleviated accompanying Type I decompression sickness (DSC) symptoms, to the resolution of cardiac DCS is not certain. Cardiac symptoms of DCS do not receive enough consideration. It is suggested that an electrocardiogram should, whenever possible, form part of the basic evaluation of suspected DCS and of the initial workup of candidates for diving. A flow diagram for management of cardiac DCS is proposed.

[Halpern, P and A Greenstein. *Aviat Space Environ Med*, 52 (6) : 350, 1981.]

XII HYPERBARIC MEDICINE

31. Quantification of Hyperbaric Oxygen Induced Toxicity Utilizing a Malarial System

This study was undertaken in recognition of the need to develop quantitative systems to evaluate the toxicity associated with hyperbaric oxygen (HBO) exposure. Malaria infected (*p. berghei berghei*) mice were briefly exposed to 100% oxygen at 3 ATA on day 10 of infection. At 24, 48 and 72h thereafter, the levels of circulating erythrocytes and percent parasitized RBC were monitored and compared to those of infected non-exposed controls. The total erythrocyte counts of the infected HBO exposed and non-exposed mice did not differ significantly. In contrast, percent parasitized cells in the oxygen-exposed mice were lowered to 55-60% of control values at 24, 48 and 72h. The mechanism of this difference needs further study, but we believe that *p. berghei* infected erythrocytes are preferentially

haemolyzed as a consequence of HBO exposure. This model system is useful in the study of HBO-induced toxicity because of its high degree of selectivity and sensitivity and its amenability to strict quantification over a period of at least several days.

[Rencricca, NJ, RM Coleman, MD Altschule, PP Faletra, AD Gray, PE Desrochers, and MJ Doyle. *Aviat Space Environ Med*, 52 (2) : 85, 1981.]

32. Lack of Hyperbaric O₂ Effect on Blood-Brain Barrier Permeability in Conscious Rats

Conscious rats were exposed to 100% O₂ at 2.5 ATA for 90 min for upto 10 consecutive days, or to a N₂-O₂ mixture (PQ_{0.3}=0.3 ATA) under the same conditions (control animals). Cerebrovascular permeability to 14C-sucrose in the experimental animals was not altered by hyperbaric O₂ exposure when compared to the value in control animals. These results differ with other reports that similar hyperbaric O₂ exposure increases cerebrovascular permeability to ferritin and to a protein enzyme.

[Gruenau, SP, MT Folker, and SI Rapoport. *Aviat Space Environ Med*, 52 (3) : 162, 1981.]

33. Early Pulmotoxic Effects of Oxygen on the Rat Alveolar Type II Epithelial Cell

Adult male rats were exposed to pure oxygen at atmospheric pressure for 12 and 24h in order to examine the early pulmotoxic signs in alveolar type II epithelial cells. Lung specimens were processed for both light and electron microscopical examination. All changes were obvious, but less pronounced than in previous reports, and appeared only after 24h of exposure. The type II cells showed dilation of the Golgi apparatus and changes in mitochondria. This experiment indicates that exposure to pure oxygen at atmospheric pressure for as short as 24h, but not for 12h, is adequate to induce subtle pulmotoxic changes in alveolar type II epithelial cells.

[Heino, ME, LA Lattinen, and T Torvo. *Aviat Space Environ Med*, 52 (5) : 294, 1981.]

34. A Non Invasive Technique for Monitoring Blood Urea in Humans during Hyperbaric Exposure

A significant increase was found in parotid gland urea excretion in nine US Navy divers during 8d of air saturation hyperbaric exposure. The parotid urea levels correlated positively and reflected changes in blood concentrations. Considering the simplicity and ease of parotid sampling, it is suggested that this method be used for monitoring blood urea levels in humans during hyperbaric exposure.

[Gilman, SC, RJ Biersner, and LW Mooney. *Aviat Space Environ Med*, 52 (7) : 392, 1981.]

XIII SPACE PHYSIOLOGY

35. In Vivo Bone Strain Measurements — Clinical Results, Animal Experiments, and a Proposal for a Study of Bone Demineralization in Weightlessness

An extensive review of the literature of the aetiology of bone demineralization in weightlessness underlines the prevalent effect of mechanical stimulations on bone structure and metabolism. The accurate determination of the mechanical environment of bone can be realised using strain gauges. The results of more than 10 years of clinical application of bone strain measurements demonstrate the interest of this technic. We designed an implantable bone strain transducer composed of a strain gauge embedded in epoxy resin and surrounded by a porous shell. The fixation of the transducer is by bone ingrowth. Results on animals and an acute experimentation on man are presented. The objective of our study in space is to compare the mechanical response of bones of an animal or of a human submitted to normal 1-G gravity and to weightlessness. The average amount of bone strains and their variations during specific movements can be compared.

[Hinsenkamp, MF Burny, R Bourgois, and M Donkerwolcke. *Aviat. Space Environ Med*, 52 (2) : 95, 1981.]

36. Residence Time and Carbon dioxide Scrubbing Efficiency in Life Support Systems

Residence time affects the CO₂ absorption rate and CO₂ absorption capacity of different CO₂ absorbents used in an enclosed space. For a given CO₂ contents in the air stream at any given environmental condition, there is a corresponding residence time between CO₂ and the absorbent which results in the maximum CO₂ absorption efficiency. Different porosities for lithium hydroxide, sodasorb, and baralyme granules were studied. The residence time effects on the CO₂ absorption patterns and CO₂ absorption capacities were observed. Lithium hydroxide had the highest CO₂ absorption capacity when the residence time was about 0.8s. The CO₂ absorption capacity of both Sodasorb and Baralyme was increased as residence time increased. However, when the residence time was less than 1.0s, the CO₂ absorption capacity of both absorbents was greatly reduced.

[Wang, TC. *Aviat Space Environ Med*, 52 (2) : 104, 1981.]

37. Variations in Gravitoinertial Force Level Affect the Gain of the Vestibulo-ocular Reflex : Implications for the Aetiology of Space Motion Sickness

Recordings of horizontal nystagmus were obtained on 16 male subjects exposed to repeated patterns of horizontal angular acceleration, constant velocity rotation, and sudden stop deceleration in the laboratory and in the free fall and high force periods of parabolic flight. Nystagmus intensity was a clear function of gravitoinertial force level: slow phase velocity and beat frequency increased during exposure to high force levels and decreased in free-fall compared to values obtained at 1G. These findings indicate that the gain of the vestibulo-ocular reflex decreases in free-fall. This fact likely accounts for the disorientation and dizziness sometimes experienced by astronauts when moving their heads in the early phases of orbital flight and again after splash-down. The implications of the present findings,

both for the etiology and for the treatment of space motion sickness, are discussed.

[Leckner, JR and A Graybiel. *Aviat Space Environ Med*, 52 (3) : 154, 1981.]

38. Functional Steadiness of the Cerebral Circulatory System under Altered Gravitational Conditions

The maintenance of hemodynamic stability is a functional characteristic of the cerebral circulatory system. This characteristic developed during the evolutionary process. It can be of use as an indi-

cator of the activity of the central processes regulating cerebral blood flow under different stress conditions, particularly, during a long space mission. Rheoencephalographic methods are qualitative and yield information that permits assessment of the changes in the functional status of the cerebral circulatory system. This was confirmed by results obtained during the Salut-4 space mission. The observations permitted us to assess indirectly the status of the cosmonauts.

[Moskalenko, YuE. *Aviat Space Environ Med*, 52 (3) : 159, 1981.]

