AVIATION MEDICINE VOLUME 29 NUMBER 2 1985

# Abstracts

## I AVIATION PHYSIOLOGY

### 1. Lactate Threshold and Distance Running Performance in Young and older Endurance Athletes

Many well trained elite older runners have performances comparable to those of much younger nonelite runners. We sought to determine whether the physiological determinants of endurance performance in two groups of such athletes were the same. Eight master athletes (age 56± 5 yr) were matched on the basis of 10 km performance and training to younger runners (age 25± 3 yr). The master athletes had a 9% lower maximum $O_2$ uptake ($VO_2$ max ($P < 0.05$) than the matched young runners, despite the similarity in their performance. Running economy was not different between these groups. However, the master athletes attained a 2.5 mM blood lactate level during steady-state exercise at a higher percentage of their $VO_2$ max ($P < 0.05$), although both groups attained this lactate level at the same running speed & $VO_2$. This, despite having significantly lower $VO_2$ maxs values, the older athletes were able to perform as well as the younger runners because they were able to work closer to their $VO_2$ max for the duration of the race.

[ALLEN, WILLIAM K. DOUGLAS R. SEALS BEN F. HURLEY, ALI A. EHSANI and JAMES M. HAGBERG. J. APPIL. Physiol 58(4) : 1281-1284, 1985 ]

### 2 Endurance Training in Humans : Aerobic Capacity and Structure of Skeletal Muscle

The adaptation of muscle structure, power output and mass-specific rate of maximal $O_2$ consumption ($VO_2$ max/Mb) with endurance training on bicycle ergometers was studied for five male and five female subjects. Biopsies of vastus lateralis muscle and $VO_2$ max determinations were made at the start and end of 6 wks of training. The power output maintained on the ergometer daily for 30 min was adjusted to achieve a heart rate exceeding 85% of the maximum for two thirds of the training session. It is proposed that the ob-

served preferential proliferation of subsarcolemmal vs. interfibrillar mitochondria and the increase in intracellular lipid deposits are two possible mechanisms by which muscle cells adapt to an increased use of fat as a fuel The relative increase of $VO_2$ max/Mb (14%) with training was found to be smaller by more than two fold than the relative increase in maximal maintained power (33%) and the relative change in the volume density of total mitochondria (+40%). However, the calculated $VO_2$ required at an efficiency of 0 25 to produce the observed mass-specific increase in maximal maintained power matched the actual increase in $VO_2$ max/Mb (8.0 and 6 5 ml $O_2$ $min^{-1}$ $kg^{-1}$, respectively) These results indicate that despite relative changes the absolute change in aerobic capacity at the local level (maintained power) can account for the increase in aerobic capacity observed at the general level ($VO_2$ max).

[HOPPELER, HANS, HANS HOWALD, KEVIN CONLEY, STAN L. LINDSTEDT, HELGARD CLAASSEN, PETER VOCK and EWALD R. WEIBEL. J. APPL. Physicl. 59(2) : 320 327, 1985.

### 3 Hyperventilation-Induced Changes of the Blood Picture

In a controlled study of 11 male volunteers the following changes (means±SD) were observed in venous blood during (D) and 75 mins after (A) a period of 20 min of voluntary hyperventilation in comparison with before (B) hyperventilation (P values referring to the difference between D and B) erythrocyte count 5.18±0 17 x $10^6$ (B), 5 70±0.21x$10^6$ (D) (P∠0 001), and 5.18±0.16 x $10^6$ /ul (A) ; hemoglobin 15.7±0.6 (B) 17.2±0.7 (D) (P∠0 001) and 15,8±0.68/dl (A) ; centrifuged hematocrit 46.6±1.0 (B), 50.4±1.7 (D) (P∠0.001) and 4.70±1.8% (A). The platelets increased from 159±30x$10^3$ (B) to 205±40x$10^3$ (D) (P∠0.001 and returned to 157±26x $10^3$/ul (A). The leukocytes (WBC) were 4,210±630 (B), 6,220±1,660 (D) (P∠0.001, and 6,190±1,870/ul (A) (P∠0.002, as compared with B). The rise of WBC during hyperventilation was mainly due to a 83% increase of lymphocytes, whereas a 93% increase of neutrophil leukocytes accounted for the increased WBC 75 mins posthyperventilation. The increase of the ratio of band forms to segmented neutrophils from 9% (B) to 19% (A) (P<0.01) indicates that band forms were released from the bone marrow The results show that WBC and platelets can be mobilized by hyperventilation by as yet unidentified mechanisms.

[STAUBLI, M, UP STAUBLE, U, WABER and P. W. STRAUB. J. APPL. Physiol. 58(4) : 1170-1175, 1985.]

### 4 Factors Predictive of stress. Organizational Effectiveness and Coronary Heart Disease Potential

Research to predict stress, organisational effectiveness, and potential for developing coronary heart disease (CHD) is presented based on two samples (n= 357 and n=225). Results indicate that perceived stress is predicted by a combination of individual and job related characteristics The data suggest that stress, in turn affect individual and organisational health and effectivness, by causing increases in cold/flue episodes, somatic symptoms, while decreasing job satisfaction. In addition, stress has an indirect effect on job performance as absenteeism. Models for predicting the ratio of total serum cholestrol divided by HDL cholesterol as an indicator of coronary heart disease potential are provided and a CHD model is provided.

[HENDRIX WH Aviat Space Environ Med : 1985 : 56 : 655-9

### 5 Stress and Accidents

Three types of stress are desribed : environmental stress, acute reactive stress and domestic or life stress. Each of these is discussed and the evidence relating the stress to accidents is evaluated. This evidence is drawn from laboratory experiments, surveys and accident and incident reports. It is concluded that there is good reason to link some forms of stress with accidents. Pos-

sible amellorative measures are suggested.

GREEN R G. Aviat Space Environ. Med. 1985 : 56 638-41

### 6 The stress of work : An Overview.

This paper looks at a number of potential occupational stressors found to predict job satisfaction and ill health (Both mental and physical) in a variety of different occupational settings. Factors intrinsic to the nature of the job, role ambiguity and conflict, poor relations at work, lack of career development, inadequate organisation structure/ climate and problems associated with the interfact between work and homelife are the flocal points of attention. Many of these sources of occupational stress are prevalent in the field of aviation, and may be exacerbated by the move towards deregulation and increasing commercial competition within the industry.

[COOPER C.L. Aviat. Space Environ. Med. 1985 627-32 ]

### 7 Occupational Stress and the Professional Pilot The Role of the Pilot Advisory Group (PAG)

This paper discusses the role of pilot peer group involvement using the pilot advisory Group (PAG) in assisting pilots who manifest personal problems which derive from occupational and other stressors. Some general aspects of "background" Occupational stress are discussed. Atitudes and opinions of Professional aviators are identified and their role in denial of symptomatology is developed. The concept of pilot Advisory Group (PAG) is then discussed in detail before its role in relation to occupational stress is introduced. While some of the better known problems associated with occupational stress in pilots are mentioned, the emphasis in the paper is on developing new perspectives regarding the identification of stress induced dysfunction and also exploring the suitability of PAG involvement. The formal obligations of the management and regulatory authorities are contrasted with what the author sees as the countervailing imperatives of pilot attitudes and beliefs.

[AVIAT. SPACE. ENVIRON' MED 1985 : 56 : 633-7]

### 8 Effect of Different ascent Profiles on Performance at 4,200m Elevation

Two groups of sea level residents were studied of the summit of Mauna Kea (4,200 m elevation) following ascent by vehicle. "Commuters" spent 6h at the summit, while "Shiftworkers" lived on the mountain for 5d. Although PaO2 levels were lower in commuters, they experienced fewer altitude sickness symptoms than shiftworkers on the first day at 4,200 m. After 5 d, shiftworkers reported fewer symptoms and performed better at tests of numerate memory and psychomotor ability than commuters. At high altitude, pulse rates were increased in both groups, but only shiftworkers exhibited an elevation in systemic blood pressure. Arterial-alveolar oxygen tension gradients were not increased at 4,200 mm. Despite frequent and rapid ascents and descent, with minimal provision for acclimatisation, high altitude pulmonary and cerebal oedema were uncommon.

[FORSTER PJG. Effect of different ascent profiles on performance at 4,200m elevation. Aviat Space Environ. Med. 1985 : 50:758-6 ]

### 9 The Desensitisation of Chronically Motion Sick Aircrew in the Royal Air Force

The FAF motion Sickness Desensilisation Programme has been in operation since 1966 and to January 1984 151 aircrew have been treated. The programme consists of a ground phase of treatment and flying phase. Since January 1981 both phases have been located at Farnborough. Additional motion stimuli have been incorporated into the ground phase. The flying phase, whichwas previously carried out in a basic jet trainer, is now carried out in a high performance aircaft, the Hunter T7. Comparison of the results of follow-up for the period 1981-83 with those for 1974-80 indicates an improvement in overall success rate and shows a significant increases in the number

that progressto fly in the demanding motion environment of fast jets.

[BAGSHAW M, STOTT JRR,—Aviat, space Environ, Med. 1985:66 1144-51]

### 10 Self-Control of Psychophysiologic Response to Motion Stress : Using Biofeedback to Treat Airsickness

Investigators of the Neuropsychiatry Branch, Clinical Sciences Division, U.S, Air Force School of Aerospace Medicine (USAFSAM), provided biofeedback-moderated behavioral treatment to 53 fliers grounded for chronic, severe motion sickness. and followed each flier for 2 years after treatment completion. Sucess was defined as returning to and maintaining satisfactory operational flying status. Of these, 42 fliers (79%) met this criterion; 3 (6%) were partially successful, and 8 (15%) were subsequently grounded for recurrent airsickness Follow-on studies will investigate psychophysiological mechanisms through which this method of treatment works.

[JONES DR, LEVY RA, GARDNER L, MARSA RW, PATTERSON JC. 56 : 1152-7

## II ACCELERATION PHYSIOLOGY

### 11 Factors Affecting Human Tolerance to Sustained Acceleration

Linear increases in 'G' tolerance with increases in anti 'G' suit (AGS) bladder inflation pressure occurred when relaxed subjects were exposed to acceleration plateaus while riding a centrifuge and were either seated upright (15° seat back angle or (SBA) or supine (60° SBA). Supine G tolerance with AGS bladder inflation decreased as G onset time was increased by factors of two and four. Changing the mode of operation of a new servo-controlled anti-G valve regulating AGS bladder pressure had no effect on G tolerance nor on AGS comfort scores. Comfort was unaffected by G onset time and reduced with high AGS bladder pressures. Results support the hypotheses that G protection provided by simultaneously applied anti-G techniques is additive and that the simple hydrostatic model of the circulatory system can adequately account for AGS bladder pressure changes required for G protection when body position is changed.

[Herebien L, Hendler E. Aviat. Space Environ Med. 1985 : 56 : 19-26.

### 12. Increased Gratavitional Stress Does not alter Maximum Expiratory Flow

D. Pyszczynski, S. N. Mink and N. R. Anthonisen, Increased gravitational stress does not alter maximum expiratory flow. J. Appl. Physiol. 59 (1) : 28-33, 1985. - We measured maximum expiratory flow-volume (MEFV) curves in six seated subject during normal ( +1 Gz) and increased (+ 2 and −3 Gz) gravitational stress. Full MEFV curves, initiated at total lung capacity, were recorded, as were partial MEFV curves, initiated at 60% of the vital capacity. Data were acquired in all subjects breathing air at +1 and +2 Gz; results were available for three subjects breathings 80% He-20% $O_2$ at +1 and +2 Gz, and in two subjects, results were obtained at +3 Gz . Changes in gravitational stress were not associated with changes of either full or partial MEFV curves. The known increase in differences of regional lung volume and recoil caused by increased gravitational stress did not influence maximum expiratory flow. Though increased gravitational stress probably changed regional emptying sequences little during full MEFV manouvers, substantial changes ence of emptying sequence were expected during partial manouvers. It is possible that such chan ges in emptying sequence occurred but were not associated with changes in maximum flow because t e latter was determined by choking in central airways common to all regions.

### 13 Performance and Physiological Effects of Acceleration-Induced (+Gz) Loss of consciousness

Loss of consciousness (LOC) was intentionally indiuced by exposing eight volunteers to individually-

titrated levels of head-to foot acceleration (+Gz) using 2-and 4-s onset rates (mean=6.1+G3 required to induce LOC) and a gradual 0.067 G. s-1 onset rate (mean)=7.2 Gz required). Subjects were trained over a prior 2-week periodon a mulititask battery comprising three simultaneously executed tasks representative of those required in piloting, and then centrifuged to LOC at each of the three onset rates on alternate days. Performance was assessed for 5 min prior and 7 min after each LOC. Primary results indicated: (a) Significant and substantial impairment in the two discrete response secondary tasks (choice reaction time and arithmetic computation), with mean recovery to pre-LOC levels within 3 min on each task, b) no group mean impairment for the primary, compensatory tracking task, c) substantial individual variation in physiologically and behaviorally defined recovery from LOC, d) a negative influence of aerobic fitness on G tolerance and LOC recoverability, and e) that recovery effects were not generally dependent upon onset rate, Mean absolute incapacitation (head dropped) for the rapid onset rates was 12.1 s. For the gradual onset rate, mean absolute incapacitation was 16 6s. Mean relative incapacitation (head erect, no voluntary task engagemcnt) for the rapid onset rateswas 11.6 s ; for the gradual onset rates mean relative incapacitation was 15.7 s. Evidence for retrograde amnesia effects was equivocal.

[HOUGHTON JO, MCBRIDE DK HANNAH K. Aviat, Space Environ. Med, 1985 ; 56 : 956-65

### 14 Operational G-Induced Loss of Conscious ness : Something old Something New

Loss of consciousness (LOC) during exposure to + Gz occurs in aircrew flying high performance aircraft. This phenomenon is responsible for several USAF aircraft losses with accompaning loss of life. It has been recognized as a potential flying problem since 1983. Acceleration-induced LOC results in 15-to 20-s periods of aircrew total incapacitation, amnesia, and clonic spasms. It can occur at relatively low G levels and without symptoms of loss of light (blackout). Operational anti-G equipment and methods are not completely effective in preventing LOC Considering the present status of G protection, a deficiency in the anti-G straining maneuver is considered to be primary cause of G-induced LOC. This deficiency usually can be corrected with proper centrifugetraining. Our present understanding of G protection suggest that the elimination of LOC as a serious problem for USAF high-performance aircraft operations must include the supination of aircrew to a minimum seat back angle of 60° to 65°.

[RURTON RR, NHINNERY JE : Aviat Space Environ Med. 1985 ; 56 812-7]

## III SPACE PHYSIOLOGY

### 15 Cardiovascular Reconditioning During Space Flight and the use of Saline as a Countermeasure to Orthostatic intolerance

Alterations in the physiology of the cardiovascular system have been noted during all exposures to the microgravity experienced in space flight. Of most importance to the operational function Space Shuttle crewmembers is orthostatic intolerance Although complex changes occur as a result of adaptation to weightlessness. the redistribution and loss of body fluid apparently plays a substantial role. Utilizing ground-based bed rest data as an analog to the absence of gravitational force encountered in orbital flight, a saline loading countermeasure was developed. In this study,17 crewmembers consumed various amounts of salt and fluid prior to the reentry phase of space shuttle flights ; 9 other astronauts served as control subjects. The countermeasure reduced the heart rate response to orthostatic stress 29% and reversed the fall in mean blood pressure. A Cardiovascular Index of Deconditioning (defined as CID= $\triangle$ HR $-$ $\triangle$ + $\triangle$ DBP) equalled 21 in those who utilized the countermeasure, a significant improvement toward baseline ($p<0.003$) when compared to the control group CID=49, The encouraging results of these investigations has led to the adoption of the countermeasure as an operational procedure by Shuttle crewmembers.

[BUNGO MW, CHARLES JB, JOHNSNN PC. Aviat Space Environ. Med. 1985 : 56 : 985-90]

## IV AVIATION NEUROPSYCHIATORY

### 16 The Impact of Life Events on Pilots: An Extension of Alkov's Approach

Recent Psychological thinking has expressed dissatisfaction with life events/life changes research. The cornerstone of such research in aviation studies is the work of Alkov. We adopted Alkov's approach and used it to see if we could extend our understanding of the mechanisms involved in the life events/accident relationship. Alkov's 22-item questionnaire was expanded and administered by post as part of a much larger study. Replies were received from 441 commercial pilots working for British companies. Multivariate analysis revealed that the pilots merely regarded the 22 items as comprising three trends - Emotional losses, Pilot Characteristics, and Emotional Gains. The overall conclusion proposes that, while Alkov's approach is interesting, expansion of it reveals that background contuxteal factors should be examined. Additionally, pilot's perception of the effects of life events on accident/incident potential is made on relatively broad discriminations, rather than on finely tuned judgements.

[SLOAN SJ. COOPER CL. Aviat. Space Environ. Med. 1985 : 56 : 1000-3]

### 17 Effects of personality on Body Temperature and mental Efficiency following Transmeridian Flight

Examination of the oral temperature rhythm in a group of young men after an eastward jet flight across eight time—zone revealed a specific disruption in the rhythm that gradually disappeared over a period of some 10d. In the first 2d, the magnitude of the disruption in individual subjects was significantly corrected with the extent of mean post flight loss of speed in performing on arithmetic calculations test, given four times per day in local day time hours within the group, neurotic introverts exhibited the greatest and neurotic extraverts the least initial rhythm disemptive ; these two per-sonality groups also showed opposing time of-day trends in post-flight changes in the performance measure. The results are discussed in relation to flight scheduling and to other studies of shifts in activity schedule ; they are tentatively accounted for in terms of a postulated dimension of circadian rhythm lability that could be primarily related to extroversion.

[Wp Colquhown. MA, Ph D. Medical Research Council Perceptual and cognitive performance Unit, Universi.y of Sassex, Beighton, England. Any Space and Environ. Med. June 1984, Vol. 55, No. 6 Page 493.

### 18 Enhancement of Military Pilot Reliability by Hypnosis and Psycho-Physiological Monitoring : Preliminary Inflight and Simulator Data

Subjects were Royal New Zealand Air Force pilots and this investigator (N=8). Skin conductance response (SCR) was measured during a localizer approach for both Inflight and simulator phases of the study. SCR's were noted following all ground controller altitude and heading change instructions and for all pilot-initiated heading and altitude changes employed to comply with the localizer approach plate. Inflight SCR's following ground controller instructions were substantially greater than those related to pilot initiated responses to cockpit information. In the flight simulator phase, posthypnotic suggestions for increased vigilance performance were administeredwith counterbalancing for hypnosis-no-hypnosis order conditions. Cockpit instrument data was video taped. Posthypnotic instructions for enhanced vigilance performance were found to dramatically increase SCR's to cockpit based information and to significantly reudce heading and altitude error correction time.

[Barabasz AF. Aviat. Space Environ Med. 1985 : 56-50.]