Abstracts from Current Aerospace Medical Literature

I Acceleration Physiology

1. Observation on the neurophysiologic theory of acceleration (+Gz) induced loss of consciousness.Whinnery JE: Aviat Space Environ Med 1989; 60:589-593.

The characteristics of centrifuge +Gz induced loss of consciousness (G-LOC) have revealed a specific kinetic pattern of resulting physiologic events. The relationship of these events provides an initial basic for describing the possible neurophysiologic mechanism of G-LOC episode into specific periods based on the psychophysiologic events that occur during inflight aerial combat maneuvering in fighter aircraft. The symptoms of myoclonic flail movements and memorable dreams which are observed in association with G-LOC may provide key information for unravelling the neurophysiologic mechanism of G-LOC and subsequent recovery. A detailed understanding of the kinetics and mechanism of G-LOC is paramount to eventually solving this critical fighter aviation related problem.

II Clinical Aviation Medicine

2. Treatment of essential hypertension with yoga relaxation therapy in US AF aviator: A case report. Brownsteing AH, Dembert MZ: Aviat Space Environ Med 1989;60 :684-687.

A 46 year old caucasian male USAF aviator with a 6 year history of mild essential hypertension (Medical waiver for flight duty) under unsuccesful treatment with hydrochlorothiazide, dietary modification, and exercise, was subsequently trained in yoga relaxation. After 6 weeks, medication had been discontinued and his diastolic blood pressure remained within normal levels. The patient was subsequently returned to full flight status with out recurrence if diastolic hypertension at follow up 6 months later. Relaxation training, of which yoga is one type, has been reported in the medical literature to have wide clinical application. It should be considered as a non-pharmacological therapy adjunct of alternative for medical disorders among personnel in occupations (eg. aviation) where the side effects from medications are of great concern and could be disqualifying from those duties.

3. Type II altitude decompression (DCS) : U.S. Air Force Experience with 133 cases. Wirjosemito SA, Touhey JE, Workman WT: Aviat Space Environ Med 1989; 60:256-262.

Type II altitude - related decompression sickness (DCS), due to its wide spectrum of symptoms, is often difficult to diagnose. This difficulty sometimes leads unnecessarily to the permanent grounding of an experienced aviator. So that this condition could be better understood, a total of 133 cases of Type II altitude DCS (on file at the United States Air Force Hyperbaric Medicine Division, School of Aerospace Medicine, Brooks AFB, TX) were reviewed. Most cases (94.7%) followed altitude chamber training. The most common manifestation was joint pain (43.6%), associated with headache (42.1%), visual disturbances (30.1%), and limb parasthesia (27.8%). The next most common symptoms were, in order of decreasing frequency: mental confusion (24.8%), limb numbness (16.5%), and extreme fatigue(10.5%). Spinal cord involvement, chokes, and unconsciousness were rate (6.9, 6%, and 1.5% respectively). Hyperbaric oxygen treatment produced fully successful results in 97.7% of the cases. Only 2.3% of the cases resulted in residual deficit no deaths occurred. A thorough knowledge of the differential diagnosis and predisposing factors is essential to narrow the margins of error in the diagonsis and predisposing factors is essential to narrow the margins of error in the diagnosis and prevention of decompression sickness in the operations or training environment. A recommendation for favorable consideration of waiver action for those aviators who suffered Type II DCS is presented. These recommendations are based on a unique classification of the severity of symptoms.

III Ergonomics

4. Effects of VDT resolution on visual fatigue and readability : An eye movement approach. Mizao M, Selim SH, Allen JS, Stark LW : Ergonomics 1989; 32(6): 603-614

The effect of VDT resolution on visual fatigue and readability were studied. Two kinds of displays with different resolutions (1664 x 1200 pixels) and fonts were used. In the first experiment, the subjects read from each display

for 1 hour to induce fatigue. Reading speed and blink rate while reading were measured. Eye movements during visual smooth pursuit tracking tasks were studied before and after reading, quantitative scoring of eye movement performance showed no significant changes. In the second experiment readability tests with three different character sizes on both displays were conducted and resulting reading eye movements were analysed. For readability of sufficiently large characters, no significant difference between the high and the standard VDT could be detected. However, for very small characters higher resolution improved readability.

5. Hill DW, Cureton KJ, Collins CÜ : Circadian specificity in exercise training. Ergonomics, 1989; 32(1): 79-92

The purpose of this study was to determine whether metabolic and cardio-respiratory adaptations to exercise training are greater at the time of day of training than at another time. Twenty-seven subjects performed cycle ergometer tests in the morning and in the afternoon before and after 6-week period during which ten subjects trained regularly in the morning, seven subjects trained in the afternoon, and ten did not train. Training caused decreases in HR, VE and rating of perceived exertion during submaximal exercise a 7.7% increase ($P < 0.01$) in VO2max and a 9.1% effects) were independent of time of day of training for all variables except VO2 at the ventilatory threshold. Compared with each other, subjects who trained in the morning, while subjects who trained in the afternoon had relatively higher values in the afternoon ($P < 0.05$). This is the evidence of circadian specificity in training and supports the notion of planning physical preparation to concise with the time of day at which one's critical performance is scheduled.

6. Circadian characteristics influencing inter individual differences in tolerance and adjustment to shiftwork. Giovanni C, Francesca L, Giovanni C, Edoardo G, Simon F: Ergonomics 1989; 32(4): 373 - 385

The study was carried out to evaluate whether shiftworkers showing different long-term tolerance to shiftwork differ in their circadian adjustments and/or in some behavioral characteristics. Three groups of eight workers, engaged on three shifts in a graphic plant and matched for age and work experience, were selected according to the presence or not of complaints related to shiftwork: (1) no complaints (2) nervous complaints (anxiety/depression, severe sleep disturbances) (3) digestive disorders (gastroduodenitis, peptic ulcer). They answered questionnaires on family conditions, health status, rigidity of sleeping habits, ability to overcome drowsiness, morningness, manifest anxiety. They also recorded several physiological parameters (oral temperature, grip strength, peak expiratory flow rate, pulse rate, sleep hours) during day and night-shifts. The data obtained indicate that the characteristics of flexibility of sleeping habits, ability to overcome drowsiness, and lower manifest anxiety, are associated with better tolerance to shiftwork. These characteristics do not seem to influence the adjustment of the circadian rhythm of oral temperature passing from day to night-shift and vice versa. Conversely, morningness appeared to be unrelated to long-term tolerance, but did influence circadian adjustments and sleep behaviour. Among the groups, the subjects with digestive disorders showed a greater phase shift and a reduction of amplitude on night-work, suggesting a possible relationship also between the short-term circadian adjustment and the long-term tolerance to shiftwork, as pointed out by other authors.

7. Performance differences of individuals classified by questionnaire as accident prone or non-accident prone. Porter CS, Houghton N, Corlett EN: Ergonomics 1989; 32(3): 317 - 333

A questionnaire (APQ) was designed to investigate accident proneness. The questioner was analysed to identify individuals who believed themselves to be accident prone (APS) and individuals who believed themselves to be non-accident prone (NAPS), and provide information concerning the circumstances in which minor accidents occur. Two groups of subjects were defined, ten APS and ten NAPS, and the circumstances in which minor accidents happened to them were identified. It appeared that individuals had minor accidents when they were not attending fully to the particular situation in which the incident occured. Therefore, a dual task experiment was run, such that subjects were

unable to concentrate fully on a blind reach task. This used a computer based unidimensional tracking task, requiring prediction, as a primary task and the decoding of an auditory tone, followed by the blind reach to the corresponding target, as the secondary one. The secondary task gave a choice of eight targets, identified by tones. Data were collected on all aspects of both primary and secondary tasks. The APS performance at the primary task was found to be significantly worse than the NAPS on all occasions. The APS performance at the blind reach task was also significantly worse, on some occasions,in terms of time taken to find the target centre. Further experimentation would be required to identify the prices nature of the aspect of performance differences between the two groups and correlates with the APQ before firm conclusions could be drawn.

IV Human Engineering

8. US Army anthropometric standards for rotary-wing aviators in the light observation helicopter. Farr WD, Buescher TM : Aviation Space Environ Med 1989; 60: A74-A76

The US Army standard anthropometric measurements for rotary-wing aircraft personnel were applied to 30 rated pilots with heights of not greater than 70 in. to determine whether these standards allow an adequate fit of the pilot to the cockpit of the OH-58A 'Kiowa' light observation helicopter, and the ability of the pilot to reach all control surfaces and panel switches. It was found that the present U.S. Army standards do not address adequately the functional ability in the OH-58A cockpit, which is the least adjustable cockpit in the combat inventory. Some pilots less than 68 inches in height could not perform all cockpit tasks in the OH-58A, without necessitating cockpit changes beyond the limited adjustments several pilots with heights over 68 inches (and, therefore, not subject to anthropometric testing upon entry into the U.S. Army aviation) were seen to have similar problems.

V Physiology

9. Ventilation perfusion relationships during induced normovolemic polycythemia in dogs. Balgos AA, David C, Willford, West JB : J Appl Physiol 1988; 65(4) : 1686-1692

Previous studies on normal subjects and patients with polycythemia have given conflicting results of the effect with polycythemia on pulmonary gas exchange. We studied acutely induced normovolemic polycythemia in the dog and measured arterial blood gases and ventilation perfusion (Va / Q) relationships using the multiple inert gas elimination technique. The mean base line hematocrit of 43 ± 5% was increased to 57 ± 4 and 68 ± 8% respectively, after two exchange transfusions of packed erythrocytes. Subsequent plasma exchange transfusion returned the mean hematocrit to 44 ± 4%. Polycythemia caused no significant arterial hypoxemia indeed there was a slight improvement in the alveolar arterial PO_2 difference. The multiple inert gas elimination measurements showed no increase in VA / Q inhemogeneity with no increase in log SD ventilation (V) or log SD blood flow (Q). There was a shift of mean V and mean Q to high VA/Q areas because of a decrease in cardiac output, presumably caused by increased blood viscosity. This study showed no deleterious effects on pulmonary gas exchange within the hematocrit range of 36 - 76%.

10. Relationship between prostaglandin synthesis and release of acidic amino acid neurotransmitters. Terrian DM, Rea MA, Dorman RV: Aviat Space Environ Med 1988;59(11 Suppl): A2-9.

The importance of glutamate as an excitatory neurotransmitter in the central nervous system has become increasingly clear. However, the presynaptic mechanism of amino acid neurotransmitter release does not appear to be consistent with existing models. A major source of controversy has been the finding that a significant amount of the amino acid release evoked by membrane depolarisation is calcium-independent,. It is often implied that this component of release is of cytosolic origin and subserve no neurotransmitter function. In this report, an alternative model is presented which suggests that the depolarisation induced movement of calcium irons into the nerve terminal acts, simultaneously to simulate the release of acidic amino acid neurotransmitters from both vascular and cytosolic compartments. According to this model, the influx of calcium may indirectly stimulate the biosynthesis of prostaglandins which lower the plasma membrane potential and reverse the electrogenic transport of amino acids to cause a net efflux. Such a mechanism could explain how

the vesicular and cytosolic neurotransmitter pools of release are functionally related.

IV Space medicine

11. A study of the effects of prolonged simulated microgravity on the musculature of the lower extremities in man : An introduction. Buchan P, Convertino VA: Aviat Space Environ Med 1989; 60: 649-52.

The reduction of muscle strength and size of the lower extremities has been observed following space flight. However, there are virtually no data from direct measurements of muscle tissue which provide a means of understanding the physiological alternations associated with the impaired function. We therefore, conducted a study in which eight healthy men underwent 30 days of continuous exposure to 6° head down tilt as an analogue for space microgravity. We used percutaneous muscle biopsy, computed tomography, anthropometry, and in vivo muscle strength measures under controlled experimental conditions to provide new data about mechanical, structural, and metabolic characteristics of skeletal muscle in man following exposure to microgravity.