

I ACCELERATION PHYSIOLOGY

1. The effects of +Gz on the coronary circulation : a review.

The exposure of the human body to +Gz acceleration produces dramatic effects on the cardiovascular system. For example, during +Gz stress, heart rate has been reported to increase in excess of 200 beats per min and left ventricular pressure has been estimated to reach 300 mm Hg. Several reviews have dealt with the overall effects of +Gz stress on the cardiovascular system. However, none of these reviews has dealt specifically with the effects of +Gz on the coronary circulation to maintain adequate perfusion of the heart. A common misconception exists within the aeromedical community that coronary blood flow must be compromised during +Gz due to the high heart rates and stress levels encountered during +Gz exposures. The purpose of this review is to deal with this issue by reviewing available information about basic coronary physiology, acceleration physiology, and their interaction. The current state of our understanding of basic coronary function is summarised. The current understanding normal coronary function is integrated with the

available information about the effects of +Gz on the heart and coronary circulation. Potential chronic effects of +Gz and its interrelationships with cardiac and cardiovascular pathology in relation to the coronary circulation is briefly considered.

Laughlin MH : Aviat Space Environ Med. 57:5, 1986.

2. Effect of seat cushions on human response to +Gz impact.

Human response to vertical (+Gz) impact acceleration was evaluated as a function of various seat cushions, including current operational cushions used in such aircraft as the A-10, F-15 and F-111 and proposed alternative cushions comprised of rate-dependent, slow-recovery polyurethane foams. There were 133 tests conducted on volunteer subjects in seven different conditions, using a vertical deceleration facility. The mean peak acceleration of the impact carriage for these tests was 9.85 G (sd 0.07) and the mean carriage velocity change was 8.01m/sec (sd 0.05). Resultant seat loads and head and chest accelerations were significantly higher for the F-111 cushion than for the rate-dependent foam cushions,

which included cushions comprised of Comfort foam or Temper foam. Resultant head and chest accelerations were also significantly higher for the ACES II cushion than for the rate-dependent foam cushions. Therefore, from an impact protection standpoint, the operational cushions were inferior to the proposed alternative cushions. Operational use of rate-dependent foam cushions is recommended to improve the impact protection performance of escape systems. Flight tests conducted by the USAF Strategic Air Command have shown that these cushions enhance crewmember sitting comfort during long-duration missions.

Hearon BF and Brinkley JW : Aviat Space Environ Med. 57:113, 1986.

### 3. Psychomotor performance after forward facing impact.

An experiment to assess psychomotor performance before and after forward-facing (-Gx) impact was conducted using the AFAMRL Horizontal Decelerator Facility. There were 10 volunteer subjects who participated in 50 tests at 4 impact levels (0 G or sham, 8 G, 10 G and 12 G). Two initial head positions were explored at the highest impact level. The manikin psychomotor task, a complex reaction time and accuracy task, was used to evaluate performance. Linear and angular accelerations were measured at the head. Although there was a weak correlation between angular head acceleration and prolonged post-impact reaction time, no compelling statistical evidence was found to support the hypothesis that psychomotor performance is degraded with increasing impact severity at these test levels. The highest

test level explored in this study may not have been sufficient to produce change in performance or, alternatively the manikin task may not have been sufficiently sensitive to measure change in performance if one was present. In addition, significantly lower angular head acceleration was observed at the 12G test level when the head was rotated forward initially rather than prepositioned upright against the headrest. The potential for temporary stunning of aircrew members during operational crash landings or ditching may be reduced by rotating the head forward prior to an imminent crash if time permits.

Hearon BF and Brinkley JW: Aviat Space Environ Med. 56:1043, 1985.

## II ACCIDENT INVESTIGATION

### 4. Injury pattern analysis of helicopter wire strike accidents (-Gz load)

Injury patterns in rotary wing aircraft wire strike accidents were reviewed to determine mechanisms of injury. It was found that US Army Safety Center data showed that between 1 Jan 1974 and 31 Aug 1981 there were 167 wire strikes involving Army helicopters which resulted in 60 injuries and 34 fatalities at a cost of \$ 12,809,100. Updated data on all military rotary wing aircraft accidents investigated between 1978 and 1982 were screened by the Division of Aerospace Pathology to determine the mechanisms of injury to flight deck personnel. From 13 Dec 1978 to 23 Jun 1982, three types of rotary wing aircraft were involved in eight fatal accidents. These mishaps accounted for 28 casualties 14

fatalities and 14 injuries. Aviators comprised 64.4% of the fatalities. Injury pattern analysis showed 100% had major head and neck injuries with 66% having basilar skull fractures. Two thirds had associated mandibular fractures or evidence of impact forces transmitted through the mandible to the skull. The same number had wedge-shaped chin lacerations from impact with the cyclic control stick. We postulate transmission of lethal impact forces primarily in the +Gz direction through the mandible to the skull. This suggests either improper use and/or a failure of the seat and restraint system.

Farr WD, Ruchle CJ, Posey DM and Wagner GN : *Aviat Space Environ Med.* 56:1216, 1985.

### III AVIATION OPHTHALMOLOGY

5. The flight acceptability of soft contact lenses and environmental trial.

Seventeen Officer Aircrew wearing soft contact lenses were subjected to adverse conditions likely to be encountered in military aviation. The stresses included hypoxia, rapid decompression, pressure breathing, vibration, climate extremes, G forces and the prolonged wearing of an aircrew respirator. Their visual performance wearing contact lenses under stress did not suffer significantly from the control values, either when wearing corrective flying spectacles or contact lenses when not under stress. It is considered that from the environmental standpoint, soft contact lenses are suitable for aircrew. As contact lenses may not be tolerated by all, and may cause undesirable side effects in

some, their use should be restricted to the aircrew to whom they offer the maximum advantages. The group most likely to benefit are young, well motivated myopic flying fast jets.

Brennan DH and Girvin JK : *Aviat Space Environ Med.* 56:43, 1985.

6. The effects of task performance on ocular accommodation and perceived size

Two studies were conducted to test the hypothesis that performance of cognitive tasks tends to induce outward shifts in ocular accommodation, that in turn results in changes in perceived size. In the first study 12 subjects participated in each of 4 conditions of rest or performance of a running memory task each with either visual or auditory stimuli. In each condition subjects made four size judgements and their mean accommodation was measured using an infrared optometer. Dark focus of accommodation was measured before and after the experiment. There were no reliable differences among the four conditions, nor between the pre and post experiment dark focus measures. A second study was conducted in which the accommodative state of 10 subjects was recorded during 4 min of rest and 4 min of performing a backward-counting task. The difference between the mean accommodative state during the last minute of rest and task performance approaches statistical reliability. It was concluded that outward shifts in accommodation may be associated with performance of tasks that involve distant targets (e.g., other aircrafts in the surrounding space) and / or require complex mental transformations

(e.g., predicting future position of an intruder aircraft relative to your own aircraft).

Gawrow VJ, Paap KR and Malmstorm FV :  
Aviat Space Environ Med. 56:225, 1985.

#### IV AVIATION OTORHINOLARYNGOLOGY

##### 7. Maxillary sinus barotrauma - case report and review.

A case is presented in which a mucous retention cyst that obliterated the right maxillary sinus caused symptoms due to pressure on two separate branches of the second branch of the fifth cranial nerve during a chamber dive to 112 ft. The symptoms of pain and numbness occurred at different times during and after the dive. Referred pain to maxillary teeth was due to pressure on the posterior superior alveolar branch and paraesthesia with numbness and tingling of the lip and cheek was caused from pressure in the infraorbital nerve prior to its emergence through infraorbital foramen. The symptoms resolved promptly in recompression treatment. The underlying mechanism for the production of sinus barotrauma and the causes of tooth and sinus pain are differentiated and a differential diagnosis of maxillary sinus opacities is schematized.

Cauzes LM : Aviat Space Environ Med.  
56:796, 1985.

#### V BEHAVIOURAL SCIENCES

##### 8. Arousal and stability: the effects of five new sympathomimetic drugs

suggest a new principle for the prevention of space motion sickness.

Sympathomimetic agents are frequent components in anti-motion sickness drug combinations because of their usefulness in counteracting the sedation caused by stressful motion or resulting from the administration of other anti-motion sickness drugs. The noradrenergic neurochemistry of the brain's arousal-attentional systems prompted us to evaluate the efficacy of five new sympathomimetic drugs and to further define the role of arousal in susceptibility to motion. Subjects were orally administered methamphetamine (20 mg), phenmetrazine (25 mg), phenteramine (37.5 mg), methylphenidate (20 mg) or pemoline (75 mg) two hours prior to taking a Staircase Profile Test. All of the drugs increased resistance to stressful coriolis stimulation by 80 to 120%. Methylphenidate and pemoline showed fewer side effects. These findings, interpreted in conjunction with the documented inefficacy of most anticholinergic and antihistaminergic drugs tested to date, suggest that sympathomimetic drugs or a generalized state of arousal can inhibit the development of motion sickness.

Kohl RL, Calkins DS and Mandel AJ :  
Aviat Space Environ Med. 57:137, 1986.

##### 9. Performance in shiftworkers operating a day-night schedule.

Performance was measured during the day (0800-1700 hours) and during the night (1700-0800 hours) of a day-night schedule, and the effect of caffeine (300 mg) was studied during the overnight periods of work. The

sleep electroencephalogram was recorded together with oral temperature and urinary electrolyte excretion. Impairment of performance within 9 h after the beginning of the daytime work period was minimal and was limited to a test continuous performance, but impairment of performance within 9 h after the beginning of the overnight work period was more pronounced and included lowered vigilance. Impaired performance overnight was related to time on task and circadian rhythmicity, and was alleviated somewhat by the use of caffeine.

Borland RG et al : Aviat Space Environ Med. 57:241, 1986.

#### VI CLINICAL AEROSPACE MEDICINE

##### 10. Prescription of diabetic diets in the 1980s.

A method is described to aid the prescription of diabetic diets, derived from newly available data for computation of metabolic rates of individuals. Absolute daily amounts of the main nutrients required to formulate diet of a patient are obtained from simple nomograms based on the patient's height and activity level. This system is more accurate and more flexible than currently accepted methods of dietary assessment and should lead to improved use of dietetic resources.

Lean MEJ and James WPT: The Lancet 723, Mar 29, 1986.

#### VII ENVIRONMENTAL PHYSIOLOGY

##### 11. Effect of physical activity and air velocity on thermal insulation clothing

Intrinsic thermal clothing insulation and surface air insulation were measured on human subjects by indirect calorimetry. Four male clothing ensembles (0.1-1.8 clo) and three female clothing ensembles (0.2-1.2 clo) were investigated. Using the standing position as reference, the influence of sitting, bicycling (40 rpm, 20 W), walking (3.75 Km/hour) and of light packing work on insulation was studied. The influence of an air velocity of 1.1 m/sec on thermal insulation during the standing and walking conditions was investigated. The results showed that: (i) intrinsic clothing insulation was maximal in the standing position. It was reduced by 8 to 18% in the seated position and by 30 to 50% during bicycling and walking. An air velocity of 1.1 m / sec did not influence the intrinsic clothing insulation during walking but decreased it by 18% in the standing position; (ii) Surface air insulation varied with activity and air velocity, but not with clothing. It was increased by up to 25% in the seated position, reduced by 7 to 26% during bicycling and by 30 to 50% during walking. An air velocity of 1.1 m / sec reduced the surface air insulation by 50% in the standing position and 30% during walking.

Ruth N, Bjarne WO and Ole Fanger P : Ergonomics 28(12):1617, 1985.

#### VIII EXERCISE PHYSIOLOGY

##### 12. Incompatibility of endurance and strength training modes of exercise.

Twentytwo male and female subjects trained for 7 weeks for endurance, for strength or for both strength and endurance to evaluate the effect of

concurrent performance of both modes of training on the in vivo force velocity relationship of human muscle and on aerobic power. The results indicate that concurrent training for strength and endurance does not alter the increase in aerobic power induced by endurance training only. In contrast, concurrent training reduces the magnitude of increase in angle-specific maximal torque at fast, but not slow, velocities of contraction.

Dudley GA and Djamil R : J Appl Physiol 59:1446, 1985.

13. Effect of acetazolamide on exercise performance and muscle mass at high altitude.

The effect of acetazolamide (Az) on exercise performance and muscle mass in acclimatized subjects at an altitude of 4846 m was assessed in 11 subjects and compared with effect of placebo on 10 other subjects. Exercise performance at 85% maximum heart rate fell by 37% in the Az group and by 45% in controls ( $p < 0.05$ ). Weight loss was greater in the placebo group at high altitude ( $p < 0.01$ ) and this correlated with the fall in exercise performance ( $p < 0.001$ ). During the expedition anterior quadriceps muscle thickness fell by 12.9% in the control group and 8.5% in the Az group ( $p < 0.001$ ) while biceps muscle thickness fell by 8.6% in controls and 2.3% in the Az group ( $p < 0.001$ ). Measurements of skinfold thickness indicated a loss of 18% of total body fat in the placebo group and 5% in the Az group by the end of the expedition ( $p < 0.001$ ). Caloric intakes at altitudes  $> 3000$  m were low and similar for the two groups.

The Az group had fewer symptoms of acute mountain sickness but differences between the two groups were not statistically significant. Acetazolamide is therefore useful for climbers and trekkers who are acclimatized to high altitudes. It could be most useful at extreme altitudes, where maintenance of exercise performance and muscle mass are important.

Bradwell AR et al : The Lancet(1):1001, May 3, 1986.

#### IX HUMAN FACTOR ENGINEERING

14. An overview of standards and guidelines for visual display terminals.

This paper provides a discussion of several standards and guidelines for designing of visual display terminal (VDT) workplaces. The material presents products of government agencies, commercial standards organisations and labour unions. Seven documents are reviewed: US MIL STD 1472-C, German DIN 66234, British HSE, Swedish ISO proposal, British APEX, US NYCOSH, and Australian ACTU-VTHC. There is considerable disagreement in the specification of design parameters in these standards. The issues are discussed in terms of their importance and the availability of supporting ergonomics research. There are several types of VDT tasks and the number and variety of applications are growing rapidly. Due to these factors and the development of new display technologies, different recommendations may be appropriate depending upon the task and the technology. Research and careful deliberation will be required to deal with this development.

Helander MG and Rupp BA : Applied Ergonomics 15.3:185, 1984.

15. Sitting posture:analysis of lumbar stress with upper limbs supported.

The analysis of lumbar stresses in the sitting posture is performed for situations in which upper limbs are fully or partially supported by a work table. A method is presented for biomechanical evaluation of moments and compressive forces acting on the lumbar intervertebral disc based on the use of a force platform, a TV Camera, and an integrated system for the elaboration of signals. The on-line pictures given by this equipment show the ground reaction vector superimposed upon the subject's image and allows a detailed analysis of the intervertebral loads. The results obtained in the subjects under study (six males and five females) are analysed statistically, and extrapolation on the basis of body weight is demonstrated to be possible in situations where the arm support forces are not known. The myoelectric activity of the erector spinae muscles was also assessed. The aim of the study was to furnish a tool that can be used in all occupational environments and will allow evaluation of the lumbar stresses in the sitting posture to be made with minimum use of complex equipment. An example of the practical application of this concept is presented.

Occhipinti E et al : Ergonomics 28(9): 1333, 1985.

16. Self reported anthropometry.

A short study of the relation

between self reported estimates of height and weight and their measured values is presented. In two male groups height was found to be significantly overestimated by 10.1 and 14.7 mm, respectively. Weight was significantly underestimated by 1.1 and 1.3 kg. Further analysis suggested that the tendency to underestimate weight increased with increasing measured body weight. Possible implications for ergonomists are considered.

Buckle PW : Ergonomics 28(11):1575 , 1985.

X SPACE MEDICINE

17. Wearing contact lenses in space shuttle operations.

More and more mission specialists are being trained to operate in the space shuttle and to eventually maintain a permanent station in space. Since up to 48% of the general population wears a visual correction of some sort, it is logical to assume that this percentage will also be found in the astronaut population. This paper proposes that the soft contact lens can be worn successfully in the space environment. The contact lens of choice is the continuous wear soft contact lens which is proving to be quite successful for the general public. These lenses must be fitted at least 6 months before space flight in order to make sure they can be worn successfully.

Hart IG : Aviat Space Environ Med. 56: 1224, 1985.