

## Abstract of Current Aerospace Medicine in Literature

### Acceleration Physiology

Njemanze PC, Antol PJ, Lundgren CEG. Perfusion of the Visual Cortex During Pressure Breathing at different High-G Stress Profiles. *Aviat Space Environ Med* 1993;64:396-400.

The effects of pressure breathing for G protection (PBG) on perfusion of the visual cortex were studied in a subject during various high-G stress profiles. Blood flow velocity was measured in the posterior cerebral artery using a transcranial Doppler (TCD) ultrasound instrument. The G profiles examined included gradual and rapid onset rates. Mean cerebral blood flow velocity (MCBFV) declined with increasing +Gz with G-suit protection alone. The MCBFV increased in direct proportion with increase in +Gz acceleration with PBG. The mediating mechanisms for the effects of PBG may include improved gaseous exchange, the diminished sympathoadrenal discharges, and cardiopulmonary reflexes. A role for TCD in further research is indicated.

McKenzie I, Gillingham KK. Incidence of cardiac dysrhythmias occurring during Centrifuge Training. *Aviat Space Environ Med* 1993;64:687-91.

High-G training has been reported to provoke dysrhythmias in many subjects. These reports have been based on small subject groups. Students attending aeromedical professional courses at the USAF School of Aerospace Medicine are offered the opportunity to participate in high-G centrifuge training on the Armstrong Laboratory centrifuge, during which ECG monitoring is routinely performed. This study documents the incidence of dysrhythmias in this large group of subjects. The pertinent information from the records of 1,180 training sessions from 1984-91 were transcribed to a database on a personal computer. Dysrhythmias were recorded in 552(47%) of the training sessions. Ventricular ectopy occurred in 480 (41%) of the sessions, and supraventricular dysrhythmias appeared in 127 (11%). In 53 (4.5%) of the sessions, training either was or would have been terminated because of the dysrhythmia. Session-terminating

dysrhythmias included: 26 ventricular tachycardias (2.2%), including 18 triplets (1.5%); 9 ventricular couplets (0.8%); 8 episodes of too-frequent ventricular premature beats (0.7%); 4 of supraventricular tachycardia (0.3%), including 2 with aberrant conduction (0.2%); 2 of aberrantly conducted beats (0.2%); and 4 of anomalous bradycardia (0.3%). Centrifuge training can provoke serious dysrhythmias in ostensibly healthy individuals, and ECG monitoring of aircrew undergoing such training is recommended for their safety. Because some of these dysrhythmias are disqualifying for aircrew duties, the need for a more lenient aeromedical disposition policy must be considered.

Hamalainen O, Vanharanta H, Kuusela T. Degeneration of cervical intervertebral disks in fighter pilots frequently exposed to high +Gz Forces. *Aviat Space Environ Med* 1993;64:692-6.

This study investigated the occurrence and the degree of cervical disk degeneration among senior fighter pilots frequently exposed to high +Gz forces, compared with nonexposed controls matched for age and sex. A resistive magnetic resonance (MR) scanner operating at 0.1 T was used to image the cervical intervertebral disks. Sagittal MR images were obtained and disk degeneration was graded 0-6. Both the occurrence and the median degree of disk degeneration were greater among the pilots than among the controls. The greatest difference in the occurrence of disk degeneration (grades 1-6), which also reached statistical significance, was detected for the C3-4 disks: 88% among the fighter pilots and 64% among the controls, respectively. With respect to the moderate degenerative changes (grades 3 and 4) in the C3-4 disk, the difference in the occurrence (88% vs 36%) was again statistically significant. There was no difference between the other disks. The median disk degeneration between the groups differed (2.0 vs 1.0), the difference being the most remarkable (3.0 vs 1.0) for the C3-4 disk. The differences in the median disk generation were also statistically significant. These findings

suggest that frequent exposure to high +Gz forces may cause premature disk degeneration.

Shamiss A, Meisel S, Rosenthal T. Acute hypertensive response to +Gz acceleration in mildly hypertensive pilots. *Aviat Space Environ Med* 1993;64:751-4.

Two fighter pilots with mild hypertension and a mildly hyper-tensive response to exercise underwent ambulatory blood pressure monitoring during a routine flight that included a brief exposure to +4 Gz stress. They exhibited an acute elevation of both systolic and diastolic blood pressures during +4 Gz stress: from 140/90 and 135/90 mm Hg to 179/139 and 180/140 mm Hg, respectively. Heart rate reached 182 and 132 beats/min. These responses of hypertensives may reflect exaggerated baroreceptor and sympathetic responses which cause a pronounced overshoot of blood pressure. The findings demonstrate the value of 24-h ambulatory blood pressure monitoring for documenting episodic elevations of blood pressure that do not influence the "normal" average blood pressure, but may nevertheless have important clinical implications.

#### **Aviation ENT**

Clarke AH, Telwes W, Oelhafen P, Scherer H. Three-dimensional aspects of caloric nystagmus in humans: i. the influence of increased gravito-inertial force. *Acta Otolaryngol (Stockh)* 1993;113:687-692.

The influence of increased gravito-inertial force on the horizontal, vertical and torsional components of caloric nystagmus response was examined. Video-oculographic (VOG) recordings were made on a group of 10 human subjects so that all three components of eye movement could be evaluated. The caloric nystagmus response at all tested g-levels included nystagmus components around all three rotation axes. Over the tested range of 1.0 g to 3.0 g, the results demonstrate that nystagmus intensity does not increase linearly with effective gravito-inertial force but appears to saturate at levels of 2.0 g and beyond. It is proposed that the vertical and torsional nystagmus components were elicited both by caloric stimulation to the (anterior) vertical canals and direct thermal mediation to the otolithic sensory cells. Vertical z-nystagmus response was also observed during centrifuge runs (previous to

caloric irrigation) at all g-levels and in all subjects. The caloric-induced vertical nystagmus response was also clearly recognisable. The observation of a reduction and inversion of nystagmus intensity during g-transitions agrees with earlier findings and is attributable to the stimulation by the canals during centrifuge acceleration, respectively deceleration.

#### **Aviation Neuropsychiatry**

McKinney EH Jr. Flight leads and crisis decision-making. *Aviat Space Environ Med* 1993;64:359-62.

Flight leads of fighter aircraft are typically considered to be superior airmen. However, little research has explicitly studied the decision-making ability of flight leads. In this study, the crisis decision-making of pilots in the role of flight lead is examined. Data from 156 fighter aircraft mechanical breakdown mishaps are used to compare the decision-making of flight leads to that of wingmen. The results suggest decision-making performance of flight leads is significantly inferior to wingmen. Further, we demonstrate this effect of flight leadership only affects experienced pilots, not inexperienced pilots. Explanations for this counter-intuitive finding include stress, training practices, and communication limitations.

Morrow D, Yesavage J, Leirer V, Dolbert N, Taylor J, Tinklenberg J. The time-course of alcohol impairment of general aviation pilot performance in a Frasca 141 simulator. *Aviat Space Environ Med* 1993;64:697-705.

This study examined the time-course of alcohol impairment of general aviation pilot simulator performance. We tested 14 young (mean age 25.8 years) and 14 older (mean age 37.9 years) pilots in a Frasca 141 simulator during alcohol and placebo conditions. In the alcohol conditions, pilots drank alcohol and were tested after reaching 0.10% BAL, and then 2, 4, 8, 24 and 48 h after they had stopped drinking. They were tested at the same times in the placebo condition. Alcohol impaired overall performance. Alcohol impairment also depended on the order in which subjects participated in the alcohol and placebo sessions, with larger decrements for the alcohol-placebo order than for the opposite order. To examine the influence of alcohol independent

of session order effects, we compared performance in the first alcohol sessions with performance in the first placebo session. This analysis showed that alcohol significantly reduced mean performance in the alcohol condition at 0.10% BAL and at 2 h. In addition, alcohol increased variability in performance in the alcohol session from 0.10% BAL to 8 h, suggesting that some subjects were more susceptible to alcohol than others. Older pilots tended to perform some radio communication tasks less accurately than younger pilots.

### *Aviation Psychology*

Yacovone DW. Mishap trends and cause factors in naval aviation: a review of naval safety centre data, 1986-90. *Aviat Space Environ Med* 1993;64:392-5.

Although the mishap rate in naval aviation has declined substantially over the period from 1950-90, there remains a residual number of mishaps per 100,000 flight hours. Many of these mishaps represent human error. There seems to be an additional risk in certain air-frames and in specific missions. We reviewed mishap trends and causes for all naval aircraft over a 4-year period, 1986-90. These were graphically represented and compared, both statistically and with other methods. The mishap rates contained a significant portion of aircrew error mishaps. Of 308 total Class A mishaps, 179 (58%) were attributed to aircrew error. There were 145 (47%) attributed to supervisory error, another form of human mistakes. Thus, the most common cause factors were directly related to human failure. The effect on training is already being seen with the establishment of aircrew coordination training as one of the top priorities in the Fleet Replacement Squadrons. Studies, both underway and in press, appear to indicate a positive response to this training.

Nye LG, Collins WE. Some personality and aptitude characteristics of air traffic control specialist trainees. *Aviat Space Environ Med* 1993;64:711-6.

This study examined the interrelations of personality traits, aptitude test scores, and job performance self-expectations as predictors of success in the FAA Academy screening program of prospective air traffic controllers. Based on the

State-Trait Personality Inventory (STPI), men and women Air Traffic Control Specialist (ATCS) trainees exhibited less anxiety and anger than normative groups of college students and Navy recruits. ATCS pass rates for 1,284 entrants were lower within each aptitude test score level for the subjects with anxiety or anger scores above the normative levels. Analyses indicated significant relationships between self-expectations of future job performance and both anxiety and aptitude test scores. Personality factors were found to affect the predictive validity of the primary test used for determining a student's aptitude for learning air traffic control principles and procedures.

Clark JB. Risk Assessment and clinical aeromedical decision-making. *Aviat Space Environ Med* 1993;64:741-7.

This article presents a format of aeromedical decision-making used in neurology cases referred to a U.S. Navy Special Board of Flight Surgeons (SBFS) from 1988 to 1990. The format consists of a series of questions addressing aeromedical concerns, an aeromedical disposition flowchart, and a decision analysis tree. Decision Analysis is a tool used in clinical medicine to assist decision-making under conditions of uncertainty. The Decision Analysis approach may be applied to complex aeromedical disposition questions that face flight surgeons. The concept of risk assessment as it applies to decision-making and aeromedical disposition is discussed. The outcome of 24 neurology cases referred for aeromedical disposition are presented.

### *Aviation Ophthalmology*

Markovits AS. Photo-refractive keratectomy (prk): threat or millennium for military pilots. *Aviat Space Environ Med* 1993;64:409-11.

The development of the excimer laser, which is capable of correcting myopia without leaving obvious scars as does radial keratotomy, makes it certain that this promising but very new modality is something the military aviation community will be facing in the immediate future. Methods of detection are available, but are expensive and time-consuming. Should military aviation permit or even sponsor a group of PRK

student pilots in order to observe them closely, and then perhaps use this new modality in place of contact lenses or even spectacles?

Mittelman MH, Siegel B, Still DL. Contact Lenses in Aviation: The Marine Corps Experience. *Aviat Space Environ Med* 1993;64:538-40.

In an attempt to limit safety and health risks, Naval Aeromedical Policy has historically prohibited the use of contact lenses in the Navy and Marine Corps Class 1 Aviation Personnel (pilots), approximately 18% of whom require spectacles. Recent technological advancements have rendered spectacles functionally incompatible with some mission-essential masks, goggles, and imaging devices, thus forcing a re-examination of existing policy. Recent US Army and US Air Force aviation studies favorably compare the performance of contact lenses to spectacles. In order to test the application of contact lenses in the unique US Marine Corps Aviation environment, encompassing shipboard, land based, and forwardly-deployed units, 90 aviation personnel assigned to several deploying squadrons were evaluated for contact lenses; flex-wear disposable lenses were the primary modality of choice. Of the subjects, 68 (73%) were successfully fit and continued contact lens wear for a period of 16 months. Safety and health were not compromised, and job performance was favorably affected. No cases of ulcerative keratitis or vision loss were reported. The first US Marine Corps aviation contact lens study supports the growing belief that contact lenses can be safely and effectively applied in the critical and hazardous aviation environment.

Mork MR, Watson LA. Prevalence of corrective lens wear in Royal Australian Air Force flight crews. *Aviat Space Environ Med* 1993;64:541-5.

This study was undertaken to determine what effect the Royal Australian Air Force's (RAAF) restrictive entry visual standards have on the prevalence of corrective lens wear in its aircrew. A 100% review of RAAF aircrew medical documents was conducted to determine the prevalence of corrective lens wear (spectacles and contact lenses) among pilots, navigators, flight engineers, loadmasters, and airborne electronics analysts. The prevalence of corrective

lens wear by aircrew in the RAAF was then compared to that published for their counterparts in the USAF. Entry visual refraction standards for the RAAF and USAF were compared and related to the prevalence of corrective lens wear in each Service. Age data for RAAF aircrew were also compared to the requirement to wear corrective lenses. The study's findings indicate that the RAAF's restrictive visual refraction standards for entry into aircrew training programs significantly reduced the prevalence of corrective lens wear among all crew positions when compared to the USAF. A discussion is presented which relates the medical wastage associated with a restrictive visual standards policy and the operational implications of such a policy.

Rabin J. Spatial contrast sensitivity through aviator's night vision imaging system. *Aviat Space Environ Med* 1993;64:706-10.

Visual acuity is often used to assess vision through image intensifying devices such as night vision goggles (NVG's). Fewer attempts have been made to measure contrast sensitivity through NVG's. Such information would be useful to better understand contrast processing through NVG's under various stimulus conditions. In this study, computer-generated letter charts were used to measure contrast sensitivity through third generation NVG's for a range of letter sizes. The red phosphor of a standard color monitor proved to be an effective stimulus for third generation devices. Different night sky conditions were simulated over a 3 log unit range. The results illustrate the profile of contrast sensitivity through third generation NVG's over a range of night sky conditions. Comparison of measurements through NVG's to measurements obtained without the device but at the same luminance and color distinguish between effects of luminance and noise on contrast sensitivity.

### *Cardiovascular Physiology*

Hildebrandt W, Shutze H, Stegemann J. Higher capillary filtration rate in the calves of endurance-trained subjects during orthostatic stress. *Aviat Space Environ Med* 1993;64:380-5.

The effect of endurance training on the rate of transcapillary filtration during orthostasis was studied in the human calf. Two groups of sports

students with markedly different aerobic capacities performed an orthostatic tilt table test (25 min supine, 10 min upright, 10 min supine). The following parameters were measured: heart rate, brachial and peripheral blood pressure (Finapres<sup>(T/M)</sup>), calf volume changes (impedance), and calf blood flow (venous-occlusion-technique). The two groups did not differ in maximal calf circumference, body height, or weight. No syncope occurred, and heart rate and blood pressure responses to upright tilt were similar in both groups. However, the capillary filtration rate revealed much higher values in the trained group: 0.086 vs 0.036 ml.min<sup>-1</sup>. 100ml<sup>-1</sup>. The estimated additional fluid accumulation in the interstitial space in trained subjects may be as high as 260 ml within the first 20 min of orthostasis and may play a role in often reported late syncopes, depending on the preexisting fluid state.

#### *Clinical Aviation Medicine*

Warburton R. Case Report: chronic sub-dural hematoma following high-speed ejection. *Aviat Space Environ Med* 1993;64:534-7.

This paper reports a case of chronic sub-dural hematoma occurring in a pilot after a high-speed ejection that was within the survival envelope of the Mark 10 Martin Baker ejection seat. The events leading up to the ejection, his subsequent hospitalisation for treatment of immediate injuries and late development of neurological signs, 6 weeks after the ejection, are presented. (A thorough search of literature has failed to reveal any previously published account of chronic sub-dural hematoma as a post-ejection complication.) His surgical treatment, recovery, and final assessment are discussed together with the possible cause of his sub-dural hematoma. Flight surgeons should take careful note of the events in this case. Sub-dural hematoma is frequently difficult to diagnose but it should not be discounted as a potential late complication from an ejection which is within the parameters of survivability and which yields, initially, only signs of relatively minor injury.

#### *Space Medicine*

Benke TH, Koserenko O, Watson VV, Gerstenbrand F. Space and cognition: the measurement of behavioural functions during a 6-day space mission. *Aviat Space Environ Med* 1993;64:376-9.

We measured nonspecific (attention, mental flexibility, psychomotor speed) and visuospatial cognitive processing in a single case study during a 6-d visit on the Russian orbital complex MIR, using computer-based psychometric tasks. Reaction times and accuracy scores showed only minor, nonsignificant changes between preflight, flight, and postflight assessments. These results suggest that several behavioral functions, among them complex visuospatial processing skills, remain essentially intact on short space visits, provided that the performing subject experiences no symptoms of space motion sickness or other physical impairments. Computerized psychometric tasks are a sensitive and flexible tool to measure behavioral functions in space sciences.

Davis BL, Cavanagh PR. Simulated reduced gravity: a review of biomechanical issues pertaining to human locomotion. *Aviat Space Environ Med* 1993;64:557-66.

In the decade preceding Apollo missions to the Moon, extensive studies were conducted on human locomotion in reduced gravity. These investigations focused primarily on issues of maneuverability and energy expenditure and not on musculoskeletal loading, which is of more interest to planners of long duration space missions. The techniques have included water immersion, parabolic aircraft flights, supine and erect cable suspension and centrifugal methods. The practical implications of the findings from these studies are: 1) the present shuttle treadmill running surface would not suffice if one wanted to run with a natural style at levels greater than 0.6 G; 2) in terms of attempting to replicate typical ground reaction force profiles during locomotor exercise at reduced gravity levels, it appears as though it is easier to match the peak rates of change of force (max DFDT) than it is to match values for the peak force magnitudes (max GRF).