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Monday, 16 September 2002 - 8:30 am

OPENING CEREMONIES & ALLARD LECTURE

THE ROYAL FLYING DOCTOR SERVICE: WHERE HAS IT BEEN, AND WHERE IS IT GOING?
DR MICHEAL LONG

Monday, 16 September 2002 - 11:00 am

CLINICAL AVIATION MEDICINE - GRAND ROUNDS 1

1. MILITARY FLYING FOLLOWING MITRAL VALVE REPAIR

A J BATCHELOR

Mitral leaflet prolapse (MLP) is a common valvular anomaly with a reported adult prevalence of up to 5% in most series. A small subgroup of individuals with MLP, particularly those with thickened and redundant valve leaflets, are at risk of developing significant mitral regurgitation (MR). Degenerative valve disease of this type is now the commonest cause of progressive MR in the Western world and has the potential to terminate a flying career. Treatment with mitral valve replacement in these cases is disqualifying for all classes of flying because of the additional risks associated with oral anticoagulation. However, a favourable prognosis following surgical repair to the valve in a subset of individuals may allow a safe return to restricted flying duties in the multicrew environment. The cases of two military aviators treated with mitral valve repair for progressive MR are described and the evidence upon which the subsequent aeromedical risk assessments were based is reviewed. It is concluded that patients with good left ventricular function, near normal left heart dimensions and a good functional result six months following mitral valve repair, may be considered for recertification restricted to the multicrew environment. Such individuals would need to be in sinus rhythm, to show no propensity to atrial fibrillation on ambulatory ECG monitoring, and to have a normal exercise tolerance without induced arrhythmias. Furthermore, they would require regular follow up at intervals not exceeding one year.

2. VENOUS THROMBOEMBOLISM IN AIRCREW – A STUDY OF THE INCIDENCE IN AIR TRAFFIC CONTROLLERS

R V JOHNSTON, ADBE EVANS

Introduction

There have been continuing concerns in the literature and lay press as to whether there is an association between air travel and venous thromboembolic disease (VTE). We have, however, previously reported a low incidence in pilots (0.21/1000/year) compared to that in the general population (1.6 – 1.8/1000/year). Air Traffic Controllers' medical standards are similar to those of professional pilots but they are not exposed to the aircraft cabin and thus they present a suitable control group for study.

Methods

A review of the medical records held within the UK Civil Aviation Authority's computerised system.

Results

The database of the CAA has the records of 3099 air traffic controllers and in the years 1990-2000 there were 4 cases of VTE (1.29/1000). This yields an approximate incidence of 0.12/1000/year. All the cases, which will be presented in detail, had well documented risk factors: trauma, severe infection, prolonged bed rest and recent surgery. Most importantly the incidence was not significantly different from that found in pilots.

Conclusions

This low incidence in a control group with similar medical fitness standards of pilots, would add further weight to the view that VTE is multifactorial and not solely due to factors in the aircraft cabin.

3. DIAGNOSIS AND CLINICAL IMPLICATIONS OF WHITE COAT HYPERTENSION IN AIRCREW

Gp Capt RK Ganjoo VSM - Classified Specialist (Medicine & Haematology), AFCME, Subroto Park, New Delhi 110010, India & Air Cmde (Mrs) P Bandopadhyay AVSM VSM - AOC, AFCME, Senior Advisor (Aerospace Medicine)

Introduction. White Coat Hypertension (WCH), a high blood pressure recorded in the clinic with normal ambulatory blood pressure monitoring (ABPM) using automated devices, is a relatively common observation in hypertensive subjects and the general population at large.

Methods. In the present study, 55 asymptomatic aircrew (37 professional civil pilots and 18 military aviators), not on any medication, were detected to have elevated blood pressure recordings, suggestive of hypertension (clinic recording of systolic/diastolic BP greater than or equal to 140/90 mmHg), at the time of periodic medical evaluation for fitness for flying. They were subjected to 24 hr ambulatory BP monitoring with a view to differentiate the truly hypertensive from those with WCH. The evaluation also included a thorough clinical examination with fundoscopy, biochemical analysis, ultrasonography of the abdomen and a detailed cardiac evaluation, to exclude secondary causes of hypertension and to assess for evidence of target organ evaluation.

Results. WCH was observed in 35 subjects (63.6% of the aircrew evaluated). None of them had any evidence of target organ involvement in the form of hypertensive retinopathy, renal involvement, concentric left ventricular

hypertrophy or left ventricular dysfunction on Echocardiography.

Conclusion. WHC is definitely more common among professional aviators when compared to the population at large. Prospective follow up studies however need to be done to assess whether these subjects of WCH are at a higher risk for cardiovascular dysfunction or target organ involvement, thereby necessitating periodic follow up and early therapeutic intervention.

Keywords. White Coat Hypertension, Ambulatory Blood Pressure Monitoring.

4. HYPERBARIC OXYGEN THERAPY. A ROLE IN ISCHAEMIC RETINAL PATHOLOGY?

J.E. RISDALL

Introduction. This clinical case report describes the use of hyperbaric oxygen therapy, as an adjunct to conventional ophthalmic care, in a pilot with chronic retinal vein occlusion. Clinical Report. A 28 year old military transport pilot presented in December of 2000 with visual loss arising from a left central retinal vein occlusion (CVRO). By January 2001 vision in the left eye had improved to 6/9 and fluorescein angiography showed no sign of ischaemia. A battery of investigations identified no predisposing factors. However, the following month he suffered a further exacerbation of his visual problems and his left eye became markedly ischaemic. He received pan-retinal laser photocoagulation to his left eye to control this, together with a course of oral steroids. Four months later his retina remained ischaemic and oedematous centrally, albeit with evidence of peripheral resolution. He was therefore referred for elective hyperbaric oxygen therapy. Although this condition is not included in the Undersea and Hyperbaric Medical Society's list of approved indications, there are a number of case reports which suggest that such patients may achieve some benefit from hyperbaric oxygen. He received a total of 20 hyperbaric treatments at 2.4 bar (14msw) for 90 minutes (RN Table 66) with good effect. This resulted in a marked reduction in retinal oedema and ischaemia as demonstrated on fluorescein angiography and an improvement in visual acuity. Subsequently, however, he suffered a further relapse with substantial loss of visual acuity and no spontaneous recovery. Aeromedical Disposal. Despite the deterioration in this pilot's left retina and loss of vision he has been returned to flying duties but cleared only to operate as or with co-pilot. Conclusion. Idiopathic CVRO in young people often resolves spontaneously with a good result. Unfortunately, in this case, the condition was aggressive and relapsing. Despite both conventional and hyperbaric therapy, retinal function in the left eye was ultimately severely compromised.

5. DRUG EFFECTS ON PILOT PERFORMANCE: NICOTINE, DONEPEZIL AND ALCOHOL

M. S. MUMENTHALER, J. L. TAYLOR, R. O'HARA, L. FRIEDMAN, H. LEE, J. A. YESAVAGE

Introduction: The cholinergic system plays an essential role in memory, learning, and attention, cognitive abilities relevant to piloting an aircraft. In previous studies, drugs that enhance the cholinergic system through different pharmacologic mechanisms have shown beneficial effects; but dissimilar cognitive measures were used. A comparison within the same cognitive tasks, within comparable samples appears desirable. Toward this aim, we compared effect sizes (ES) of therapeutic doses of nicotine (a nicotinic receptor agonist) and donepezil (an acetylcholinesterase inhibitor) as found in our prior work on pilot performance. We also compared cholinergic ES to those of alcohol. Methods: In three randomized, placebo controlled trials, we tested the flight performance of aircraft pilots in a Frasca 141 simulator. I: Crossover, double-blind study (n=16) testing the acute effects of nicotine gum 2 mg. II: Parallel group double-blind study (n=18) testing the effects of administration of 5 mg donepezil/day for 30 days. III: Parallel group single-blind study (n=13) testing the acute and 8h-hangover effects of alcohol after a target peak BAC of 0.10%. We calculated the ES of nicotine, donepezil, and alcohol on a flight summary score and 6 flight component scores (take-off, ATC communication, traffic avoidance, emergencies, approach, landing). Results: Compared to placebo, nicotine and donepezil improved while alcohol impaired overall flight performance significantly: ES (nicotine)=0.80; ES (donepezil)=0.58; ES (alcohol acute)=-3.31; ES (alcohol 8h)=-0.77). Both cholinergic drugs showed the largest effects on flight tasks requiring sustained attention - nicotine on approach (ES=0.60), and donepezil on approach (ES=0.52) and emergencies (ES=0.56). Acute alcohol intoxication mainly impaired performance on communication (ES=-1.15), emergencies (ES=-1.46) and approach (ES=-1.37). Conclusions: Though the two tested cholinergic drugs have different pharmacologic mechanisms, their effects on flight performance were similar in kind and size. The acute effect of alcohol was 4-6 times larger than the effect of the cholinergic drugs on overall flight performance and the 8h-hangover alcohol effect was about the same size as the effects of the cholinergic drugs.

6. THE DIABETIC TRAVELER

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Air travel is a popular and familiar way of travelling nowadays, with millions of people traveling by air each year. Many of these people travel with a co-existing disease. Type 1 diabetes mellitus is one such common disease. Air travel, especially during long haul flights, entails crossing multiple time zones often with enroute stops, which will result in a shift of the person's circadian rhythm. This shift in circadian rhythm will necessitate readjustment of the traveller's insulin dosage scheme.

Type I diabetic patients are affected by many factors during air travel. These include irregular meals on board the airplane and the number of transit stops involved in their flight. Some studies have shown that doctors are not always able to adequately deal with these cases. A study done in England in 1993 where different flight situations were taken into consideration showed that the response rate of doctors was only 37%, 6% of their replies were

unhelpful, 14% were liable to result in hypoglycemia, 13% advised a change to a "basal bolus" system, while the rest of the replies were variations on the theme of additional insulin for westward flight and reduced insulin for eastward flight.

Every doctor treating diabetics should be aware of the importance of readjusting their patients' insulin dosage during traveling especially long distance air travel. This can mean giving a supplement of short acting insulin in eastward flights according to the glucose level readings, and adding short acting insulin later in the day in westward flight. In this way Type I diabetics can be managed when they travel on long-haul journeys crossing multiple time

Monday, 16 September 2002 - 1:30 pm

AEROSPACE PHYSIOLOGY

7. IMMUNE FUNCTION IN MICROGRAVITY: LYMPHOCYTE LOCOMOTION AND SIGNAL PERTURBATION.

A.SUNDARESAN1, D.RISIN2 AND N.R.PELLIS2.

Introduction: Immune suppression in microgravity is of serious concern in the era of the ISS. Long-term space travel/residence requires optimal performance of the immune system. Both spaceflight and ground based experiments have documented problems in human immune function. Locomotion of immune cells is critical for their function. This is significantly inhibited in microgravity. Restoration of Protein Kinase C (PKC) activity by the phorbol ester PMA (phorbol myristate acetate), could restore locomotion by upto 87% (Sundaresan et al, 2002). Status of upstream molecules in lymphocyte signaling such as Phospholipase C gamma 1(PLC-g1) and its transmembrane activator LAT (linker for activation of T cells) were investigated. These molecules are crucial for generation of DAG (diacylglycerol) which is a major cellular PKC activator.

Methods: Human peripheral blood mononuclear cells (PBMCs) were isolated and cultured under 1g and microgravity analog conditions (NASA Bioreactor). Cells were sampled over 4 days and total cellular protein was isolated. Immunoprecipitation and immunoblotting were then employed to quantitatively detect upstream signaling molecules.

Results: PLC-g1 was not sufficiently activated in modeled microgravity (inhibition>60%). Inactive PLC-g1 accumulated in microgravity. Immunoblotting revealed that LAT, which is an adaptor protein crucial for Phospholipase C gamma recruitment in T cell activation, was significantly down regulated in lymphocytes cultured at 72 and 96 hours in modeled microgravity.

Conclusions: Both upstream molecules explored were negatively regulated in analog microgravity conditions. This indicates transmembrane and internal signal perturbation in the lymphocyte. The delineation of signaling defects in microgravity would be instrumental to the fund of scientific knowledge and the design of countermeasures for optimal immune function in microgravity.

8. A COMPARATIVE ASSESSMENT OF TWO TECHNIQUES FOR INVESTIGATING CARDIOVASCULAR REFLEXES UNDER ORTHOSTATIC STRESS

C.A RICKARDS, D.G NEWMAN

Introduction. Head-up tilt (HUT) has been widely used as an orthostatic challenge for investigating cardiovascular reflexes in the clinical and research settings. The squat-stand test (SST) has recently been introduced as an alternative to HUT. This study aimed to determine whether these two orthostatic tests produce equivalent cardiovascular challenge. Methods. Eleven females and thirteen males underwent +750 head-up tilt (HUT) and a squat-stand test (SST). Mean arterial pressure (MAP) and heart rate (HR) were determined non-invasively. Data were recorded on a beat-to-beat basis 10 sec prior to (control) and 10 sec after tilt or stand (event) for the HUT and SST respectively. Event MAP and HR responses were compared and analysed by calculating the deviation from control for both variables. These values were then used to assess correlation and agreement between the two orthostatic challenges. Results. The average MAP responses to HUT and SST were -11.6 ± 2.0 mmHg and -24.8 ± 1.8 mmHg respectively ($p < 0.01$). The average HR responses for HUT and SST were not significantly different. For the two tests, HR and MAP were poorly correlated ($r = 0.31$ and $r = 0.16$ respectively), and demonstrated poor agreement. Conclusions. This study suggests that HUT and SST are two physiologically different orthostatic challenges. It appears that the active nature of the SST leads to more pronounced arterial blood pressure changes compared to the passive nature of HUT. As such, the SST represents a more exaggerated orthostatic challenge.

9. INFLUENCE OF b2 ADRENERGIC RECEPTOR HAPLOTYPE ON AIRWAY FUNCTION DURING EXERCISE IN HEALTHY ADULTS

BD Johnson, JR Hickman, KC Beck, ST Turner, MJ Joyner, NM Dietz

Introduction: Factors accounting for the variability in airway changes during exercise in healthy adults remain unclear. The beta 2 adrenergic receptor (b2AR) has been shown to influence airway smooth muscle. Interestingly, there are a number of common polymorphisms that may influence this receptor and subsequently airway tone. Recently Drysdale and colleagues (Proc. Nat'l Acad.Sci. 2000;vol 97:10483-10488) have assessed all b2AR polymorphisms in a large sample and found 5 common haplotype pairs (2/2, 2/4, 2/6, 4/4, 4/6) in the population. Methods: We inferred b2AR haplotypes using a combination of genotyping alleles 16 and 27, the known haplotype frequencies, and the known disequilibrium between alleles 16 and 27. This technique yielded an accuracy of 80 –

100%. To determine if b2AR haplotype influences airway function during exercise, 28 healthy non-asthmatics, (haplotype 2/2 n=5, 4/4 n=11, 2/6 n=10, 6/6 n=2, age=30, VO₂max= 24-44 ml/min/kg) performed maximal expiratory flow-volume maneuvers to determine forced expiratory volume at 50% of vital capacity (FEF50) while exercising at 40% (8 min) and 75% (to exhaustion) of their peak achievable work levels. Baseline responses to bronchodilator were also measured.

Results: Haplotype 4/4 tended to have a reduced baseline response to bronchodilators (4% increase in FEF50 vs 11, 12 and 25% increase for haplotypes 2/2, 2/6 and 6/6, p<0.05). During exercise FEF50 increased from 30% to 57%, with haplotype 4/4 demonstrating the least increase in airflow (30%). After 10 min recovery from exercise, FEF50 returned to pre-exercise values in haplotype 4/4, but remained elevated in the other haplotypes (remaining higher than pre-exercise levels by 10 to 18%).

Conclusion: These data suggest that b2AR genotype influences airway function during and post exercise. Haplotype 4/4 subjects appear to show less airway accommodation to exercise.

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10. EXERCISE AND USE OF DOPPLER ULTRASOUND IN THE PREDICTION OF DECOMPRESSION SICKNESS

BELTRAN, E.(1), BUTLER, B. (2), FIFE, C.(2) , DELCLOS, G (3).

Astronauts performing extravehicular activities (EVA) are at risk for occupational hazards due to a hypobaric environment, in particular Decompression Sickness (DCS). Denitrogenation achieved through lengthy staged decompression protocols has been the mainstay of prevention of DCS in space. Due to the greater number and duration of EVAs for International Space Station more efficient alternatives are desirable.

This multi-center (NASA-Prebreathe Reduction Protocol study " PRP") was designed to identify shorter denitrogenation protocols that could be implemented before an EVA, based on the combination of adynamia and exercise-enhanced oxygen prebreathe. Human volunteers underwent three different combinations of intense and light exercise prior to decompression in an altitude chamber. The outcome variables were detection of venous gas embolism (VGE) by precordial Doppler ultrasound, and clinical manifestations of DCS.

Ten percent of the subjects developed DCS and 20% showed evidence of high grade VGE. No cases of DCS occurred in one particular RPP phase with use of the combination of dual-cycle ergometry (10 minutes at 75% of VO₂ peak) plus 24 minutes of light EVA exercise (p=0.04). High grade VGE showed a strong correlation with subsequent development of DCS (sensitivity, 88.2 %; specificity, 87.2%). In the presence of high grade VGE, the relative risk for DCS ranged from 7.52 to 35.0.

In summary, a good safety level can be achieved with exercise-enhanced oxygen denitrogenation that can be generalized to the astronaut population. Exercise is beneficial in preventing DCS if a specific schedule is followed with an individualized VO₂ prescription. VGE Doppler detection is a useful clinical tool for prediction of altitude DCS. Because of the small number of high-grade VGE episodes, the identification of a high probability DCS situation based on the presence of high grade VGE seems justified in astronauts.

11. A PRELIMINARY STUDY OF APRL MANEUVER FOR FACILITATING RECOVERY FROM VESTIBULAR ILLUSIONS: PART I

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INTRODUCTION. Spatial disorientation (SD) is the most common cause of fatal class A mishaps in the Air Force. It continues to be a stealthy killer in aviation operation. To address this problem, an APRL maneuver was empirically developed by our laboratory. This special technique involves repeated explosive yelling "hah" (no less than 120 dB) and intervened with a short inhale, which is similar to some oriental martial arts including karate and taekwondo in the phase of attack. METHODS. A SD (Vertifuge) was adopted for generating otolith-based flight illusions. For this purpose, the cockpit was placed in three different horizontal positions including head-in, head-out, and head-tangential. The maximal G level was 1.3 G during each acceleration profile. In these studies, 209 trainees were randomly instructed to glare at the attitude indicator with yelling or no yelling while tilt (fore and aft) or bank (right) illusions onset. The recovery time from various illusions was counted according to the vocal reports from the subject. RESULTS. When performing APRL maneuver, there were 62.1%, 58.3%, and 84.6% of helicopter pilots recovered significantly earlier from three exposures than doing nothing (time reduced from 9.4 % to 19.1%). Similarly, there were 77.3%, 91.7%, and 70.6% of fighter pilots also significantly acquired benefit from APRL maneuver during their three trials (time reduced from 13.1% to 31.5%). We also noticed that three separated yelling was much more effective than a simple yelling or several continuous yelling in regaining spatial orientation. CONCLUSION. The preliminary data confirmed the use of APRL maneuver could subside the somatogravic illusion to some extent. But the trainees need to be coached performing the maneuver properly. The underlying mechanism also remains to be determined by further clinical studies.

12. A PRELIMINARY STUDY OF APRL MANEUVER FOR FACILITATING RECOVERY FROM VESTIBULAR ILLUSIONS: PART II

CHIEN-LIANG CHEN, TE-SHENG WEN, and MIN-TE LEE - Aviation Physiology Research Laboratory, Armed Force Kang-Shan Hospital Koa-Hsiung 820, Taiwan

INTRODUCTION. To extend the previous study, our laboratory has conducted human experiments for testing the

effectiveness of APRL while exposed to Coriolis force. Besides, unpleasant tumbling during deceleration is the universal side effect reported by human centrifuge riders. So we investigated how APRL maneuver might overcome this type of oculogyral illusion. METHODS: Total 78 trainees voluntarily participated this study. Two SD demonstrators (Vertifuge and Vertigon) were adopted for generating the mixed type of vestibular illusion and Coriolis illusion. The former operation comprised 30° pitch-up, 30° pitch-down, and then level-off after reaching a plateau angular velocity. The latter operation was to expose the subject to cross-coupled stimulation of the semicircular canals by pushing a button on the lower panel. The subject was randomly instructed to utter three yelling or not while suffered from SD. The same strategy was also encouraged using at the moment of centrifuge offset. The time consumed for orienting was counted based upon the vocal report or gesture from the subject. RESULTS. When performing APRL maneuver, we found 54.8% of trainees recovered from the multiple vestibular stimulation significantly earlier than keeping silence (time reduced from 8.3% to 72.4%). The same result was also observed in the case of Coriolis illusion with 80.0% success (time reduced from 4.7% to 80.0%). In addition, 95.2% of centrifuge riders reported its positive effect on motion sickness (time reduced from 21.2% to 80.0%). CONCLUSION. APRL maneuver seems to be a potential countermeasure for reducing SD recovery time or diminishing the comfort caused by centrifuge deceleration. Perhaps the yelling component could awaken the reticular activating system in the brain stem and override the vestibular ascending impulse. This hypothesis needs to be tested by further related studies.

Monday, 16 September 2002 - 3:20 pm

OCCUPATIONAL, ENVIRONMENTAL & TRAVEL MEDICINE

13. THE IMPACT OF ZAGREB AIRPORT ON PEOPLE AND ENVIRONMENT

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Summary: Zagreb Airport has been operating on its present location (17 km SE of Zagreb on a surface of 300 ha) for four decades. It has used the existing spatial capabilities for development almost to the full extent. Zagreb Airport will develop on the principles of viable development. That involves preserving the environment which is of much interest for future generations. The circumstances of further building and spreading have to be defined. The analysis and results of the research connected with the contamination of water and soil, and the exhaust gases as well as the measures of prevention are presented in the paper.

Zagreb Airport with the current traffic volume does not impose a burden on the environment more than other polluters in the vicinity, such as the Zagreb industrial facilities and local roads. The only real danger by Zagreb Airport is to the drinking water well Crnkovec, in case of incidents with possible spilling of aircraft fuel on the runway and taxiway and the Zagreb environment. Taking into consideration that the drainage system of the Zagreb Airport runway has not been solved yet, it is obvious that the existence of an adequate "Emergency Plan" is of vital significance for the airport and the surrounding area. It is necessary to insure both preventive measures, and, in case of trouble, all the necessary measures to protect the water supply areas. Teams should be trained for timely action in repairing the polluted soil by digging and removing. If Zagreb Airport is expanded and the second runway built, it is necessary to make a good estimate of the impact on the environment in all phases.

Key words: Zagreb Airport, water supply area, water wells, pollution, traffic-generated emissions

14. AIRCRAFT DISINSECTION

RUSSELL B. RAYMAN, M.D.

Aircraft disinsection has been an international practice since the 1920's. Its purpose is to protect public health, the environment, agriculture, and livestock by the eradication of disease vectors. Many nations of the world have discontinued this practice over the years based upon their belief that it is unnecessary while others cite outbreaks of airport malaria and runway malaria as reasons to continue the practice.

Aircraft disinsection is sanctioned by international law with the World Health Organization (WHO) publishing in the International Health Regulations general guidelines for its implementation. There are currently four acceptable procedures for aerosol spraying: blocks away, top of descent, on arrival, and residual. The pyrethroid family, 2% pyrethrum or 2% permethrin, is the recommended agent because it is an extremely effective insecticidal while posing a minimal health risk to passengers and crew. Nevertheless, a few cases of asthmatic-like symptoms and skin rash have been reported allegedly due to exposure onboard aircraft. Although other harmful effects, particularly neurotoxic, have been found in laboratory animals, there is no evidence of this in human beings exposed to low concentrations of pyrethroids as currently utilized in aircraft. Although the use of insecticides for aircraft disinsection is controversial, national policies compelling this requirement must be respected.

This paper will explore the background of aircraft disinsection, the procedures, the types of agents, the toxicity, and conclude with recommendations.

15. PRÉVENTION DES RISQUES SUR PISTE D'AÉROPORT : 3) LA CIRCULATION 4) LES CHUTES DE HAUTEUR

PREVENTION OF AIRPORT HAZARDS ON TARMAC : 3) TRAFFIC 4) FALL DOWN WORKING

JP Donne

Introduction : Après le bruit et la pollution traités lors du 49ème CIMAS à Genève, et dans le but de prévenir les autres risques rencontrés dans les aéroports, les accidents dus à la circulation en piste et aux chutes de hauteur parmi les agents AF du Hub de CDG ont été étudiés. L'aéroport de CDG comme d'autres aéroports dans le monde est devenu une importante plate forme de correspondance où les impératifs de sécurité coexistent avec les préoccupations de ponctualité permettant la réussite du parcours prévu dans le temps proposé. En piste des engins très divers cohabitent : "Tex" tirant des convois de chariots à bagages, engins de chargement ou loaders, engins de lavage ou "Fenwick", "Tana" pour effectuer les "démarrages" avions etc..., mais aussi des transports de passagers par cars voire fourgonnettes plus légères. Le code de la route s'applique à leurs déplacements. Par ailleurs porte de soute avion, plate forme de loaders, issue avion des passerelles sont autant de risques de chute de hauteur qu'il faut prévenir.

Méthodes : Les accidents de la circulation concernant des agents au sol piétons et ceux des conducteurs de véhicules ont été comparés les deux dernières années. Parallèlement les accidents du travail trajet (sur le chemin du travail à l'aller ou au retour) ont été notés ; les hommes et les femmes ont été comparés. Ces accidents concernent aussi bien des agents du passage, du trafic ou de la piste.

Résultats : Pour l'an 2000, 151 accidents de trajet sont survenus concernant 95 femmes et 56 hommes pour un effectif moyen de 7500 agents. Parallèlement, il y a eu 9 accidents du travail pour les conducteurs ou passagers, de véhicules pour la piste et le trafic. Les chutes de hauteur, moins nombreuses concernent moins de 5 agents.

Conclusion : La prévention des accidents de circulation sur les pistes d'aéroports mettant en jeu la sécurité aéronautique passe par l'éducation des jeunes embauchés au travers des permis spécifiques et qualifications aux différents engins. Elle passe aussi par le respect pour tous les agents des règles de circulation en particulier des limitations de vitesse. L'usage de produits psycho-actifs est à proscrire, quitte à retirer de leur poste les consommateurs et de les traiter afin de minimiser au maximum les risques "circulation". La prévention des chutes de hauteur passe, elle, par le respect des procédures et le renforcement des sécurités des postes de travail élevés.

16. THE HAZARD OF DEPLETED URANIUM IN AIRCRAFT

Dr R M C HUNTER MSc(Radiation Biology) MBBS MFOM DA vMed

Depleted Uranium (DU) is a heavy metal which is commonly used as counterbalance weight in older aircraft. DU is used in the tail cone, flying control surfaces and other parts of the aircraft. A Boeing 747 may be fitted with several hundred kilogrammes of DU. The DU weights normally have a protective cadmium plating and left undisturbed in this form DU represents little hazard. However, if DU is cut, abraded or burnt, it represents a much greater radiological and toxicological hazard. In the case of an aircraft crash resulting in a fire, the DU may be burnt to form uranium oxide, which may be dispersed in the environment as airborne particles.

This presentation reviews: The physical properties of DU and its suitability for its application; Substitution with other materials such as lead; The use and location of DU in aircraft; Regulatory controls on use, handling and recycling; Models of environmental dispersion of uranium oxide in aircraft fires; Estimations of health detriment due to environmental dispersion in aircraft fires and studies of specific crashes; The management of aircraft fires. In normal regulated use, DU in aircraft presents no significant health risk. The aircraft salvage industry represents a possible area of loss of DU from regulatory control. Aircraft fires involving the burning of DU and atmospheric dispersion of the oxide are very rare events. 'Bystanders at aircraft fires in worst case scenarios have been estimated to have been exposed to less than 1mSv, the risk to health from this exposure is very small.' Toxic effects associated with the ingestion of large quantities of DU are known to occur, however, such effects have not been seen following aircraft fire incidents nor have they been seen in military personnel some of whom have had DU shrapnel embedded in their bodies for some years.

17. AN APPROACH TO THE AEROMEDICAL ASPECTS OF ULTRA-LONG RANGE AIRLINE OPERATIONS.

DR I. M. HOSEGOOD

Introduction: The introduction of the Ultra-long Range (ULR) aircraft types from both Airbus and Boeing will mean that any two points on the globe can be connected with a single sector flight, often over 18 hours in duration and sometimes traversing the poles. This type of flying brings with it an exacerbation of many current aeromedical issues and also introduces some new challenges to the airline industry. Amongst the most significant issues are crew fatigue/on-board rest, cosmic radiation exposure and passenger health. This presentation briefly describes one airline's approach to the introduction of the A340-500.

Methods: One of the most challenging issues is aircrew fatigue. No airline has regularly flown 18+ hour sectors before and therefore no predictive data exists. Issues addressed include crew composition, crew rest design, rostering/scheduling, in-flight rest planning, personal strategies and countermeasures, mathematical fatigue

modelling, on-board testing of fatigue levels, and regulation/validation of individual city pairings.

Cosmic radiation exposure is revisited as these operations involve longer flight times at extremes of latitude and have the theoretical potential to increase exposure levels. A combination of in-flight testing and computer modelling of dosage based on actual waypoints was used to give predictive dosages for the proposed ultra-long haul and polar routes.

These operations mean longer passenger exposure to the hypobaric / hypoxic environment and immobility. Potentially, therefore we may see a disproportionate increase in medical incidents and/or diversions. Diversion medical facilities are either non-existent or poor on many of these sectors, particularly polar routes. We are investigating methods to both reduce the number of in-flight emergencies as well as mitigate when they arise. Methods include revisiting the medical clearance of passengers, reviewing medical kit contents and equipment (including Medical Telemetry) and concentrating on prevention strategies. An extensive review of en-route diversion medical facilities has also been undertaken.

Results/Conclusions: Results in each of the areas addressed above are indicating that ULR Ops will bring significant but not insurmountable challenges to the aviation medicine practitioner. This is not simply a matter of applying current practice to a new operation but in certain areas requires a paradigm shift in an airline's approach to new operations. For a successful transition, each issue requires careful consideration and liaison between airlines, manufacturers, scientists and regulators is essential.

18. MANAGEMENT OF JET-LAG FOR EXECUTIVES

D.MALHOTRA

Introduction

World travel for busy business executives has become a daily occurrence in most industrial nations. These executives have to travel for long distances and due to a paucity of time need to attend meetings immediately where important decisions are made. If such an executive is tired and jet-lagged his/her decision-making ability is affected. These decisions if erroneous can some times result in big losses.

This paper present the results of a double blind placebo controlled cross over trial of 30 volunteers flown from Sydney to London and back.

Methods

The subjects were divided into two groups of 15 each. One group received 20 milligrams of Temazepam on arrival in London while the other received a placebo. Reverse drug administration was given on return to Sydney.

The volunteers were given three tasks to perform in London and Sydney to assess their recovery from jet lag.

The tasks used were (1) Reaction time testing (2) Little man test (3) Mathematical problem solving. Bias was removed from the trial as results of each test were compared for the individual.

Results

The test proved that significant changes took place when volunteers were subjected to jet lag.

All three tests showed a marked improvement in the volunteers reaction times, spatial figuration as used in the little man test and mathematical problem solving ability after the administration of 20 milligrams of Temazepam.

Volunteers who were given placebo took on an average three days to recover from jet lag.

Conclusions

This study proved that circadian dysrrhythmia occurs when long distance travel is carried out over several time zones. The effects of travel can be countered with the use of 20 Milligrams of Temazepam on arrival at the destination. The correct use of Temazepam will enable executives to be alert and fully functional while making important decisions

Monday, 16 September 2002 - 5:00 pm

MISCELLANEOUS

19. EPIDEMIOLOGY OF U.S. HOT AIR BALLOON CRASHES, 1996-2000

C. T. COWL, MD, MS.

INTRODUCTION: The sport of hot air ballooning has become more popular each year since the 1960s. With its increasing popularity has come an influx of new pilots and balloons, as well as more crashes with associated property damage, severe injuries, and fatalities. Risk factors for fatality and serious injury for crashes between 1964 and 1995 were published previously by our group. We studied the subsequent five-year interval to identify possible trends.

METHODS: Records of 577 hot air balloon crashes records by the Civil Aeronautics Board (1964-1967) and the National Transportation Safety Board (1967-2000), including passenger and pilot statements and associated medical records were reviewed and cumulative data evaluated in a univariate fashion. Logistic regression models were developed to identify risk factors for fatality or serious injury.

RESULTS: From 1964 to 2000, a total of 577 hot air balloon crashes involving 1,925 persons were reported and included 99 fatalities and 484 serious injuries. Pilot error or incapacitation was determined subjectively by crash

investigators to contribute to 83.0% of the crashes. Five-year trends showed a decrease in the number of fatal injuries between 1996 and 2000 ($p < 0.05$). Frequency of crashes involving commercial hot air balloon flights with larger fabric envelopes and greater numbers of passengers aboard increased in the past five years. Crashes involving power line contacts decreased but not at a statistically significant level ($p = 0.16$). Regression models continue to identify power line contact as the single greatest predictor of fatality in U.S. hot air balloon crashes.

CONCLUSIONS: Although a number of factors contribute to increased severity of hot air balloon crashes, the prevalence of fatal injuries has decreased in the past five years. Overall trends in factors causing hot air balloon crashes have not changed significantly since 1996 and include power line contact as the greatest predictor of fatal injury.

20. ACCIDENTS IN GENERAL AVIATION : ISSUES ON MEDICAL FITNESS OF "ELDERLY" PILOTS D. DELAITRE1, G. MARION2

Introduction : Le rôle du vieillissement semble souligné dans certains incidents et parfois accidents, sans pouvoir être clairement démontré. Il n'existe en aviation générale ni limite réglementaire, ni norme médicale permettant de sanctionner un pilote en raison de son âge. Toutefois, le médecin est parfois désigné comme l'interlocuteur susceptible de pouvoir mettre fin à une situation embarrassant la communauté aéronautique en prononçant pour raison médicale l'inaptitude d'un pilote âgé. **Méthodes :** Le travail porte sur l'analyse des dossiers d'accidents et d'incidents impliquant des pilotes de plus de soixante ans. Le contexte d'exploitation, les circonstances et les conséquences de l'événement ainsi que les éléments de l'aptitude médicale sont étudiés. **Résultats :** Plus d'une cinquantaine d'accidents et incidents surviennent en France chaque année impliquant des pilotes âgées de plus de soixante ans. Ils possèdent des expériences aéronautiques allant de quelques dizaines à quelques milliers d'heures. Les accidents révèlent des conditions d'exploitation parfois intensives, inadaptées aux limites physiologiques des pilotes. Ils révèlent également un nombre important de manœuvres inadéquates, notamment au décollage ou à l'atterrissage. **Conclusions :** Un manque de flexibilité intellectuelle ou "fluid intelligence" demeure évoqué dans la plupart des situations. Le savoir et l'expérience accumulés, ou "crystallized intelligence" ne compensent plus nécessairement les altérations fonctionnelles en raison de l'évolution technique et réglementaire. Une analyse méthodique des circonstances de ces événements doit être approfondie avec rigueur pour permettre de préciser les déficiences et altérations fonctionnelles. La composante mentale de l'aptitude des pilotes, au même titre que la composante physique, peut être prise en compte par les médecins dans la sélection, le suivi médical aéronautique des pilotes et les enquêtes sur les accidents et incidents.

21. INTÉRÊT D'UNE DÉMARCHE QUALITÉ PAR LA CERTIFICATION ISO 9001 APPLIQUÉE À UN CENTRE DE VACCINATIONS INTERNATIONALES D'UNE COMPAGNIE AÉRIENNE. V. FEUILLIE (1), J.P. FRESNEY (1), P. RODRIGUEZ (2)

Introduction :

L'évolution épidémiologique mondiale fait apparaître de nouveaux cas de fièvre jaune, une augmentation sensible du paludisme principalement en provenance du continent africain ainsi qu'une recrudescence de certaines pathologies tropicales comme la dengue sur l'ensemble des zones intertropicales.

Les personnels navigants aériens techniques et commerciaux ainsi que les voyageurs se rendant en zone intertropicale ont besoin de vaccins obligatoires ou recommandés ainsi que des conseils médicaux adaptés au voyage (paludisme, dengue, hygiène alimentaire, etc.).

Les centres de vaccinations internationaux et de conseils aux voyageurs doivent répondre à ce type de demande.

Méthodes :

Nous décrivons une démarche qualité originale dont le but a été de mieux répondre à l'attente de nos personnels navigants et de notre clientèle de voyageurs tout en gardant des exigences de sécurité au niveau des informations épidémiologiques devant rester à jour et une parfaite traçabilité des vaccins administrés.

Le Centre de Vaccinations Internationales et de conseils aux voyageurs Air France a choisi la certification Qualité selon la Norme ISO 9001 version 2000.

Résultats :

Le centre de vaccinations a obtenu la certification ISO 9001 depuis juin 2001

Des outils informatiques originaux ont été développés spécifiquement pour le suivi de l'ensemble des processus liés à la vaccination.

Une formation continue du personnel de soins a été mise en place et adaptée à la Médecine des Voyages.

Une documentation est remise en fonction des pays visités avec des conseils spécifiques en particulier sur la protection contre le paludisme et les risques sanitaires sur place mais aussi des recommandations médicales à bord des avions.

Conclusions :

Les services médicaux des compagnies aériennes doivent tenir compte des risques liés aux pathologies en zone intertropicale.

La mise en place d'une certification qualité est un moyen de garantir les vaccinations adaptées et conseils appropriés à nos clients et nos personnels.

22. VITAMIN D AND MATRIX METALLOPROTEINASE 9 IN SUBMARINERS

A.B.BAKER¹, P.M.TIMMS², A.J.ALLSOPP¹, and R.J.PETHYBRIDGE¹

Introduction

Much of our Vitamin D is produced by the action of ultraviolet light on skin. Submariners are shielded from sunlight for prolonged periods during patrols, and a reduction in Vitamin D can be demonstrated. Vitamin D deficiency is associated with many infective, inflammatory and malignant diseases. An association between these states and raised matrix metalloproteinase 9 (MMP9) has been observed in certain ethnic groups.

Studies of mortality in submariners show no excess due to cardiovascular, respiratory, or malignant disease. However, submariners may be at increased risk of MMP9 moderated disease due to repeated, prolonged ultraviolet deprivation.

Method

49 submariners deploying on patrol following winter ashore, and 43 shore side controls, gave informed consent for blood sampling for Vitamin D and MMP9. Samples were collected from both groups immediately before the patrol and again in the final week. Initial and final questionnaires were used to identify confounding factors. Early and late samples were batched in pairs for assay. Changes in Vitamin D and MMP9 concentrations were assessed.

Results

Vitamin D levels rose in the control group and fell in the submariners. Pre patrol MMP9 levels were similar in the two groups. In the later samples mean MMP9 doubled in submariners and did not rise in controls.

Conclusions

MMP9 levels rise in a screened healthy population during a submarine patrol. Further studies will indicate whether ultraviolet replacement or dietary supplementation prevents this rise.

Tuesday, 17 September 2002 - 8:30 am

PANEL: TRAINING OF AEROSPACE MEDICINE PROFESSIONALS

23. THE ROYAL COLLEGE OF PHYSICIANS (LONDON) TRAINING SCHEME FOR SPECIALISTS IN AVIATION MEDICINE.

Wing Commander DP GRADWELL

Aviation medicine is practiced by doctors from many disciplines but in the United Kingdom RAF aviation medicine specialists have directed their efforts principally towards research and postgraduate teaching in advanced and operational aspects of aviation physiology and medicine. With changes in both National Health Service training schemes and the Defence Medical Services structures a marked reduction in aviation medical manning was experienced in the last decade. Action was necessary to rebuild a new cadre of trained specialists.

Specialists are required to conduct research into aspects of advanced human physiology, often in adverse environments such as high altitude, sustained radial acceleration, impact biodynamics, thermal and neuro-physiology. To train individuals to undertake this type of work requires a well-structured and directed programme aimed at equipping trainees with appropriate medical and scientific skills. With the assistance of the Royal College of Physicians of London a new training programme, which addresses these needs, has been devised.

Trainees, after general profession training and with membership of an appropriate royal medical college, will embark on a programme lasting a minimum of four years and included within which is experience in clinical aviation medicine, postgraduate teaching and research to doctorate level.

On completion of training young specialists will be assessed by the RCP (London) and if found satisfactorily trained will be able to take up consultant appointments in aviation medicine. The development of this programme has allowed the UK to restart training young doctors in this exciting speciality.

24. EDUCATION OF AEROSPACE MEDICAL SPECIALISTS IN VICTORIA, AUSTRALIA

M. MELINDA TRUESDALE MBBS FACEM ACCAM

The Medical Emergency Adult Retrieval Service (MEARS) commenced operation in 1993. It provides a doctor at consultant level for clinical escort of patients in rural Victoria, Southern New South Wales and Tasmania. The retrieval physicians are all specialists in emergency medicine, anaesthesia, or intensive care. However, until this year, there was no formal education program in aeromedical retrieval available to potential MEARS doctors. To address this, a three-day "Introduction to Aeromedical Retrieval" course was developed during 2001. Primary planning was conducted by a MEARS retrieval physician with qualifications in aviation medicine and who had worked with other retrieval organizations in Australia and Canada. The course is run under the auspices of the

Monash University Centre for Ambulance & Paramedic Studies, which is responsible for the education of flight paramedics who work with the Air Ambulance Service. A Graduate Certificate of Aeromedical Retrieval has been proposed, of which the current three-day "Introduction to Aeromedical Retrieval" course is the first component. The course has been held twice this year with both present and potential MEARS physicians participating. A third course is planned for late October 2002. Overall the course has been very well received. The intention is to broaden the range of prospective attendees to include neonatal, paediatric, rural Victorian and international retrieval physicians. This paper will discuss the planning, content and implementation of the three-day course.

25. US AIR FORCE AEROSPACE MEDICAL TRAINING IN THE 21ST CENTURY SECURITY ENVIRONMENT

T.W. TRAVIS, Colonel

Introduction – In the 1990s the United States Air Force Medical Service recognized the value of "small footprint" incremental forward medical presence. The USAF School of Aerospace Medicine (USAFSAM), traditionally responsible for all aerospace medical professional training, is now also responsible for cross-specialty expeditionary medical training such as combat casualty care and critical care air transport training. These new training capabilities recognize the breadth of skills necessary to support a global strike force with fewer forward-deployed personnel. International training, both in residence and exported, is also taking on a greater level of importance for the USAF. Expanding this capability acknowledges the importance of aeromedical interoperability in remote, unanticipated theaters. Additionally, many aerospace medicine team skills, such as food and water safety, patient decontamination, epidemiology and health surveillance now have come to the fore in light of attacks on the US homeland. There is a need for military aerospace professionals to interact more than ever with civil support agencies to protect our own homeland.

Methods – Aerospace medicine professional training in the context of the US and world security environment will be described. The integration of expanded international training will also be described.

Conclusion – The 21st century security environment, the expeditionary medical teams being deployed to support US and allied forces, and the homeland security mission dictate a significant evolution of aerospace medical professional training. USAFSAM is changing to meet this challenge.

26. WEB BASED POSTGRADUATE AEROSPACE MEDICINE TRAINING

E. Donaldson, P.Bates

Introduction

In response to a need for training in Aerospace Medicine for medical practitioners in remote areas at the beginning of the academic year 2001 Griffith University offered a 4 year postgraduate course in Aerospace Medicine entirely web based. The course offered a number of exit points with appropriate qualifications to meet the varying needs of the students.

SUBSTANCE

After successfully completing the first two semesters of Aviation Physiology and Clinical Aviation Medicine the student can graduate with a Certificate of Aviation Medicine which then qualifies the graduate to apply for registration as a Designated Medical Examiner of pilots and air traffic controllers for the Civil Aviation Safety Authority.

After completion of two further semesters - Operational Aviation Medicine and Space Medicine- the student may exit with a Graduate Certificate of Aerospace Medicine and after a further year which addresses the competencies of the Faculty of Occupational Medicine, the student may graduate with Master of Aerospace Medicine. If the student's performance on the course has reached a high standard then after a further year and presentation of a thesis the graduate will exit with a Master of Aerospace Medicine with Honours.

METHOD

Acknowledged authorities on the topics covered in the course advise the students of a reading list and using the facilities of "Blackboard" post a problem in a Discussion Forum. The discussion which ensues between the students and the lecturers takes place over a week and because of the diverse student backgrounds this is a major teaching entity. The Blackboard Virtual Classroom facility is used for student and lecturer exchange - a Chat Room. Assessment is made on contribution to the Discussion Forum, a written assignment and a two hour written examination in each subject.

Tuesday, 17 September 2002 - 9:30 am
ALTITUDE PHYSIOLOGY

27. AN ASSESSMENT OF THREE THERAPEUTIC OXYGEN SYSTEMS FOR AIRLINE PASSENGERS
J ERNSTING, M V COATS, J HUNTER, E JOHN, P B MARRIAGE, T S J WOODVILLE-PRICE

INTRODUCTION

Continuous oxygen therapy is usually provided to patients with severe pulmonary disease by nasal cannulae (NC) delivering a continuous flow of oxygen (CF). Recently equipment delivering a bolus of oxygen at the beginning of each inspiration – pulse dose (PD) – through NC has been developed for use in flight [Aeromedic Innovations]. The effectiveness of these NC systems and the standard emergency drop-down mask [DDM – Scott] in relieving hypoxia at altitude were compared using healthy subjects.

METHODS

Oxygen was delivered at flow rates of 2 and 4 litre/min to each of five subjects by each of the three systems in turn at pressure altitudes at 0, 8,000 and 15,000 feet. The subject sat at rest and exercised on a cycle ergometer at 30 and 60 watts. Respired gas tensions were recorded by mass spectrometry and pulmonary ventilation was measured in each test condition.

RESULTS

The end-tidal partial pressure of oxygen (PETO₂) at a given oxygen flow rate fell progressively with increases in pulmonary ventilation and altitude. In identical conditions the CF and PD systems produced very similar PETO₂s. The DDM always gave a considerably higher PETO₂ than the NC systems under similar conditions. AT 8,000 feet and an oxygen flow rate of 2 litre/min the mean PETO₂s produced by the DDM, CF and PD systems at a pulmonary ventilation of 10 litre (BTPS)/min were 196, 102 and 109 mm Hg respectively; at a pulmonary ventilation of 20 litre (BTPS)/min the PETO₂s were 129, 86 and 90 mm Hg respectively.

CONCLUSION

At equivalent oxygen flow rate settings Pulse Dose with its potential 60-70% reduction of the rate of consumption of bottled oxygen is as effective as a continuous flow delivered by nasal cannulae. Neither nasal cannulae system is however as effective as the same oxygen flow rate delivered by a drop-down mask with its flexible oxygen reservoir.

28. TYMPANOMETRIC AND OTOSCOPIC EVALUATION PRE AND POST FLIGHT IN HYPOBARIC CHAMBER

R. GESSINGER¹, J. CASTRO^{1,2}, F. XAVIER³, T. RUSSOMA^{NO²}

The tympanometric and otoscopic condition of 25 pilots (male, 18 – 24 years old), School of Aeronautical Science's students / PUCRS, Brazil was studied pre and post flight in a hypobaric chamber. Evaluations were measured in 3 conditions: a) pre-flight before Valsalva maneuver, b) pre-flight after Valsalva maneuver, and c) post-flight. All the subjects were asymptomatic pre and post-flight. The performance of flight included ascent until 25,000 feet and a rapid decompression. The evaluations were performed by the same physician with otoscopy and a portable impedance audiometer.

The maximum peak pressure average (P) were –51 daPa (pre-flight before Valsalva maneuver) and after Valsalva maneuver were –27 daPa (significantly). After Valsalva maneuver the acoustic reflex were present in all 50 ears evaluated.

After flight no significant difference were noted in peak of pressure. The acoustic reflex were present in 33 ears (66%) and absent in 17 ears (34%). Two subjects developed middle ear effusion.

Acknowledgment to NulFISAL (Núcleo do Instituto de Fisiologia Aeroespacial / Aerospace Physiology Institute), Campos dos Afonsos, Rio de Janeiro, Brazil.

29. CHANGES OF RESPIRATORY FUNCTION AND BLOOD GAS PARAMETERS IN CYSTIC FIBROSIS PATIENTS DURING REDUCED ENVIRONMENTAL PRESSURE

D.-M. ROSE¹, O. THEWS², B. FLECK³, & W.E.S. KAMIN⁴.

Introduction: Patients with cystic fibrosis (CF) suffer from hypoxemia even under normobaric conditions at sea level. During air travel the cabin pressure is reduced equal to an altitude of 1800-2450 m. The resulting reduction of the inspiratory pO₂ could cause medical problems for these patients since a fall in the arterial pO₂ to approx. 55 mmHg is seen even in healthy subjects and therefore a greater decrease might be expected in CF patients. The aim of this study was to assess the risk during air travel in CF patients by analyzing changes in arterial blood gases and lung function in CF patients under hypobaric conditions compared to healthy control subjects.

Methods: Ten CF patients and 27 healthy control subjects were investigated in a hypobaric chamber at normal ground pressure level and pressure altitudes at 2000 and 3000 m. At each level the arterial blood gases, O₂ saturation and lung function parameters were measured.

Results: The respiratory function was significantly reduced in the CF patients with a vital capacity of 3.0 l and a forced expiratory 1-second volume of 2.1 l. These parameters were only slightly diminished at reduced ambient pressure indicating that the respiratory function was not worsened under these conditions. Mean arterial pO₂, however, decreased from 80 mmHg at ground level to 60 mmHg at 2000 m and 46 mmHg at 3000 m.

Conclusions: This result indicates that during air travel, the arterial pO₂ of CF patients remains above the critical value of 50 mmHg as long as the cabin pressure is not reduced below that found at 2500 m altitude. These findings suggest that air travel should not compromise the safety of CF patients in terms of arterial pO₂ and respiratory function.

30. NITRERGIC SYSTEM AND HYPOBARIC HYPOXIA

F. RIOS², AP. FERNANDEZ¹, JM ENCINAS¹, J. SERRANO¹, ML BENTURA¹, M, SANTACANA¹, P. MUÑOZ¹, J. SANCHEZ², J. RODRIGO¹, R. MARTINEZ-MURILLO¹, L. NAVARRO² and S. CASTRO-BLANCO¹

INTRODUCTION. The changes in the central and peripheral nervous system consequent on exposure to hypobaric hypoxia may be mediated by the endogenous generation of nitric oxide (NO) synthesized by the enzyme nitric oxide synthase (NOS). The expression of neuronal and inducible isoforms of the NOS, the nNOS and iNOS, plus nitrotyrosine, as a marker of protein nitration and peroxynitrite formation was studied in the cerebral cortex of rats. **METHODS.** In a research altitude chamber, rats were submitted for 30 minutes at 11.585 m, then sacrificed at sea level (reoxygenation period) at elapsed time: 0, 24 h, 5th, 8th and 30th day. Analysis were carried out using immunocytochemical techniques. **RESULTS.** The findings showed that after hypobaric hypoxia and reoxygenation period at 0-5days, large immunoreactive interneurons (Type I) present in control animals and small neurons (Type II) present only under this conditions, were progressively increased in number. In addition the nitrergic plexus was increased surrounding the vasodilated vessels, which induce morphological deformation on the closest neuronal cell bodies. After 8 days the normal morphology was reestablished, decreasing dramatically the number of small neurons and reaching similar number and morphology to animals under normal conditions at 30 days of survival. Immunoreactivity of iNOS was always negative in neurons distributed in cortical areas. Neurons containing nitrotyrosine was increased at 0-8 h. The immunoreactivity that normally was related to nuclear area was moved to the cytoplasm and processes, returning again to initial position at 30 days. **CONCLUSIONS.** The morphological changes and enzymatic activity might be related to certain cortico-cortical disconnection and morphological deformation of large interneurons, inducing the reactive plasticity as specific NO function.

Tuesday, 17 September 2002 - 11:00 am

JOHN ERNSTING PANEL - COSMIC RADIATION

31. BRITISH AIRWAYS COMPLIANCE WITH THE EUROPEAN COSMIC RADIATION DIRECTIVE

M. BAGSHAW

Introduction

Natural ionising radiation consists of cosmic rays from outer space, and gamma rays from earth materials. Cosmic radiation is produced when primary photons and alpha particles from outside the solar system interact with components of the earth's atmosphere. A second source is the release of charged particles from the sun which become significant during periods of solar flare.

Protection from cosmic radiation is provided by the earth's magnetic field and by the atmosphere. Thus there is an increase in exposure at higher latitudes and higher altitudes, the biological effect depending also upon the length of time of exposure and the components of the radiation field.

In 1991 the International Commission on Radiological Protection (ICRP) recommended that exposure of crew to cosmic radiation in jet aircraft should be considered part of occupational exposure. Subsequently the Council of the European Communities issued Directive 96/29 EURATOM stipulating dose limits for workers, including professional flightcrew.

Methods

Monitoring equipment for ionising radiation is installed in Concorde. British Airways (BA) works closely with the National Radiological Protection Board (NRPB) and independent studies have been carried out both on Concorde and on ultra-long haul, high latitude, Boeing 747-400 routes.

Dose estimates are performed for all BA crew members and duty travellers using the Federal Aviation Administration (FAA) computer programme CARI-6E. This is regularly validated by the NRPB, who perform similar validation of the monitoring equipment installed in Concorde.

Results

NRPB validations confirm the accuracy of the CARI estimations and the Concorde monitors. No BA crew members or duty travellers approach the ICRP occupational exposure limits nor the trigger level for classification as a controlled worker.

Conclusion

BA complies with the European Council Directive on Cosmic Radiation. No BA staff member approaches the control level or dose limit recommended by the ICRP. Independent analysis of the BA pension scheme shows no evidence of an increase in cancers which may be related to radiation exposure.

32. NORTH AMERICAN AIR CARRIER RADIATION CONCERNS RUSSELL B. RAYMAN, M.D.

There has been increasing interest by air carrier crews as well as passengers in radiation exposure during commercial air travel. It is a well-known fact that high levels of exposure can increase the risk of cancer, mutagenic defects, and defects to the unborn infant. Sources in flight include galactic radiation, solar radiation, and onboard radioactive pharmaceuticals. At this time, regulatory authorities in Canada and the U.S. do not believe that radiation is a hazard for the non-pregnant crewmember, but on some flights radiation standards could be exceeded for those that are pregnant.

Consequently, airline policy in N. America is to provide educational materials including FAA CARI data so that aircrew can make informed decisions regarding their flying. At this time, airline regulatory authorities have not published standards although some may adhere to those of various agencies such as the International Commission on Radiation Protection and Measurement. Furthermore, the commercial airlines of N. America do not routinely monitor radiation levels in flight. The policy of education in lieu of regulation is based upon the lack of epidemiological evidence that there are differences in cancer, mutagenic, and teratogenic incidences between the flying population and the general population. However, research is ongoing in this area that could eventually lead

33. "COSMIC RADIATION AND AIR TRANSPORT: THE ESCAPE EUROPEAN AIRCREW COHORT STUDY" DR. HAJO ZEEB, MSC

Abstract:

The occupational health of aircrew in civil or military aviation has been studied by epidemiologists only since the beginning of the 1990s. Cockpit crew and flight attendants work in an occupational environment which is unique with respect to several factors, among them ionizing radiation of cosmic origin. The average annual doses received are relatively low, however, and commonly range between 2 and 6 mSv. Several epidemiologic studies on mortality and cancer risk among flight personnel have been published. Results of the early studies were equivocal: elevated cancer risks for specific tumours were observed in some studies, but not in others. However, none of these studies included data on the occupational exposure, not even on duration of service. More recently nine European countries have conducted cohort studies in which cancer mortality and - incidence of aircrew were investigated. A pooled analysis of these studies is currently under way (ESCAPE study). So far, the results of studies in Nordic countries indicate a raised melanoma risk among cockpit crew as a main common finding. An risk increase for breast cancer among female cabin crew has also been noted. Overall, the influence of occupational factors on the cancer risk appears limited. The presentation will give an overview of the available epidemiological data and the approaches to radiation dose estimation in the context of epidemiological studies; design and descriptive results of the ESCAPE European cohort study will be discussed.

34. COMMERCIAL AIR TRAVEL AND FOETAL RISKS OF BIRTH DEFECTS AND CANCER FROM EXPOSURE TO IONIZING RADIATION

**R. L. SMITH, M.D - Northwest Hospital/University Hospital
Seattle, Washington, U.S.A.**

Introduction: The risk of harm to the developing foetus from ionizing radiation in commercial air travel has been discussed at length with some excessive emphasis of the risks. This is mainly targeted at those pregnant frequent flyers and cabin attendants. Discussion: Exclusive of Space Shuttle missions, International Space Station missions, and interplanetary missions, all of which can and probably will expose the foetus to unacceptable levels of ionizing radiation (i.e. greater than 10 REMS), the risk to the developing foetus in all other cases is within acceptable parameters. Foetal exposure to 5-10 REMS possibly may have some foetal sequelae. Ionizing radiation dose effects on the foetus of the pregnant woman are different in the reimplantation stage, organogenesis stage, and foetal stage. They can not be added together in drawing any valid conclusions re foetal loss, foetal abnormalities, growth retardation, and possible cancer at a later date, but must be evaluated separately. Conclusion: Even considering the current increase in flight altitudes, flight times, and polar flight, the foetal radiation doses are less than 1 REM over 950 block hours of flying per year. When considering the Q factor re types of ionizing radiation foetal levels do not approach a critical threshold. A solar storm is the exception to the rule.

35. MONITORING OF THE COSMIC RADIATION AT IBERIA COMMERCIAL FLIGHTS: One year experience of in-flight measurements

R DOMÍNGUEZ-MOMPELL*, P ORTIZ*, F MERELO*, J M PÉREZ*, J RUANO* & J C SÁEZ, A M ROMERO**, R RODRIGUEZ****

Introduction.-The results from the first year on the experimental measurements of in-board radiation doses received by the crew of IBERIA commercial flights are presented. The studied routes cover the most significant IBERIA destinations and provide a good estimate for the route doses as required by the Spanish new regulations on air crew radiation protection.

Method.- The results from the different instruments (including compensated rem-meters, ion chambers and Tissue Equivalent Proportional Counter TEPC) and their comparison with the predictions from some route-dose codes (CARI, EPCARD) are discussed. High LET detectors were tested in the CERF facility at CERN, which provides a

realistic approach to the fields encountered at 9-12 km altitudes.

In contrast with the already published data which are mainly focused on North latitudes over parallel 50, many of the data presented in this work have been obtained for routes to Central and South America. These data can be of special interest for the route dose code developers.

Results.- First analysis of the obtained data shows that the annual dose received by the IBERIA air crew members ranges from 0.5 to 3.0 mSv, considering 600 hours of effective flying time (from take-off to landing). These values are well below the current dose limits in Spain (20 mSv/year) but also below the reference of 6 mSv/year for radiation workers type A which should require individual monitoring.

Conclusions.- Most of the air crew members receive more than 1 mSv/year and therefore a specific radiation protection programme and annual dose estimates are required by actual Spanish regulations. Collected data will allow to make simulations and to include correction factors to the algorithms of software codes developers in order to calculate the Effective Dose.

36. COSMIC RADIATION EXPOSURE ON CANADIAN-BASED ROUTES

L.G.I. BENNETT, B.J. LEWIS, A.R. GREEN

For over a decade, surveys and measurements of cosmic radiation at jet altitudes have been taken on both military and commercial aircraft. The first year-long survey (Canadian Forces Pilot Survey, CFPS) indicated that those pilots in the Transport Air Group, TAG, could receive close to the proposed public limit of 1 milliSievert (mSv) annually. A second survey (Canadian Aircrew Radiation Environment Study, CARES) was then undertaken with the co-operation of several Canadian-based airlines, which revealed that, with their higher flying hours, both flight deck and cabin crew could meet or exceed this limit. Used for both these surveys were small bubble detectors that are neutron-sensitive, neutrons being about half the total cosmic radiation at altitude. In addition, several dedicated flights were taken with a variety of scientific radiation-measuring equipment. With the availability of a tissue equivalent proportional counter (TEPC) which measures the total radiation every minute (rather than cumulatively for a flight), additional flights are being measured and will continue in order to cover the 11-year solar cycle.

For these surveys, an interactive database program was developed both to handle the collected individual and route data as well as to provide a means of estimating doses, which was done for about twenty personnel during that year. This one-time effort provided the idea to derive a more universal program that would be valid world-wide and throughout the solar cycle. In conjunction with the more detailed measurements from the TEPC, the Predictive Code for Aircrew Radiation Exposure (PCAIRE) was developed. Essentially, the collected TEPC data were plotted on a single curve for which a function was found and then programmed into a code. The results from the PCAIRE code are comparable to theoretical code predictions (e.g., CARI) and to measurements from other groups. Additionally, a solar flare capability is being incorporated.

Financial support for this work has come from the Director General Nuclear Safety, Department of National Defence and Aviation-Occupational Safety and Health, Transport Canada

Tuesday, 17 September 2002 - 1:30 pm

CLINICAL AVIATION MEDICINE - GRAND ROUNDS II

37. EAR AND SINUS BAROTRAUMA IN TAP AIR PORTUGAL CREW: THREE-YEAR RETROSPECTIVE STUDY

R POMBAL, H PEIXOTO, A JORGE, M LIMA. UCS

INTRODUCTION

At TAP Air Portugal, ear and sinus barotrauma (ESBT) is considered an occupational health hazard for insurance claim purposes, accounting for over half of all occupational injuries among air/cabin crew, and an average of 1.6 days of sickness absence per crewmember per annum.

METHODS

A retrospective study aiming to characterise barotrauma incidence within the 1999-2001 period was conducted on a cohort of all 1,969 TAP air/cabin crewmembers. Data were collected from the insurance claim clinical reports. ESBT cases were characterised regarding: gender, age, work-post, and seniority, as well as time of year, laterality, ear and/or sinus, degree (Teed's), and length of incapacitation.

RESULTS

A total 978 cases (0.5 per crewmember) of ESBT were reported in three years. Annual incidence was highest among female flight attendants (220:1,000), and lowest among captains (67:1,000). A bimodal peak was found at 0-5 and ³10 years of seniority. Barotitis peaked in the Winter months and in April. Its distribution according to degree (1st through 5th) was: 47.1%, 36.3%, 14.2%, 2.1%, and 0.3%, respectively. In 281 cases (29.0%) ear involvement was bilateral. Sinus barotrauma accounted for 22 cases (2.2%), half with concomitant barotitis. Median sickness absence varied narrowly between 8 and 9 days (min = 0; 99th centile = 32; max = 126 days); analysis was made for gender, age and seniority groups, and crew-posts. Median length of incapacitation increased with barotrauma degree (6, 9, 12, 17, and 26 days).

CONCLUSIONS

ESBT is an important cause of morbidity for all TAP crewmember groups. Peak incidence was associated with female FAs, either the most junior or the most senior crew, and the typical coryza/flu and allergic rhinitis seasons. Less severe forms of barotrauma were commonest, and incapacitation seemed to increase most clearly with clinical severity.

38. THE USAF PRK STUDY

DOUGLAS J. IVAN COL, USAF, MC, CFS

Photorefractive keratectomy (PRK) has emerged as one of the most effective corneal surgical procedure to correct refractive errors of the eye. It offers the advantages of reducing dependence on optical appliances and widening the prospective candidate pool. However, its potential complications, stability and post-operative effects on the quality of visual performance in operational conditions required unique investigations in order to evaluate this procedure with respect to military applications, especially flying. Such studies were not likely to be performed in civilian settings. The USAF has just completed a 30 month comprehensive study of PRK using 80 non-flying military volunteers and 20 controls. These subjects underwent comprehensive ophthalmological testing and were exposed to altitude, centrifuge, night vision goggle, glare sensitivity, and cockpit simulation tests to assess PRK effects. This paper will present the findings and aeromedical recommendations of that study.

39. EFFECTS AND SAFETY OF ANTIHYPERTENSIVE TREATMENT IN RUSSIAN AVIATION MEDICINE

Yu.I. Voronkov, L.M. Filatova, O.Y. Kolesnitchenko, Z.A. Krivitsina, N.V. Degterenkova, O.B. Pasekova, Yu.I. Anitov, N.V. Yakimovitch

Introduction: For aviation and space medicine specialists the problem of essential arterial hypertension includes more important questions than for other clinicians, namely the questions of flights safety. The aim of research project "Antihypertensive treatment in Russian aviation medicine" is study of effectiveness and safety of modern antihypertensive medicines application: calcium antagonist - lacipil ("GlaxoSmithKline"), angiotensin converting enzyme inhibitor - corpril ("Ranbaxy"), and beta1-adrenergic receptors antagonist - nebilet ("Berlin-Chemie") at pilots with essential arterial hypertension admitted to flight activity. Methods: The treatment by each medicine was carried out to success within six months by three steps (each of treatment steps lasted within two months). The groups were formed of pilots carrying out regular flights via Earth meridians at airliners: Yak-40, Tu-154, IL-62, IL-86, IL-96, A-310. The treatment was controlled by 24-hour ambulatory blood pressure monitoring (recorder BR-102, "SCHILLER"). In some cases, 24-hour ambulatory blood pressure monitoring was carried out during flights. Results: The results are show positive dynamics of instrumental-diagnostic parameters and sufficient treatment effectiveness, which was directed to the different pathogenesis parts of essential arterial hypertension. Generally, the side effects of treatment at pilots were not observed, and those side effects, which took place, were not very significant and didn't be cause of refusal of treatment. At the psychological testing under treatment weren't revealed causes of dropping cognitive functions. Conclusion: The given data have shown that lacipil, corpril, and nebilet are an effective and safe medicines for treatment of the pilots and that fulfil the requirements of the ICAO. The official continual treatment by antihypertensive medicines with simple regime of reception (once a day) didn't burden for pilots during flight activity, and will further for decrease the dissemination of coronary disease, which has lead position within causes of pilot's dismissing from flight activity.

40. ACUTE STRESS DISORDER AND POSTTRAUMATIC STRESS DISORDER IN FLIGHT ATTENDANTS

FOLLOWING A NEAR MIDAIR COLLISION

M.KADOKURA, N.MATSUNAGA, H.OKOSHI, Y.HIJKATA, Y.OKAWA, N.MAKI, H.MIYAZAKI, Y.NOGUCHI, M.KAJI, I.ASUKATA

The two Japan Airline jetliners narrowly avoided a midair collision over Yaizu in Shizuoka Prefecture 31 January 2001. One jetliner took a sudden dive to avoid colliding with the other jetliner. All 12 flight attendants on the jetliner that took evasive action were hurled and injured, and two of them were severely injured.

Company mental health professionals immediately offered psychological intervention. We examined the prevalence of acute stress disorder (ASD) and posttraumatic stress disorder (PTSD) in 12 injured flight attendants following the frightening near collision.

They had symptoms such as sleeplessness, irritability, poor concentration, intrusive distressing recollections, marked avoidance of stimuli associated with the trauma, and impairment in social and occupational areas of functioning. They were repeatedly afraid they might experience a similar accident in the future. Ten (83%) flight attendants met the DSM-IV criteria for ASD and 2 (17%) met them for PTSD. It took between 17 and 121 days to return to work. We could see a positive relationship between the length of the period for reinstatement and the severity of the situation they encounter.

It must be noted that flight attendants are likely to have ASD and PTSD after traumatic events such as aircraft accidents or violent turbulence in their workplace. We will report the possible benefit of early and systematic crisis intervention by company mental health professionals to prevent the deterioration of ASD and PTSD symptoms and to restore employees to normal life function.

41. THE INFLUENCE OF LIFE STYLE ON THE BIOLOGICAL AGE OF AIR FORCE PERSONNEL IN THE SLOVAK REPUBLIC

O.TAKÁČ, P. DAXNER

Right life style is the most important factor which influences human health (cca 50 % portion).

To determine adherence to correct life style principles, regular checks upon health status are used, from which the authors examined body composition by the apparatus BODYSTAT 500. There were three groups examined: group 1 of air force personnel (n = 203 – in 1996; n = 198 – in 1998), group 2 of persons from air management (n = 190 in 1996; n = 205 – in 1998), group 3 - employers from the civil sectors acted as a control group (n = 258 – only in 1998). The age range of the persons examined was 30 - 60 years. At the same time as the examination, the authors also used a special software program elaborated by the second author. In the program, 21 parameters for the determination of health risks on the basis of the evaluation of the biological age were used. Of the risk factors of ischaemic cardiac disease the authors determined total cholesterol, BMI, and biological age – as a complex of laboratory parameters of the health status. From the analysis of the results obtained it follows: 1) the worst results of total cholesterol determination were found in the control group (21.3% - more than 6.8 mmol.l⁻¹. The best results had the air force personnel – only 12.8 % more than 6.8 mmol.l⁻¹ in 1996; with a decrease in 1998 – to 10.9 % . 2) the worst results of BMI again were in the control group : 24 % persons investigated had BMI more than 30 and 54 % persons had BMI between 25 and 29.9. In 1996 BMI, more than 30 air management personnel had 8.5 %, and air force personnel had 2.5 % . In the course of two years (in 1998) in the group of air management personnel with BMI more than 30 had reduced their BMI by 1.2 % (from 8.5 % to 7.3 %) and the percentage of persons with BMI between 25 and 29.9 was by 4.1 higher (from 51 to 51.1 %). In 1996 (the first examination) in the group of air force personnel these values were 2.5 and 51.7 % vs. 4.2 and 51 % in 1998. In our opinion these results are evidence of the stability of body weight of air force personnel; 3) by comparing the calendar and biological ages of the persons examined, it

is apparent that the third group (the civil employers) had the median biological age (45.57 years) by 1.17 years higher than was their median calendar age. The biological age of the air force personnel was in 1996 smaller by 3.72 years than was their calendar age (36.04 vs. 39.76).

In 1998 this difference was even higher – 4 years. The total difference between calendar and biological ages to the advantage of air force personnel (in a comparison with the civil - control group) was 5.17 years. It is possible elucidate this result by the regular care of air force military personnel in The Slovak Republic.

Wednesday, 18 September 2002 - 8:30 am

AEROMEDICAL STANDARDS & FITNESS TO FLY

42. MEDICAL DISQUALIFICATIONS IN NORWEGIAN CIVIL AVIATION 1982-2001

P. ÅRVA MD, Chief Medical Officer, Civil Aviation Authority, and A. WAGSTAFF MD, DavMed, PhD, Director, RNoAF Institute of Aviation Medicine, Oslo, Norway

Introduction: This study presents the reasons for medical disqualification during a twenty year period among the Norwegian professional (Class 1) pilot population. During the observation period the European medical requirements (JAR-FCL 3) have been introduced in the majority of the European states. JAR-FCL 3 is more detailed and in some areas stricter than the ICAO Annex 1 minimum requirements. This may have influenced aeromedical decision making.

Methods: The Aeromedical Section possesses a complete archive of medical files for all Norwegian pilots since the 1920s. The current data has been collected from the past 20 years. During this observation period the number of Class 1 pilots has increased from 1828 in 1982 to 3070 in 2001. The study population consists of, in all, 48 229 pilot years.

Results: During the observation period 275 Class 1 pilots have been permanently grounded, which gives an average disqualification rate of 5,7/1000 pilots/ year. The number of medical disqualifications shows a peak in the 51 - 55 age group. The main reasons for disqualification are cardiovascular (34,9 %), neurology (15,6 %), musculoskeletal (13,8 %), psychiatric (12,7 %), ENT (7,2 %) and ophthalmic (4,0 %). A further 11,8 % came in the miscellaneous group.

This 20 years study also shows a variation in the number of disqualification rate from year to year (range 9,3 – 3,7).

Conclusion: The first issue of JAR-FCL 3 was published on 28th February 1997 and was officially implemented in

43. THE COMPARISON OF MEDICAL EXAMINATION RESULTS AMONG THE GROUP OF PILOTS AND GENERAL POPULATION IN THE CZECH REPUBLIC

TRUSKA, O.; CETTL, L.

The Institute of Aviation Medicine in Prague has practised selection, periodical examination of flying personnel in the Czech Republic since 1953. Since 1998 we have organised also the examination of small groups (about 20 people) of non-flying personnel, usually managers, during weekends.

The extension of such as examinations is very similar to these for pilots. But we do not perform psychological examinations at managers.

We wanted to compare the examinations' results of military pilots, civilian pilots and managers. We took

randomised samples of 50 military and 50 civilian pilots and 100 managers where 17 women were present too. In the end we excluded 17 women, because our pilots are mostly men.

To be able to compare these three groups, we split them in subgroups according their age. We evaluated the subgroups with age 21-30; 31 - 40; 41 - 50; 51 - 60 and we compared the data's which we could express in numerical way, such as blood pressure, heart frequency, Body mass index (BMI), the blood level of uratic acid, bilirubin, liver transaminases, cholesterol, glycemia and the number of diagnosis.

We have found the significant changes in the level of uratic acid, diastolic blood pressure, BMI , the number of diagnosis and bilirubin.

The cardiovascular diseases are the main cause of death in the Czech Republic in spite of that we can see a slight improvement in the recent years. We focused on main risk factors - hyperlipoproteinemia, smoking, obesity and hypertension.

Conclusions:

1. We have seen the statistically significant differences in the level of uratic acid in the age groups 21-30, 31-40 and 41 -50 among military pilots and managers, probably due to controlled diet at military bases.
2. Body mass index showed difference only between military and civilian pilots in the age group 31-40. The interesting thing is that military pilots are more obese than civilian in this age. We do not know exactly why, but we think that older military flying personnel is oriented more on "paper work" in the office than their younger colleagues.
3. We have found the significant difference in higher diastolic blood pressure among the managers and both civilian and military pilots at the age group 41 -50. We think that it is due to regular exercise at the flying personnel.
4. If we compare the number of diagnosis per one person, we can see in all age groups significant difference among managers and flying personnel. We know that the explanation is not so simple, there are many factors such

44. ENTRY MEDICAL STANDARDS FOR AUSTRALIAN DEFENCE FORCES AIRCREW: A PROPOSAL FOR REFORM

1.BHUPI SINGH; 2.A. PEARSON;

Introduction

Initial medical standards for selection as aircrew for Australian Defence Forces (ADF) have traditionally been extremely rigorous. Such high standards are likely to exclude at least some candidates who may otherwise show high aptitude for a career as aircrew in the ADF. With Australia's relatively small selection pool it would be advantageous if aircrew medical standards were to allow the maximum aircrew selection pool. It is thought that there may be a scope for relaxation of such standards without compromising safety. In order to assess the scope of any such reform, a database was set up to store all available information about initial aircrew medical examinations conducted in the past.

Method

The initial aircrew applicant database was constructed spanning the period from 1996 to 2002. The database was analysed to determine the causes of rejection and waivers granted.

Results

A total of 1445 aircrew applicants for entry into the ADF as aircrew were medically examined during the study period (1996-2002). 74% of all applicants were assessed fit, whereas 16% were assessed as permanently unfit for entry. 40% of the rejections were on account of substandard visual acuity. Musculoskeletal conditions (14%) and ENT conditions (13%) were the next most common reasons for permanent exclusion from aircrew training. Detailed statistics regarding causes of rejection and waivers are presented. The study results are compared with similar studies conducted in the past. Various factors driving the need for reforming the standards are discussed. Some of the factors are: the collective accumulated experience in the field of aviation medicine; better understanding of various medical conditions; the need to maintain harmony with similar standards in other developed countries, notably the allied forces; the need to maintain harmony with a more liberal world culture, with emphasis on individual rights and freedom to indulge; the need to maintain a sufficiently large pool of applicants, keeping in mind the country's relatively small population base; continue to address flight safety, with more complex flying machines and associated systems. Areas in which there is scope for relaxation of the standards are proposed.

45. DIAGNOSTIC CATEGORIES FOR MEDICAL DISQUALIFICATIONS IN THE NORWEGIAN PROFESSIONAL PILOT POPULATION 1982-2001

A. WAGSTAFF MD, DavMed, PhD, Director, RNoAF, P. ÅRVA MD, Chief Medical Officer

Introduction: This study presents the diagnostic categories and subgroups for medical disqualification during a twenty year period among the Norwegian professional (Class 1) pilot population. The most important diagnostic groups are of interest, both from the point of view of analysing aeromedical decisionmaking, but also as a focus for possible prevention in the future. Analysing groups in standardised rates also makes possible comparisons between the different member states of JAA (Joint Aviation Authorities) regarding effectuation of the common medical standards in Europe.

Methods: The current data have been collected from the past 20 years. The study population consists of , in all, 48 229 pilot years. Diagnostic categorisation has been performed on the basis of JAA nomenclature. Standardised rates are calculated for different diagnostic groups. Results and Conclusions: During the observation period 275 Class 1 pilots have been permanently grounded. The mean ages of disqualification are all between 48 and 49 years for the most common diagnostic groups - cardiovascular, neurological, musculoskeletal and psychiatric. For the same groups, the rates of disqualifications per1000 pilots/year are 2.0, 0.9, 0.8 and 0.7 respectively. The

importance of the different subgroups regarding flight safety is discussed in detail.

46. NEURAL REFLEX SYNCOPAL SYNDROMES (VASO-VAGAL SYNCOPE) AND AEROMEDICAL CERTIFICATION

Michael Joy

Introduction. It is estimated that between 1/3 and 2/3rd of the population suffer an episode of vaso-vagal syncope during their lifetime. It is the commonest form of syncope and accounts for some 3% of ER attendances. It is, therefore, perhaps surprising that only in the last few years has there been much interest in the phenomenon and its Aeromedical complications.

First presentation is commonly in adolescence or early adulthood and is characterised by a warning syndrome of visceral symptoms most commonly including a sense of nausea, with or without vomiting, which may also continue following the syncopal episode. A sensation of warmth, sweating and/or of excessive intestinal activity may also be experienced. In the so-called malignant form, there is no warning which gives rise to significant certificatory problems. The events often cluster and may be followed by years of freedom from attacks. Recovery is gradual and the subject cannot be considered fit for continuing duty until at least 30 – 60 minutes have elapsed.

Provocative circumstances include stress, pain, standing for prolonged periods, alcohol and hypoglycaemia. It is less common in the sitting position and very rare in the recumbent position. The differential diagnosis is substantial and includes orthostatic hypotension, the carotid sinus syndrome, atrio-ventricular conduction disorders, supra-ventricular/ventricular arrhythmias of all varieties, the Brugada and long QT syndromes, valvular heart disease, myocardial infarction, aortic dissection, to give but a few. From the Aeromedical point of view, the issue is the minimum data-set required for confident certification with the least burden on the airman.

Conclusion. The existing protocols of investigation are burdensome and will be discussed.

47. PERTE DE LICENCE DÉFINITIVE DU PERSONNEL NAVIGANT COMMERCIAL AF EVOLUTION DES CAUSES DEPUIS 40 ANS PERMANENT GROUNDINGS IN AF CABIN CREW OVER FORTY YEARS

A. MARTIN SAINT LAURENT, JP DONNE

Introduction : En France, les navigants commerciaux (PNC) sont détenteurs au même titre que les navigants techniques (PNT) d'une licence de vol délivrée par l'aviation civile donc soumise à des normes médicales à l'embauche et lors de visites médicales révisionnelles. Lorsque les dérogations ne sont pas possibles en cours de carrière, l'inaptitude définitive au vol est décidée par le Conseil Médical de l'Aéronautique Civile. Cette étude compare l'évolution des causes de pertes définitives de licences sur les 40 dernières années.

Méthodes : Pour apprécier l'évolution des causes de perte de licence définitive au service aérien des navigants commerciaux d'Air France dans les 40 dernières années, deux études ont été comparées : un premier recensement épidémiologique sur 30 ans de 1962 à 1991 avec un travail plus récent concernant les cinq dernières années (1998 à 2002). La première étude portait sur 428 cas et la deuxième sur 279 cas.

Résultats : Du point de vue épidémiologie : la tranche d'âge 46/50 est très vulnérable.

- Les inaptitudes définitives pour problèmes psychologiques restent stables ; 30 % environ des inaptitudes définitives.
- Les causes rhumatologiques atteignent 23 % et sont augmentées par rapport à l'étude antérieure où elles atteignaient 16 %.
- En ORL les causes d'inaptitudes sont de 11 % pour 12 % avant, donc stables.
- Les accidents et séquelles après traumatismes ont baissé à 1,8 % pour 10,3 % antérieurement.
- Les troubles neurologiques sont de 6,8 % actuellement pour 6,3 % avant.
- En cardio-vasculaire, on retrouve 4,6 % d'inaptitude définitive pour 9,6 % antérieurement.
- L'endocrinologie atteint 4,3 % pour 1,9 %.
- Les causes gynéco 2,8 % pour 1,9 % antérieurement.

Conclusion : Il y a augmentation des inaptitudes définitives chez les navigants commerciaux pour maladies rhumatologiques. Cette augmentation est essentiellement féminine. Les autres pathologies dominantes restent la psychiatrie et l'ORL qui restent stables.

48. QUANTITATIVE INPACITATION RISK - A CRITICAL REVIEW OF THE '1% RULE' A D B EVANS, S J MITCHELL

Introduction

Since the 1980s, the UK Civil Aviation Authority has applied a risk-orientated approach to aeromedical decision-making. Based on the '1% Rule' professional pilots who were thought to have a medical incapacitation risk of greater than 1% per annum have been excluded from flying.

Over the past 20 years commercial aviation has changed. Average flight time is longer, aircraft have improved performance, sophisticated automation is more common both for simulators and aircraft, and crew resource management training has been developed.

Methods

The assumptions underlying the derivation of the 1% Rule were examined. The risk of a failed handover during a critical period of flight (take-off and initial climb, approach and landing) was reviewed. Further, the period of a typical flight which should be regarded as 'critical' was re-assessed.

Results

Because of improved training and greater aircraft automation it is likely that the risk of a failed handover of control from an incapacitated handling pilot is now less than was originally assumed. Previously 1 in 100 such events were considered to have the potential to result in a fatal accident, but 1 in 200 events might now be more realistic.

Because flight time has doubled over the last 20 years from one to two hours, a reduced percentage of total flight time is now critical. If flight below 1000 feet is regarded as critical i.e. above 1000 feet there should be no danger of a failed handover, modern aircraft spend only 2.5% of their time in a critical flight phase. Previously 10% of the flight was regarded as critical.

Conclusions

The 1% Rule has been useful in developing consistency in aeromedical decision making. However, re-examination of the assumptions on which it is based can result in a conclusion that medical standards might be relaxed without detriment to flight safety.

49. THE COLOUR PERCEPTION STANDARD IN AVIATION, A BRIEF REVIEW

A.M. PAPE, MBBS

The author has been interested in the colour perception standard for twenty five years. During this time he has had some influence in shaping the implementation of the standard in the Australian aviation environment, and has represented the International Aircraft Owners and Pilots Association in the ICAO study group dealing with this particular standard.

Clearly, there are diverging trends among ICAO member states in their implementation and administration of the standard, such that the notion of a uniform standard in international aviation is becoming an ever more remote prospect.

This presentation will examine briefly the traditional rationale for the existence of this standard, the Australian experience in this regard, and whether or not there is an ongoing need to maintain a colour perception standard in international civil aviation.

There is now a sufficiently large pool of highly trained and qualified pilots with abnormal colour perception, whose performance in all the practical tasks associated with flying sophisticated modern aircraft can be directly assessed in accordance with sound scientific practice.

Wednesday, 18 September 2002 - 11:00 am

ACCELERATION PHYSIOLOGY

50. CARDIOVASCULAR ADAPTATION TO REPETITIVE +GZ EXPOSURE: A LONGITUDINAL TRAINING STUDY

D.G. NEWMAN, MB, BS, DA_vMed, PhD; R. CALLISTER, MSc, PhD*

Introduction: A fundamental difference in the cardiovascular response to an accelerative stimulus between a group of fighter pilots (FP) and a group of non-pilots (NP) has been demonstrated previously. This study was conducted in order to demonstrate the cardiovascular training effect induced by repetitive exposure to +Gz. Methods: 6 FP and 9 NP subjects underwent rapid +750 head-up tilt (HUT) on two separate occasions. The FP group were tested after a non-flying period of 5 weeks (Test 1), and then tested again after a period of repetitive exposure to high +Gz missions (Test 2). The NP group did not fly at all between their Test 1 and Test 2. Mean arterial pressure (MAP), heart rate (HR), stroke volume (SV) and total peripheral resistance (TPR) were all measured non-invasively. SV was determined using impedance cardiography and calculated via the Kubicek equation. For each variable, resting values and the response to tilt for both HUT tests within and between each group were compared. Results: In the FP group, resting MAP was higher ($p < 0.01$) in Test 2 compared with Test 1. Between groups, FP resting MAP was only different from the NP resting MAP in Test 2. The FP HR response to HUT significantly increased ($p < 0.01$) between the two tests. Conclusions: These findings suggest a +Gz-induced cardiovascular training effect in the FP group. Repetitive exposure to +Gz results in an increased resting MAP and an enhancement of cardiovascular performance, reflected in an elevated HR response to tilt.

51. A COMPARISON OF THE EFFECT OF FOUR ANTI-G SUIT SYSTEMS
U I BALLDIN², R B O'CONNOR - WYLE LABORATORIES, INC., BROOKS AIR FORCE BASE,
TEXAS, USA & W M ISDAHL, P M WERCHAN, & T R MORGAN - AIR FORCE RESEARCH
LABORATORY,
BIODYNAMICS AND PROTECTION DIVISION

Introduction: This study compared the impact of heat stress on G-tolerance for four different USAF anti-G systems. Methods: Six subjects completed four trials each, wearing the standard CSU-13B/P anti-G suit (STD), COMBAT EDGE (CE), the Advanced Technology Anti-G Suit (ATAGS), or CE with ATAGS. The thermal stress consisted of walking for 20 minutes on a treadmill in a chamber heated to 35 °C, with radiant heat and 85% relative humidity. G-tolerance and flight simulation tracking performance were registered in a centrifuge. Results: Following the heat stress, there were no physiologically significant differences between the four conditions regarding maximal rectal and chest skin temperatures, weight loss, or hemoglobin and hematocrit. Maximal attained relaxed G-loads with gradual onset before heat stress were 7.2 G, 8.0 G, 8.1 G and 8.6 G with STD, CE, ATAGS and CE/ATAGS, respectively and 6.5 G, 7.7 G, 6.6 G and 8.6 G after heat stress. Maximum attained relaxed G was significantly lower with STD as compared to the others before and after heat stress. The relaxed, rapid onset G-tolerance with CE/ATAGS was significantly higher than STD both before and after heat stress. During rapid onset G-profiles that permitted subjects to strain if needed, heart rate was significantly lower with ATAGS and CE/ATAGS. Flight simulation tracking scores during closed loop G-exposures after thermal stress were significantly better with ATAGS and CE/ATAGS in RMS (deviations from the target) and time on target. Conclusions: Heat stress caused significant rectal and skin temperature elevations and fluid loss with all four anti-G systems, but with no physiologically significant differences between the four systems. After heat stress the G-tolerance was impaired or maintained during the different G-exposures with the four anti-G systems. However, the CE/ATAGS combination appeared to provide the best G-protection and performance task scores both before and after heat stress.

52. CERVICAL MUSCLE FORCES IN HIGH PERFORMANCE COMBAT PILOTS:
METHODOLOGICAL
CONSIDERATIONS FOR PROCESSING IN-FLIGHT ELECTROMYOGRAPHIC RECORDINGS
K. J. NETTO¹, A. F. BURNETT¹, D. G. LLOYD² & T. F. BESIER²

Occurrences of neck injury in high performance combat pilots (HPCP) have been widely reported. These injuries have been attributed to a combination of exposure to high acceleration forces (+Gz) during aerial combat manoeuvring (ACM) and the mechanical arrangement of the head-neck system, with the weight of the head, the helmet and various helmet-mounted devices HPCP have placed at the end of the kinetic chain. An important area in the understanding of mechanisms of injury during human movement is the development of accurate, non-invasive means of predicting individual muscle force-time histories. A method of doing this involves the use of processed electromyographic (EMG) readings as input into a Hill-type musculoskeletal model. This method has been successfully utilised in investigations of lumbar muscle loads in lifting tasks and knee muscle and ligament loads in cutting and running tasks, and static stabilisation tasks. Surface EMG data were collected in-flight from four cervical muscles whilst a pilot performed various typical ACM. The signal was low-pass filtered, full wave rectified and then high pass filtered. The data were then normalised to a maximum voluntary isometric contraction taken from the pilot pre-flight (typical procedure for modelling muscle force). Exceedingly high cervical muscle activation levels (up to 270% of MVC) were recorded and these are illustrated in the table below.

Table 1
 Percentage MVC of Four Right-Side Neck Muscles Recorded during Three Different ACM

Muscle	+3 Gz Left Turn	+3 Gz Right Turn	+4 Gz Barrel Roll
Sternocleidomastoid	29	55	147
Levator Scapulae	78	197	245
Erector Spinae	50	213	183
Trapezius	138	183	286

These results indicate EMG recordings made in-flight during ACM cannot be simply processed as typical recordings made during various activities. Also, the process of using an MVC may not be a valid normalising routine to use in these situations and as a muscle model input. Other methods may need to be utilised and these may include normalising to an event that occurs in-flight.

53. INJURY PREVENTION IN HIGH PERFORMANCE COMBAT PILOTS: A NECK
STRENGTHENING PROGRAM.
F.L NAUMANN, A.F BURNETT - Edith Cowan University, Perth, Western Australia

The high incidence of neck injury in high performance combat pilots has been identified as a major concern in aviation medicine. Such injuries have been attributed to exposure to high and often sustained acceleration forces (+Gz) during aerial combat manoeuvring and the increasing use of helmet mounted display devices. Neck-conditioning exercises have been suggested to prevent this injury, however, little is known in terms of the

suitability, type, duration or intensity of exercise that will bring about a sufficient increase in neck strength. The purpose of our research was twofold. The first purpose was to determine if an increase in isometric neck strength occurred naturally in response to flying training. The second purpose was to examine the effectiveness of various neck-conditioning exercises to increase neck strength. The first phase of the study investigated the cervical muscle isometric strength response to flying under moderate +Gz (4-6+Gz), with no other intervention. Cervical isometric strength was monitored in nine RAAF pilots completing an eight-month flight training course at Pearce Airbase, Western Australia. Neck strength was assessed using the Multi-Cervical Unit (MCU) (Hanoun, Canada). Results indicated limited increases in cervical isometric strength. Recommendations were made to engage in neck strength training outside the aircraft to prepare the pilot for future combat flying. The second phase of our research investigated the effectiveness of three training modalities, the MCU, dynaband and isometric training, to increase neck strength. Results indicated isometric neck strength increased the most training on the MCU. However, significant increases were also found training with the other modalities. This research provided preliminary information as to whether the neck can be trained to better cope with flight demands and ultimately prevent injury.

54. THE PUSH-PULL EFFECT PERSISTS DURING CONSTANT RATE VENTRICULAR PACING IN CONSCIOUS AV-BLOCKED DOGS

DON D. SHERIFF

Introduction

Tolerance to +Gz (hypergravity) is reduced when +Gz stress is immediately preceded by exposure to hypogravity, termed the "push-pull" effect. The push-pull effect is associated with a potent bradycardia that is initiated during the push. We sought to determine whether a push-pull effect persists when heart rate is held constant.

Methods

Atrioventricular block was created surgically in four 20-22 kg dogs. A catheter was implanted in a femoral artery for measurement of arterial pressure referenced to the level of the right atrium. Between experiments, the dogs were paced at 72 beats/min via stainless steel pacing wires attached to the apex of the left ventricle. For data collection, the animals were sedated with acepromazine (20-40 mg iv), restrained in lateral recumbency (0 Gz) on a tilt table, and paced at 100 beats/min. A control g-profile was imposed by tilting the animal 30° head-up for 1 min. A control g-profile was imposed before and after a push-pull g-profile, which consisted of 10 s of -15° head-down tilt immediately preceding 1 min of 30° head-up tilt. One min was allowed between tilts for recovery.

Results

Baseline arterial pressure was similar for the control (78.3 ±6.9 mmHg) and push-pull (78.2 ±6.8 mmHg) trials. There was a statistically significant push-pull effect (P <0.01) in that at second 4 following the onset of +Gz gravitational stress, arterial pressure for the push-pull trials (60.9 ±9.7 mmHg) was less than arterial pressure for the control trials (72.4 ±7.3 mmHg).

Conclusions

Alterations in heart rate are not required for expression of a push-pull effect. Although the normally occurring alterations in heart rate may exacerbate the push-pull effect, peripheral vascular factors can produce a push-pull effect during mild gravitational stress in sedated dogs. Supported by NIH HL46314.

55. CORNEAL TOPOGRAPHY CHANGES AFTER EXPOSURE TO HIGH +Gz

D.J. IVAN MD; R.C. TUTT OD

Introduction: The impact of high levels of +Gz on corneal morphology remains unexplored and undefined.

Advanced techniques to analyze corneal morphology have currently reached a high level of clinical and technological sophistication using computerized corneal topographical analysis to map out exquisitely fine corneal contours. Corneal topography has had wide application in a variety of clinical conditions and is a routine clinical requirement before performing refractive surgery. However, its use to evaluate potential changes induced by high +Gz forces has previously not been reported. This paper will present data on corneal topographical studies performed on non-aviator volunteer subjects who underwent high levels of +Gz in the centrifuge. **Methods:** Visual performance data, to include corneal topography, was collected on 15 subjects at baseline and immediately before and after centrifuge rides to levels of +Gz of 3.0, 5.0, 7.0 and to as high as 9.00 to include simulated air combat maneuvers. **Results:** While some subjects had small changes induced by these exposures, there were no statistically or clinically significant changes in corneal morphology induced in these normal subjects at these levels of Gz exposure. **Conclusion:** Corneal morphology of normal corneas, as analyzed by computerized corneal topography, remains unchanged by levels of +Gz typically associated with high performance military aircraft maneuvers up to +9.0 Gz. The application of this information is important to understand corneal dynamics under +Gz levels routinely experienced by normal fighter pilots and will be useful for comparing the stability of the cornea under similar operational conditions, such as after refractive surgery, that may be performed on aviators in the future.

Wednesday, 18 September 2002 - 1:30 pm

PANEL: HYPOXIA TRAINING

56. COMBINED ALTITUDE DEPLETED OXYGEN (CADO): A NEW CONCEPT IN HYPOXIA TRAINING

DR. GORDON G. CABLE , M.B. B.S. D.AvMed.

DR. BHUPINDER SINGH MD.

IAN PINCH - Royal Australian Air Force Institute of Aviation Medicine

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Most major Air Forces carry out hypoxia training to familiarise their aircrew with the symptoms of hypoxia, in order to better prepare them to identify and respond to such symptoms in the air. Hypoxia training normally involves a controlled exposure to reduced barometric pressures in a hypobaric chamber. Major hazards associated with such training are the risks of decompression illness (DCI), barotrauma and loss of consciousness. The risk of neurological DCI can lead to long term or permanent disability and can be life threatening. The Australian Defence Force (ADF) consider the magnitude of risks of hypobaric chamber training, based on the documented incidents of injury over the past 6 to 7 years, unacceptable. Consequently, the Royal Australian Air Force Institute of Aviation Medicine has developed an alternate method of imparting hypoxia training which combines exposure to moderate altitude of 10 000 feet in a hypobaric chamber with breathing of a gas mixture containing 10% Oxygen and 90% Nitrogen. The paradigm, called Combined Altitude and Decreased Oxygen (CADO), places the subjects at a physiological altitude of 28,000 feet, and provides demonstration of symptoms of hypoxia and the effects of pressure change in a safe manner by eliminating the risk of DCI, and with greater fidelity of training.

57. REDUCED OXYGEN BREATHING ENVIRONMENT (ROBE): A HIGHLY EFFECTIVE, LOW RISK METHOD TO REPLACE DANGEROUS HYPOBARIC EXPOSURES IN AIRCREW HYPOXIA REFRESHER TRAINING

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78235-5252

BACKGROUND: For the past 40 years, the United States Air Force has exposed personnel to low-pressure environments to reacquaint and reinforce their familiarity with the signs and symptoms of hypoxia. Although effective, this method has significant risks of barotrauma (the most common adverse effect) and decompression sickness (DCS – at a rate of 2 – 3 cases requiring treatment per 1000 exposures). A much safer method of hypoxia induction exists without the risks of pressure change. By reducing the inspired fraction of oxygen at ground level pressures, effective training can be accomplished with zero risk of barotrauma or DCS. Open-cockpit realism is maintained.

METHODS: Using current chamber equipment, plus a source of nitrogen gas, a ROBE is created which reproduces the hypoxic physiologic effects of altitude exposure. Per the alveolar gas equation, 6.1% O₂ is equivalent to 28,000 feet of altitude. Time of useful consciousness at this level is 6 minutes.

RESULTS: On 3 April 2002, a very successful manned demonstration of the ROBE concept was conducted at the Brooks AFB altitude chamber. This presentation will review key concepts of ROBE implementation and a video of the test.

CONCLUSION: By migrating to a ROBE for periodic refresher hypoxia training (initial training still requires altitude exposure) we can increase training efficiency while reducing risks of personal injury. Risks of initial training may be controlled through centralization at a location with appropriate treatment facilities.

58. SUBJECTIVE REVIEW OF COMBINED ALTITUDE AND DEPLETED OXYGEN (CADO) HYPOXIA AWARENESS TRAINING PROTOCOL

SQNLDR APARNA HEGDE, MBBS DAvMed MPH&TM FRACGP

Hypoxia training in the hypobaric chamber at RAAF Base Edinburgh was ceased from Jan 2001 to Dec 2001. During this time alternatives to using the traditional hypobaric profile were researched. The main focus was to decrease the risk of Decompression Illness to an absolute minimum while retaining the training benefits of being able to produce hypoxia symptoms. Analysis of hypoxia incidents in the RAAF from 1990 - 2001 revealed that the majority of hypoxia incidents occur in fast jet aircrew that routinely fly "on mask".[1] A protocol called "Combined Altitude and Depleted Oxygen (CADO) Hypoxia Awareness Training Protocol" was developed at the Institute of Aviation Medicine. This retains the training benefits of the traditional protocol - the production of hypoxia symptoms enabling their recognition and allowing for students to take corrective actions. The aim of this study is to analyse the subjective feedback from the students regarding the effectiveness of CADO. This data will be a useful precursor to an objective study using the biomedical monitoring of students to validate this protocol. Method: This is a prospective study based on subjective data from questionnaires. Questionnaires were distributed to students following a CADO run as part of the "debrief process". Analysis of data from these questionnaires was broken down into the following: how many students have previously undergone hypoxia training at 25,000ft; what

symptoms of hypoxia are experienced by the students during the CADO run; how these symptoms subjectively compare to the traditional protocol including their rate of onset and if there have been any adverse effects in the 24 hrs following the CADO run. Results: The study commenced on 3 Apr 2002 and as of 30 Jun 2002, 190 students had been surveyed. 127 of these students previously had undergone hypoxia training with the traditional protocol. The results so far indicate that 92% of these students get similar hypoxia symptoms during the CADO run and of these 67.5% report a slower rate of onset of these symptoms. The adverse effects documented in the 24 hrs following the CADO protocol include aural barotrauma (0.2%), "oxygen ear" (0.1%) and headache (0.05%). Conclusion: Analysis of the most recent subjective data upholds the validity of the CADO protocol and supports future objective studies.

59. DECOMPRESSION SICKNESS AND PHYSIOLOGICAL TRAINING IN ALTITUDE CHAMBER IN BRAZILIAN AIR FORCE WALDO F. TEMPORAL

Introduction

Physiological Training flights in Altitude Chamber have been used by Brazilian Air Force since October 23rd, 1951. In the past the internationally adopted flight profiles and several training procedures were very aggressive compared to those nowadays performed. That explains the high incidence of Decompression Sickness (DCS) at that age. Since 1979 the Physiological Training Altitude Chamber flights profiles and procedures suffered important modifications in Brazil reducing drastically the occurrence of DCS. The aim of this work is to present and analyze those modifications and its real effectiveness to reduce the occurrence of DCS.

Methods

All exposures to decompression in Hypobaric Chamber in Brazilian Air Force in the last 22 years were analyzed and the incidence of DCS was compared with incidence in different countries based on available data in the literature.

Results

The adopted modifications in Physiological Training in Altitude Chamber, such as in Denitrogenation, in Flight Profiles, and in Rapid Decompression resulted in a significant reduction of incidence of DCS.

Conclusions

The incidence of DCS can be reduced with simple and effective modifications in Physiological Training in Hypobaric Chamber procedures and flight profiles. Those modifications can increase safety without any disadvantage to any objective of physiological training in Altitude Chamber.

Wednesday, 18 September 2002 - 3:05 pm PANEL: PERSPECTIVES IN SPACE MEDICINE

60. CULTURE AND DECISION MAKING KRAFT NO1, ORASANU J1, FISCHER U2 and MCDONNELL L1

Abstract

Before long-duration flights with international crews can be safely undertaken, potential interpersonal and intercultural difficulties will need to be addressed. Decision-making processes involving international crews and international ground controllers during the long-duration experiment "Simulation of the Flight of the International Crew on the Space Station" (SFINCSS-99) lead to an unexpected and not at all preferred outcome. This case provided an opportunity to study the reaction and interpersonal relationships of participants and space agencies from different cultures. This analysis was based on the final report of SFINCSS-99 and publicly available sources. We applied a newly developed decision making model to determine how the decision led to the outcome. A crew member from one culture left the experiment half way through and a crew member from another culture went public and to court over two unexpected incidents. The decision-making process, after the two incidents, seemed to have been influenced by groupthink, pressure towards uniformity, inferential errors (differing by culture) and dominance. Crew members who exercised relatively little power felt angered, frustrated, or disheartened by their impotence. Furthermore, psychological closing, crew autonomy, alienation phenomena and decrease of relevant information exchange occurred as a crew reaction to ground controllers decisions (differently for each culture), which have also been observed during long-duration space flights. A shared understanding of the problem would have enabled all participants to contribute appropriately to its solution. Therefore, selection should focus on communication and interpersonal skills, multicultural training and analysis of group dynamics and interpersonal relationships for all international participants both in space and on the ground.

61. MICROGRAVITY LABORATORY/PUCRS THE BRAZILIAN SPACE LIFE SCIENCE RESEARCH CENTER T. RUSSOMANO

The recent involvement of Brazil in the construction and utilization of the International Space Station has motivated several Brazilian research institutions and universities to establish study centers related to Space Sciences. The Pontificia Universidade Catolica do Rio Grande do Sul (PUCRS) is no exception. With 50 years of

university tradition, PUCRS is now the leading Brazilian University in the area of aeronautics and astronautics. The University initiated in 1993 the first degree course training students to operate commercial aircraft in South America. A further step was the decision to build the first Brazilian laboratory dedicated to the conduct of experiments in ground-based microgravity simulation, aviation physiology and aerospace engineering. Established in 1998, the Microgravity Laboratory is supported by the Schools of Medicine, Aeronautical Sciences and Electrical Engineering/Biomedical Engineering of PUCRS. The Microgravity Laboratory research areas include head-down tilt as a simulation of microgravity; hypoxia and microgravity; commercial aviation in the 21st century; aerospace Biomedical engineering; aerospace pharmacology; and telemedicine. The philosophy of the Microgravity Laboratory has been based on that its research projects should: (1) be of short duration and low cost; (2) act as an educational and scientific motivation for researchers, teachers and students; (3) be a link between Brazil and universities and institutions by the exchange of investigators, students, equipment and joint funds of collaborative projects; (4) add some contribution to the knowledge of Space Life Sciences with clear scientific, technological, social and economic benefits for society. Professors, researchers, students and technicians from eight Schools of PUCRS have been participating in the activities of the Microgravity Laboratory. Research projects studies have been conducted with King's College London (KCL, UK) and German Space Agency (DLR, Germany). Exchange programs for trainees and scholars from the Microgravity Laboratory have been developed with NASA centres, KCL-UK, DLR-Germany, and Universities in the USA.

62. A SYSTEMS EXAMINATION OF KEY ISSUES FOR A LONG DURATION SPACEFLIGHT TO MARS WITH EMPHASIS ON THEORETICAL BONE DEMINERALIZATION PROFILES FOR VARIOUS ORBITAL TRAJECTORIES, AND SOME FURTHER COMMENTS ON COUNTERMEASURES UNDER INVESTIGATION

D.A. HOLLAND, Ph.D 1., J.D. MUCCIO, M.D 2., J.A. JONES, M.D

Introduction. One significant challenge for long duration spaceflight is the problem of Bone Mineral Density (BMD) decreases. To date, bedrest and in-flight results have shown that losses from 0-4 %/month are possible. This loss increases fracture risk and enhances the chance of kidney stone formation. Methods. Theoretical BMD loss profiles are computed for several Mars mission trajectories. This loss model is based upon population and theoretical osteoporosis research combined. Results suggest that fracture risk in a given region is related to three factors: BMDs, direction/magnitude of force and body habitus. Discussion. Osteoporotic population studies on Earth yield fracture thresholds for the lumbar spine (0.9 gm/cm²), and hip (0.65 gm/cm²). These could be useful to help estimate risk upon return to Earth after a long Mars mission. Three types of Mars missions with differing orbital mechanics considerations are evaluated with these theoretical curves superimposed upon the corresponding mission lengths: "Conjunction Class" (235 days outbound, stay 516, return 191 days), "Opposition Class" (169 days outbound, stay of 40, 361 day return—but with a riskier Venus fly-by), and "Fast Transit" higher energy trajectories (120 days outbound, 614 stay on Mars, return 120 days). Conclusions. Assuming certain rates of bone loss per month in space and on Mars (which is totally hypothetical at present), a theoretical fracture risk model can be developed to evaluate the sensitivity of mission parameters on certain loss profiles. This along with countermeasures data generated thus far and a systems perspective, gives planners yet another piece of information upon which to allocate precious space program resources for future studies and space mission development.

63. PSYCHOLOGICAL EFFECTS OF SOCIAL EVENTS DURING ISOLATION

LK MCDONNELL, NO KRAFT, J ORASANU

An important issue when selecting and preparing crews for long-duration space flights is the impact of visiting crews on the psychological well-being of "resident" crews. The Simulation of the Flight of the International Crew on the Space Station (SFINCSS-99) study provided an opportunity to examine the effects of diverse visiting crews on the psychological well-being of resident crews. During the first half of this 264-day simulation, two resident crews (1 & 2) were visited by a crew (4V) from their same cultural background. During the second half of the simulation, Crew 2 left and was replaced by an international crew (3); Crews 1 and 3 were then visited by an international crew (5V). The diaries written by the resident crew members during the week following the departure of each visiting crew were analyzed to determine the reported psychological impacts of the visits. The diaries indicated a high number of negative comments from resident Crews 1 and 2 after Crew 4V left, which was attributed to the stress of having to play host to the visitors. This negative effect was not found with resident Crews 1 and 3 after Crew 5V left. Crew diaries after the second visit indicated that neither resident crew felt obligated to host the international visitors, who were perceived as competent research partners, so they were able to enjoy the positive social benefits of the visit. The fact that psychological stress increased only when resident crews felt obligated to host their visitors indicates that the increase in stress is more dependent on the expectations of the resident crewmembers than the visitors themselves, or the specific cultures of the resident or visiting crews. These findings suggest that attention needs to be given to the expectations of resident crews, and efforts need to be made to promote cooperative work between crews to mitigate potentially negative host/visitor effects.

64. INTERNATIONAL SPACE STATION (ISS) CREW MEDICAL SELECTION AND CERTIFICATION: CURRENT EXPERIENCE AND PERSPECTIVES

SL POOL*, VV MORGUN**, V. DAMANN, G. GRAY****C. SEKIGUCHI*****, AE SARGSYAN********

The agencies participating in the ISS Program, including the Russian Space Agency (RSA), the European Space Agency (ESA), the National Space Development Agency of Japan (NASDA), and the Canadian Space Agency

(CSA), have established the ISS Multilateral Space Medicine Board (MSMB). The board is comprised of five physicians representing their respective agencies and functions on the principle of consensus. Responsibilities of the MSMB include initial medical certification and annual re-certification of crewmembers for training and space flight on ISS, and for spaceflight passengers. The MSMB is also responsible for international certification of physicians for practice of medicine in space, as well as in ground phases of the ISS Program. Each Agency selects, medically certifies, and re-certifies their ISS crewmembers, to meet or exceed medical standards and evaluation requirements established by the ISS Multilateral Medical Operations Panel. Medical data are then presented to the MSMB. In the majority of cases, a decision is made and documented during the session. Several aspects of MSMB's accomplishments and current activities will be presented. This presentation will review the function of the MSMB, and data will be presented on MSMB activities since its chartering in 1997. MSMB has considered medical data of 77 ISS crewmember candidates and of three members of short-duration visiting missions. 48 re-certification events have also been documented. In seven out of these 80 cases, the Board has requested additional specific medical data. In one case, an additional diagnostic study has been requested, and a conditional certification status granted pending its normal results. In the other two cases, the Board has limited medical certification status to short - duration space flight eligibility. MSMB has considered the credentials of 14 flight surgeons from all ISS Partner agencies, to approve their entrance into the ISS Program as flight surgeons.

65. PSYCHIATRIC ISSUES AND THE INTERNATIONAL SPACE STATION

N.A. KANAS, M.D.

INTRODUCTION. Anecdotal reports from space and results from space analog studies on Earth have suggested that a number of psychiatric issues may affect space travelers engaged in multicultural long-duration missions, such as those involving the International Space Station. Relevant syndromes include: adjustment and somatoform disorders, mood and thought disorders, asthenia, and post-mission personality and marital effects. Crew heterogeneity, changes in cohesion over time, variations in leadership role, and cultural and language differences may result in on-board intrapsychic and interpersonal stress that may negatively impact on the psychological well being of the crewmembers.

METHODS. Empirical data from space related to some of these psychiatric issues were accumulated during our 4½-year NASA-funded study of 13 astronauts and cosmonauts and 58 American and Russian mission control personnel who participated in a series of missions during the Shuttle/Mir program.

RESULTS. There was evidence for the displacement of tension and unpleasant emotions from people in space to people in mission control, and from mission control personnel to management. Americans were less happy with their work environment than Russians. This may have been due to cultural differences between these two groups, although in space the single American astronaut was always in the minority. Crew and ground subjects generally scored in the healthy ranges on our measures, and on one indicator of mood states there was no evidence to support the presence of asthenia in space.

CONCLUSIONS. More work needs to be done to explore the impact of displacement and the relevant importance of cultural versus minority influences on crew behavior. New psychometric measures need to be developed to study specific psychiatric syndromes in space, especially asthenia. Further work should be done to evaluate the impact of psychiatric medications and other treatments on crewmembers during future space missions.

Wednesday, 18 September 2002 - 4:35 pm

AEROMEDICAL EVACUATION

66. THE SWEDISH NATIONAL AIR MEDEVAC (SNAM) - A PROJECT TO CONVERT A PASSENGER AIRLINER INTO A LARGE-SCALE AIR AMBULANCE - A NATIONAL ASSET FOR MEDICAL TRANSPORTATION OF INJURED OR SICK PATIENTS IN WAR OR PEACETIME.

H BRANDSTROM MD, P BROLE 'N PROJECT DIRECTOR SNAM

The project is headed by the Swedish Civil Aviation Administration in cooperation with the Swedish National Board of Health and Welfare and Scandinavian Airlines (SAS). The purpose is that SAS within three years will have an organisation ready and exercised for converting passenger airliners into large air ambulances.

The organisation will in war or peacetime transport injured or sick patients after a major accident or disaster to wherever they can get the best treatment and care available at the moment. SNAM is basically designed for domestic use, but can also be used for international relief- or humanitarian missions.

After call from relevant authority a SAS aircraft is taken out of ordinary service at Stockholm Arlanda Airport and converted into a large air ambulance. A SAS flight crew and a special medical care team are also alerted. In six hours from call the air ambulance will be mission ready. Should there be need, a second plane will be ready within another 6 hours. For maximum flexibility and cost savings, any aircraft to be used will not need any prior modifications.

Self-contained, advanced lightweight man-portable mobile intensive care units will be installed on board and connected to the airplane's ordinary electrical system. Oxygen bottles for the units are stored in a special rack on each unit. All onboard equipment and installations will be certified in accordance with current civil aviation regulations. Each airplane will be equipped with six units for patients requiring intensive care, eight units for

advanced monitoring of less severely injured patients. There will also be room for up to 20 seated passengers with

67. NURSE-ASSISTED PASSENGER TRAVEL IN A MAJOR AIRLINE
N. KOWALSKY, M.D., D. McKENAS, M.D., MPH, L. CAMPBELL, RN.

In February, 2001, the American Airlines Medical Department implemented a service that offers a new medical option for those travelers with serious medical conditions and special needs who cannot travel independently but do not require more expensive air ambulance transportation. This paper will describe a series of over 60 such passengers, their medical conditions, outcomes, operational procedures and challenges.

68. THE EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) TECHNOLOGY UPDATE: READY AND RESPONDING
M W Lischak, J K Wright, and L P Krock

Introduction: Administration of hyperbaric oxygen (HBO) at remote locations or during transportation has traditionally been severely limited due to the weight and complexity of systems for providing this life saving modality. HBO for individual injuries or mass casualty situations resulting from military operations or civilian catastrophic events (i.e., earthquakes, tornadoes, etc.) can reduce the magnitude of the sustained injury and shorten the duration of recovery from acute trauma.

Methods and Results: Exhaustive test and evaluation of the EEHS demonstrated a simple and robust, yet lightweight and portable, system capable of staged-storage, deployability, rapid treatment initiation, and transport of casualties. Additional flight and human factors tests proved the EEHS to be reliable and rugged for fixed and rotor wing aircraft transport. The EEHS was deployed to staged locations for use and/or aeromedical evacuation when required. The process for deploying the EEHS into the field required development of a concept of operations (CONOPS) and education and training of teams to support employment of the EEHS. Discussion covers an overview of a Concept of Operations (CONOPS) for deployment and employment of the EEHS and medical team at the incident site and during aeromedical transport. Employment requires a minimum of a physician and supporting technician/medic to treat the patient and operate the EEHS. Training can be completed for this team in as little as three days.

Conclusions: Historically, utilization of Hyperbaric Medicine was limited to conditions that would endure the return to CONUS, or at best, local support. This is no longer the case. We are able to initiate treatment for the combatant/civilian at the incident site, thus preserving the combatant's optimal mission capability. Treatment can now be initiated under the most austere conditions and continue uninterrupted throughout aeromedical evacuation without imposing an undue transportation burden due to weight or altitude restrictions..

69. THE AIR DOCTORS OF SOUTH AUSTRALIA AND NORTHERN TERRITORY - A HISTORICAL PERSPECTIVE
Dr Robert Cooter AM

The history of Flying Medical Services in SA & NT commenced in Alice Springs when the first base was established in 1936 by the Rev. John Flynn, the founder of the R.F.D.S.

The second base was established in 1938 at Caduna in the remote west of SA by the Bush Church Aid – a humanitarian organisation created by the Anglican Church of Australia.

Three doctors only gave service to the Ceduna base over its whole life of 30 years. Port Augusta in 1955 and the last base in Adelaide in 1988. The history of the service activities of each base are highlighted in this paper.

The writer has been involved in the Port Augusta and Adelaide operations over 32 years, as a Flying Doctor in Port Augusta (1956-65), a councillor on the RFDS Council (1977-1999) and President of Central Operations (1985-88).

The history of the central operations of the RFDS is traced from its humble beginning in 1955 as part of a group general Practice in Port Augusta to an aero-medical service of excellence covering all of rural South Australia and 2/3 of the Northern Territory.

BUSH CHURCH AID (CEDUNA SA) 1938 – 68
ROYAL FLYING DOCTORS SERVICE ALICE SPRINGS (NT) 1936-
PORT AUGUSTA 1955
ADELAIDE 1988 –

Monday, 16 September 2002 - 2:00 pm

POSTER SESSION 1

1p. A HIGH ALTITUDE EXPOSURE INDUCES ACTIVATION OF NEURONS IN THE AREA POSTREMA AND NUCLEUS TRACTUS SOLITARIUS

C.KAUR - Department of Anatomy, Faculty of Medicine, Blk MD10, 4 Medical Drive, National University of Singapore, Singapore 117597, G. SIGH - Undergraduate year 4 Medicine student, Faculty of Medicine, National University of Singapore, Singapore 117597, J. SINGH -Presenting Author (Dr J. Singh, Member of IAASM) Singapore Technologies Medical Services Pte. Ltd., Aeromedical Centre, 492 Airport Road, Singapore 539945, C.M. PENG - 3. Singapore Technologies Medical Services Pte. Ltd., Aeromedical Centre, 492 Airport Road, Singapore 539945 & E.A. LING - 1. Department of Anatomy, Faculty of Medicine, Blk MD10, 4 Medical Drive, National University of Singapore, Singapore 117597

Introduction. Nausea and vomiting (emesis) are often experienced during rapid ascent to high altitude. The area postrema (AP) is a small circumventricular organ located near the tip of the obex on the dorsal surface of the medulla oblongata at the caudal part of the fourth ventricle and it has been implicated as an essential chemoreceptor zone involved in the control of emesis. It is thought that activation of the neurons in the AP leads to nausea and vomiting through its projection to the neighbouring nucleus tractus solitarius (NTS). The present study aimed to investigate the response of the neurons in the AP and NTS following an altitude exposure which leads to the development of hypobaric hypoxia. Methods. Male adult Wistar rats weighing 250g were exposed to an altitude of 8000m in an altitude chamber (Model 16M ETC, USA) following which they were sacrificed at various time intervals ranging from 1h to 14 days. Normal rats (not exposed to altitude) were used as controls. Results. Fos (a marker of neuronal activation) expression was induced in the neurons of AP and NTS 1-4h after altitude exposure but was not observed in the neurons of control and longer surviving rats. At the ultrastructural level, some of the neurons in the AP and NTS appeared swollen at 4-7d after altitude exposure. At this time interval, many axons in these areas showed the presence of dense bodies indicative of degeneration. Macrophages were observed to engulf the degenerating axons at this stage. These changes subsided with time so that at 14d after altitude exposure the neurons appeared comparable to neurons in the controls and degenerating axons were not observed. Conclusions. It is suggested that hypobaric hypoxia is responsible for the initial activation of the neurons in the AP and NTS and this activation may be responsible for nausea and vomiting experienced at high altitude. The subsequent neuronal and axonal changes may be due to the delayed effects of hypoxia. This study was supported by a Research Grant (R181-000-020-112) from the National University of Singapore

2p. ADAPTATION TO CHANGING TASK REQUIREMENTS IN SIMULATED HIGH ALTITUDE CONDITIONS

ANDOR GRÓSZ2, LÁSZLÓ BALÁZS1, ISTVÁN CZIGLER1, ERIKA TÓTH3, JÓZSEF HORNYIK3

Influence of high altitude conditions on operators' ability to adapt to changing task requirements was investigated. Experienced pilots were tested before and after a simulated takeoff, and during the steady state condition in a simulated altitude of 5500 m. Stimuli were male and female names pronounced by 3 male and 3 female speakers. Stimuli were delivered via stereo headphones. The subjects had to switch between the following two task conditions. In the "voice" task, they had to respond to male voices with the right button and to female voices with the left. In the "name" task, subjects were to press the right button to a man's name, and the left to a woman's name. The task conditions were signalled by the direction of voices. Voices in the right ear indicated the "name" task while voices in the left ear denoted the "voice" task. After a block of 3 similar trials stimuli moved to the opposite ear and subjects had to switch task. Results indicated that switching between tasks was associated with considerable cost in reaction time and number of errors. Both reaction time and number of errors were higher in the first trial after switching compared to the consecutive trials within the same task block. Deterioration of performance in the hypoxic condition was manifested in the increased number of errors as well as in slower reaction times. Hypoxia lead to particularly slow responding in the second and third trials after task switching. This suggests that mechanisms that allow more efficient information processing once task switching has taken place are taxed more heavily by hypoxia.

3p. HUMAN FACTORS IN UNMANNED VEHICLE OPERATIONS IN INDIA: A PRELIMINARY REPORT

Wg Cdr Sanjiv Sharma - Squadron Medical Officer, 34 Wing AF, IAF, C/O 99 APO, India, Gp Capt N Rattan - JDMS(MB), Air HQ, RK Puram, New Delhi, India & Wg Cdr VV Joshi - Classified Specialist (Aerospace Medicine), 1 AMTC, Hindon, India Gp Capt N Rattan+ Wg Cdr VV Joshi#

Introduction. All modern armed forces have introduced Unmanned Aerial vehicles (UAV) for surveillance, reconnaissance, target acquisition or missions based on customer furnished payloads. The Indian Air Force (IAF) also has operational, multi-payload UAV system, with varying range and endurance. The advent of these sophisticated systems makes it imperative on the operators to exploit the potential of the UAV system maximally. The operators include Mission Commander (MC), External Pilot (EP), Internal Pilot (IP) and Observer (OB).
Methodology. The approach for Human Factor Ergonomics (HFE) analysis was personal interaction and a questionnaire feedback from the operators and the observations made during the missions. Five factors were analysed viz the individual, the tasks performed, tools and the technologies used, the physical and the organisational environment. **Results.** UAV missions involve psychomotor and cognitive skills, intense concentration, perfect eye hand co-ordination, endless patience and perhaps a high mental workload for their vigilance task. The human element therefore is critical for the success of a UAV mission, as in any other aeronautical mission. Each operator works in different environments, has different roles, but has to closely integrate with other crew members to ensure success in accomplishing a mission. **Conclusions.** Selections of individuals for various aspects of UAV flying are discussed. Work rest schedules are also recommended. Methods to keep the operators in good mental and physical health are suggested. **Keywords.** Unmanned Aerial Vehicle, Human Factors and Ergonomics, Mental Workload, Work Schedule, Crew Resource Management

4p. HUMAN ERROR ANALYSIS OF INDIAN NAVAL AVIATION ACCIDENTS (1990-2001) - THE APPLICATION OF HUMAN FACTOR ANALYSIS AND CLASSIFICATION SYSTEM (HFACS) **Surg Lt Cdr SS Khanuja - Graded Specialist, Aerospace Medicine, INS Utkrosh, Port Blair & Group Captain Harish Malik - DDMS(AM) and Senior Advisor Aerospace Medicine, Air Headquarters, RK Puram, New Delhi**

Introduction. Human Error (HE) has been implicated in 70-85% of aviation accidents in both military and civil aircraft accidents. Investigation agencies concentrate mainly on pilot error (Active Errors) and the role of Latent errors in the causation of aircraft accidents is less clear. The HFACS, developed by Weigmann et al provides a system of identification and classification of HE, both active and latent. This study uses the HFACS to bring out the type of HE committed in Indian Naval Aviation. **Methodology.** The Inquiry reports of all naval aircraft accidents during the period 01 Jan 1990 to 31 Dec 2001 were scrutinized. For each accident, Cause and Factors were identified and tabulated in the HFACS model of classification of Human Factors and then analysed. **Results.** 203 causes/factors contributed to 66 aircraft accidents, during the period Jan 1990 to Dec 2001. Major accidents contributed to 63.6 % of all accidents. A total of 54.5% of all accidents were attributed to human error (as decided by the investigating agency). Unsafe supervision appeared to be the dominant error committed accounting for 31.5% of all accidents, followed by Unsafe acts (29.06%). Pre-conditions for unsafe acts and organizational influences each contributed 19.7% to all accidents. The study brings out a dichotomy as regards to the high prevalence of Decision Errors over Skill based errors detected in this study as compared to the studies carried out by Weigmann and Shappell. **Conclusion.** The study brings out the efficacy of the HFACS to identify and classify various factors identified in the causation of aircraft accidents in the Indian Navy. Unsafe Acts (by aircrew) contributed to approximately one third of all factors identified in accident causation. Latent errors contributed to the remaining two thirds. Common errors committed have been described and methods to counter these suggested.

5p. ANTIOXIDATIVE ENZYME PROFILES IN POLISH FIGHTER PILOTS **E. ZAWADZKA-BARTCZAK M.D. PH.D. *, L. KOPKA M.D. PH.D. ***

Introduction: We present the evaluation of the activities of red blood cell antioxidative enzymes, total antioxidant serum ability (TAS), and lipid concentrations in clinically healthy men. **Methods:** In 229 fighter pilots we measured: total cholesterol (T-CH), low-density cholesterol (LDL-CH), high-density cholesterol (HDL-CH), triglycerides (TG) and lipoprotein (a) [Lp (a)], and we calculated the index of atherogenicity (T-CH/HDL-CH). In addition, we measured superoxide dismutase (SOD) and glutathione peroxidase (GPx) activities, and total antioxidant serum ability (TAS). The results obtained were statistically evaluated using ANOVA test of linearity. **Results:** Mean lipid concentrations in the group studied fell within the reference ranges. 40.6% of the pilots had mild hyperlipidemia, whereas 30.4% and 7.4% of them had respectively moderate and severe hyperlipidemia and 22.2% had normal and low lipid levels. Mean value of the atherogenic index in the whole group was >5. There were statistically significant differences of SOD and GPx activities, and TAS in relation to different T-CH concentrations. **Conclusions:** 1) The activities of SOD and GPx, and TAS in fighter pilots can considerably exceed the upper limits of the respective reference ranges, being (in our study): SOD - 794-2863 mean 1528.77 ± 351,32 U/gHb, GPx - 16.8-135.4 mean 57.2 ± 21.24 U/gHb, TAS - 0.58-2.32 mean 1,47 ± 0,29 mmol/l. 2) People with T-CH concentration above 7.7 mmol/l have considerably decreased (below standard reference ranges) activities of SOD and GPx, and TAS. 3) Normal T-CH concentration does not exclude concomitant increase in LDL-CH and/or decrease in HDL-CH, and an abnormal index of atherogenicity.

6p. DEVELOPMENT OF AN ARTERIALISED EAR LOBE BLOOD SAMPLER FOR USE IN MICROGRAVITY

T. RUSSOMANO

There would be considerable value in the ability to measure accurately the partial pressures of oxygen (PO₂) and carbon dioxide (PCO₂) in arterial blood in long duration space missions both for the management of medical emergencies and for research. The sampling of arterialised blood from the earlobe has been employed in clinical medicine for over thirty years as a substitute for direct sampling of blood from a peripheral artery. The present authors have successfully employed the technique in simulated microgravity with and without hypoxia and light exercise and one of us (TR) proposed that it could be used in space flight. A prototype apparatus for taking blood samples from the earlobe anaerobically in microgravity has been built and tested. The apparatus is designed to incise the earlobe and collect two samples of arterialised blood without contamination of the environment of the spacecraft. The apparatus comprises two units. The blood-sampling unit to which the vasodilated earlobe is clamped carries: (i) A fine scalpel blade attached to a spring-loaded plunger release of which produces an incision (2-3 mm depth) in the earlobe (ii) Two heparinised capillary tubes, each of which can be brought sequentially in contact with the blood flowing from the incision, and, (iii) A pledge of cottonwool, which can be brought over the incision to stem the bleeding. The blood sampling unit is held in place by a headband similar to a communication headset. In initial tests of the prototype apparatus, analysis of the blood samples collected from a healthy subject yielded a PO₂ = 93 mmHg; PCO₂ = 40 mmHg; Sa O₂ = 96.9% and pH = 7.37. A formal comparison of the blood gases in blood samples taken with the apparatus with those taken simultaneously from the radial artery is to be conducted in the near future

7p. TOLERANCE OF ACCELERATION IN HEAD TO FEET AXIS (+Gz) AND HEART RATE INCREASES.

ZAWADZKA-BARTCZAK E. MD PHD, KOPKA L. MD PHD

Background: During the onset of acceleration in the +Gz axis, blood is displaced towards the lower parts of the body. Compensatory reflexes provoke generalised vasoconstriction and a rapid increase of heart rate. The aim of this study was to answer the question is there any correlation between tolerance of acceleration and changes/oscillation of heart rate during an interval test in a centrifuge. Methods: Electrocardiograms of 40 pilots obtained during the centrifuge tests were assessed. Correlation between maximal heart rate increases (?HR) and tolerance of +Gz acceleration during each step of the centrifuge procedure (before, at the top and after each interval) were estimated. Results: Tolerance levels were divided into three groups: I) 5.0-5.5 Gz, II) 6.0-6.5 Gz, and III) 7.0 Gz. There were 9, 17 and 14 pilots in each group respectively. The average baseline (HRb), top (HRt) and end (HRe) heart rate were: a) for group I – 142.8 (SD±28.3); 167.5 (SD±24.8); 155.8 (SD±27.6); b) for group II – 139.3 (SD±23.8); 164.0 (SD±24.3); 148.3 (SD±26.3); c) for group III – 139.2 (SD±29.6); 166.4 (SD±27.5); 143.5 (SD±41.6). Conclusions: We concluded that tolerance of acceleration depends on spontaneous tension oscillations of sympathetic system (of which heart rate variations are a consequence). The degree of heart rate increase (?HR), especially in the top step of intervals is in linear correlation with tolerance of +Gz acceleration.

8p. INFLUENCE OF +GZ STRESS ON DYSRRHYTHMIAS OCCURRENCE AND HEART RHYTHM FREQUENCY OF PROVOKED SUPRAVENTRICULAR TACHYCARDIA

E. ZAWADZKA-BARTCZAK*, L. KOPKA*, A. DOMIN**

Introduction: Dysrhythmias and their haemodynamics consequences, which have been provoked on +Gz stress, was the subject of many studies. Methods: The group of 5210 clinically healthy pilots and pilot candidates (17 – 37, av. 21 year old) assessed for G tolerance was taken under study. All the pilots have received ECG monitoring during assessment in human centrifuge. Results: Their ECG showed following dysrhythmias: bradycardia (63%), sinus node arrest with atrioventricular junction replacing rhythm (8,2%), single ventricular extrasystolia (periodically numerous) (7%), supraventricular extrasystolia (2,5%), unsustained ventricular tachycardia (0,08%), transient heart automatism inhibition with asystolia (0,04%). There were two SVT incidents during the +Gz stress. One of them was SVT (250bpm) during pilot candidate assessment. SVT occurred at +5Gz and was conducted to the ventricles with intraventricular aberration. Examinee remained conscious all the time in spite of rapid heart rhythm and acting acceleration. After deceleration, HR slowed down to 205bpm and intraventricular conduct disturbances stopped. Administration of repeated adenosine dosage (last 12mg i.v.) was of no effect. Sinus rhythm returned after transoesophageal stimulation (BURST type, 350epm). That confirms re-entry mechanism of this arrhythmia. The second SVT incident (170bpm) happened at +6Gz lasted about 33sec. and stopped spontaneously after deceleration. There was no organic background for dysrhythmias occurrence in all cases. Tachyarrhythmias were most common during acceleration onset and bradyarrhythmias during acceleration offset. Conclusions: 1. Combined psychological and accelerative stress can provoke various dysrhythmias, potentially life threatening; 2. Sympathetic stimulation and catecholamine release under G stress can not only provoke SVT, but also lead to dangerous increase of its rhythm; 3. Presented results confirm necessity of ECG monitoring during centrifuge examinations.

Tuesday, 17 September 2002 - 2:00 pm
POSTER SESSION 2

9p. CHANGES OF PEPTIDES IN GASTROINTESTINAL TRACT TISSUE OF MICROGRAVITY SIMULATION

SHEN DONGYUN, WANG JIANGUO, JIN YONGCHENG, ZOU DIANXING

Objective To determine changes of brain-gut peptides of rabbit in simulation microgravity. Methods Tissue samples were taken from 9 parts: gastric antrum, duodenum, jejunum upper, jejunum middle and jejunum lower, ileum upper and ileum lower, colon tenue and colon major. Seven peptides, motilin, endothelin, somatostatin, beta-endorphin, glucago, substance P and gastrin were measured by radioimmunoassay. Results After 15 d simulation microgravity, levels of somatostatin in test group decreased than that of control group. Conclusion Changes of these peptides might regulate gastrointestinal activity in simulate microgravity.

10p. IN-FLIGHT HYPOXIA INCIDENTS IN THE AUSTRALIAN DEFENCE FORCE : 1990 - 2001

DR. GORDON G. CABLE , M.B. B.S. D.AvMed

Since the earliest days of aviation when aviators first took to the skies in balloons, hypoxia has been recognised as a significant physiological threat at altitude. The aim of this study was to analyse incidents of hypoxia reported to the Directorate of Flying Safety of the Australian Defence Force (DFS-ADF) for the period 1990 – 2001, as no previous analysis of these incidents has been undertaken. The data will be useful in planning future training strategies for aircrew in aviation physiology. Method: A search was requested of the DFS-ADF database, for all Aircraft Safety Occurrence Reports (ASOR) listing “hypoxia” as a factor. These cases were reviewed and the following data analysed: aircraft type, number of persons on board (POB), number of POB hypoxic, any fatalities, whether the victims were trained or untrained as aircrew, if the symptoms were recognised as hypoxia, symptoms experienced, the altitude at which the incident occurred and the likely cause. Results: During the period studied, 27 reports of hypoxia were filed, involving 29 aircrew. There was one fatality amongst them. Most incidents (85.1%) occurred in fighter or training aircraft with aircrew who use oxygen equipment routinely. The most common cause of hypoxia (63%) in these aircraft is the failure of the mask or regulator, or a mask leak. Symptoms are subtle and often involve cognitive impairment highlighting the danger of even mild hypoxia in flight. The vast majority (75.8%) of these episodes were recognised by the aircrew themselves, highlighting the importance of hypoxia training. Conclusion: The data calls into question the validity of hypobaric chamber exposures as a training technique, as this analysis demonstrates that in flight most aircrew do not develop hypoxia following a rapid decompression, or indeed with oxygen masks off. Instead the onset is subtle, affects cognitive functions most commonly, and occurs while breathing from oxygen equipment.

11p. SLOVAKIA IN SPACE

M. PROKOP

After the peaceful dissolution of former Czechoslovakia, Slovakia became a new member of “space community”. In 1998 the first Slovak astronaut Ivan Bella was launched to space in cooperation with Russian space experts. Air Force Military Hospital (AFMH) in Košice is only institution assigned to practice aviation and space medicine in Slovakia. In 1997 AFMH participated in selection of Slovak astronaut out of 28 fighter pilots. 120 parameters were examined for every candidate (physical examination, blood examination, x-ray, GIT endoscopy, spiroergometry, body mass index, psychological tests etc.) For each examination candidate received certain score. Four candidates with highest score were selected to take the examinations in Star City, Russia in order to undergo further medical tests under the supervision of Russian flight surgeons. Three candidates were found to be capable of space flight. Two of them underwent the final training. Astronaut Ivan Bella was selected to fly to MIR and to fulfill Slovak Space Mission to Station MIR conducted by Slovak Academy of Sciences (Endotest, Sensoasymetry project and Quail project). Slovak professionals in space research would like to continue in cooperation with space scientists from other countries. Euro Valley project is the promise for such cooperation.

12p. G-TOLERANCE DURING PASSIVE AND ACTIVE FLIGHT ON TS-11 "ISKRA" AIRCRAFT AND HUMAN CENTRIFUGE TESTING
ZAWADZKA-BARTCZAK E. MD PHD, KOPKA L. MD PHD, OLSZEWSKI R, PHD, TARNOWSKI A, PHD

Introduction: Acceleration tolerance is one of the most important predictors of pilot performance. Not only are there physical and medical determinants of human response to acceleration, but there are also some psychological and situational factors which are important for acceleration tolerance. Methods: In the present study, three psychologically different situations with identical acceleration levels were studied. Two groups of pilots, experienced instructors and cadets after 1 year of training, performed active flight (as pilots) and passive flight (as passengers) in the TS-11 "Iskra" aircraft, and a centrifuge exposure. All subjects completed a detailed questionnaire, which investigated their reactions to the acceleration experienced in the three situations. The task for subjects was to estimate when an anti-G maneuver was required, their subjective sense of acceleration and the degree of any accompanying psychological stress. Results: Analysis of the survey showed strong differences between a pilot's psychological reactions during active flight compared with passive flight and the centrifuge test. The subjective tolerance of acceleration and the requirement to perform an anti-G manoeuvre were much better during active flight, where the stress was perceived as less significant. Conclusions: 1. Tolerating G is subjectively more difficult during passive flight and centrifuge tests than it is during active piloting. Consequently positive results of the routine centrifuge tests are confirmation of strong gravity load tolerance and ability for air force service. 2. The level of stress is higher during a centrifuge test than in a real flight. 3. Experienced pilots are more able to judge their own G tolerance than cadet pilots. The results of this study have potentially important implications for routine aeromedical testing and human factor investigations.

13p. PRE-FLIGHT MEDICAL CLEARANCE: UCS'S EXPERIENCE WITH TAP AIR PORTUGAL
A JORGE, R POMBAL, H PEIXOTO, M LIMA UCS

INTRODUCTION The steadily increasing numbers of airline passengers world-wide are mirrored by a growing number of elderly, incapacitated, or ill passengers for whom specific in-flight equipment or services are needed, in order to minimise possible adverse effects associated with the cabin environment. In this study, requests to UCS for medical clearance (MEDIFs) for TAP passengers were characterised. UCS is a multi-specialty medical centre which provides healthcare mainly to TAP workers and their families, and includes an aviation medicine and a travel clinic. METHODS MEDIFs from between 1-1-1999 and 31-12-2001 were retrospectively reviewed and characterised by descriptive statistics. RESULTS Over half of a total of 1387 MEDIF requests were for male passengers, the most common age group ranging between 61 and 70 years. The most common conditions were musculoskeletal (especially lower limb fractures), followed by neurological, cardiac, respiratory and neoplastic conditions. A significant proportion of passengers needed a travel companion or a qualified escort, and/or wheelchairs, oxygen or stretchers. Thirty-two of the clearance requests were refused, and 25 deemed unnecessary. The most frequent reasons for refusal were recent myocardial infarction, or insufficient clinical data. Although the number of MEDIFs within the period studied corresponded to a rate of a mere 0.91 cases per 10,000 passengers, they may have prevented unexpected in-flight medical problems in about 0.8% of all TAP flights. CONCLUSIONS The results from this study allow us to better know and approach the actual medical clearance cases in our practice. Disseminating this type of data may also help to make passengers and their physicians more acutely aware of the importance of advance travel planning, taking into account issues such as medication, contagiousness and type of assistance required.

14p. THE INFLUENCE OF DIFFERENT GRAVITATIONAL ENVIRONMENTS ON THE MECHANOTRANSDUCTION IN OSTEOBLASTS
ZHANG SHU1, WANG BIN1, WU YAN-HONG1, WU XING-YU1, LI YING-HUI2

Introduction: Mechanical stress can produce loading-dependent flow of interstitial fluid through the lacunar-canalicular network of bone. Bone cells, particularly osteoblasts and osteocytes, can detect fluid flow as mechanical signal in situ, transduce the physical stimuli into biochemical signals and integrate these signals into appropriate changes in the architecture of bone. This process, termed mechanotransduction. Methods: We examined the effects of 1 h fluid shear stress (FSS) on the production of prostaglandin E2 (PGE2) and on the expression of constitutive and inducible cyclo-oxygenases, COX-1 and COX-2, by the rat calvarial osteoblasts cultured 60 h in three different gravitational environments, i.e. 1G terrestrial gravitational condition, 3G gravitational condition and simulated weightlessness condition. Results: Osteoblasts cultured in 1G condition reacted to 1.5 Pa FSS treatment with an enhanced production of PGE2. The response reached measurable stimulation values within 5 min after onset of flow. Stimulation continued throughout the 1 h FSS treatment period. In addition, 1.5 Pa FSS induced the expression of COX-2 but not COX-1. The COX-2 mRNA expression was gradually increased during 1 h FSS treatment period. As to the osteoblasts cultured in simulated weightlessness by using clinostat, mechanical stimulation by 1.5 Pa FSS resulted, after 30 min, in increased PGE2 production. And stimulation continued throughout the next 30 min FSS treatment period. The COX-2 mRNA expression was only detected after 60 min FSS treatment, however, the level of COX-2 message was decreased. The nature of cell responsiveness was not significantly different between 1G

and 3G gravitational conditions ($P>0.01$) but between simulated weightlessness and other two conditions ($P<0.01$). Conclusion: These results suggested that mechanotransduction in osteoblasts was affected by stimulated microgravity, whereas it was not altered in 3G gravitational environment. This abnormal mechanotransduction might contribute to the disturbed bone metabolism observed in crewmembers.

15p. HUMAN CARDIOVASCULAR RESPONSES IN DAILY 1.5 +Gz LOADING BY SHORT ARM CENTRIFUGE

ZHANG SHU, XU ZHI-PENG, MA FEI, LI JUN, CAO XIN-SHENG, FENG DAI-YA

Introduction: In addition to exercise training as a countermeasure, short arm human centrifuge has been proposed as a countermeasure against physiological problems during long exposure to weightlessness in space station and during extra planetary exploration. However, nothing is solidly established regarding the most desirable program for artificial G application. Methods: The present study evaluated the effects of a daily +Gz load on cardiovascular function by short arm centrifuge. 1.5 G of +Gz and 20 minutes centrifugation was adopted to 10 healthy male subjects using 1.9 m radius centrifuge equipped to The Fourth Military Medical University. Results: The variables recorded were thoracic impedance (Tz), stroke volume (SV), heart rate (HR), left ventricular ejection time (LVET) and cardiac index (CI). After 3 days training, compared with the data of pre-G load period, HR was significantly decreased ($P<0.05$), SV and LVET had a trend to increase. TPR and Tz had a trend to decrease. 7 days training caused a greater increase in SV ($P<0.01$), LVET ($P<0.05$) and SV ($P<0.01$), though the changes of Tz, TPR and CI were still non-significant. Conclusion: Our results suggest that daily repeated 20 min +1.5Gz load can ameliorate the orthostatic and acceleration intolerances induced by prolonged bed rest (BR) or spaceflight. From this study a short-arm centrifuge can be recommended as a countermeasure against cardiovascular deconditioning in weightlessness.

Wednesday, 18 September 2002 - 2:00 pm

POSTER SESSION 3

16p. DISTURBANCES OF 48-HOUR SLEEP DEPRIVATION ON PERFORMANCE OF ONE-HAND AND TWO-HAND TRACKING.

ZHANG SHU, WU XING-YU, LI XUE-YI, HAN LI-PING

Introduction: Manned space flights have shown it is possible to sleep in microgravity. However, some sleep disturbances, i.e. sleep deprivation, sleep reversal, naps, shift in sleep onset time, and circadian rhythm alternation, have been reported which influence performance of the crew and safety of space flight. The main purpose of the research was to study the effect of sleep deprivation up to 48 h on tracking performance. Method: Fourteen healthy male subjects (aged 19~21) underwent sleep deprivation up to 48 hours. During which one-hand dual task test (tracking and visual reaction of oddball mode), as well as two-hand tracking were done every 4 hours. Results: Distances (D) of one-hand tracking test were significantly increased at 32 h, 44 h and 48 h of sleep deprivation ($P<0.05$). From 20 h to 48 h of sleep deprivation the mean reaction time (mRT), the reaction time of target stimulation (TsRT) and the reaction time of non-target stimulation (NTsRT) in visual reaction test were significantly longer than those of control ($P<0.05$), while the general accurate rate (AR) and the accurate rate of target stimulation (TsAR) were remarkably lowered ($P<0.05$). Distances (D) of two-hand tracking increased significantly ($P<0.01$) at 48 h of sleep deprivation. Conclusions: Sleep deprivation up to 48 hours can disturb the performance of one-hand and two-hand tracking. This abnormal performance may limit the capabilities of crewmembers during space missions.

17p. ALTERATIONS IN PULMONARY MECHANICS AND CARDIAC OUTPUT WITH EXPIRATORY LOADING AND HYPERINFLATION DURING EXERCISE

BD Johnson, JR Hickman, KC Beck

INTRODUCTION: The influence of an expiratory load (ExpLd) on cardiac function during activity is unclear. Several clinical and non-clinical conditions (COPD, asthma, external breathing devices, swimming) produce an increased ExpLd. Methods: The consequences of a 10-cmH₂O ExpLd on cardiac output (CO) with and without voluntary hyperinflation (VolHyp) at rest and during exercise in 7 untrained healthy subjects were determined. The subjects, age 22-53 (3F), performed an initial VO₂max evaluation followed by constant load exercise at 40% and 70% of peak workload. During the latter study, CO (acetylene wash-in technique) was determined under the following conditions: (1) non-loaded breathing, (2) ExpLd, (3) ExpLd with VolHyp. Heart rate (HR), pleural-pressure

(Ppl) and gastric-pressure (Pga) were monitored continuously. Results: With ExpLd, CO decreased by 1.1 L/min at 40% and 1.3 L/min at 70% of peak work (~10%). VolHyp during ExpLd returned CO to near non-loaded values. The changes in CO were caused by changes in stroke volume (SV), as HR did not vary. With ExpLd, end-expiratory lung volume, expiratory Ppl, and work of breathing (WOB) increased, while inspiratory Ppl became more negative. Expiratory Ppl and WOB remained constant during VolHyp, but inspiratory Ppl became more negative. Pga also increased during ExpLd except when combined with VolHyp. Conclusions: Our data suggest that ExpLd reduces CO during exercise by decreasing SV, most likely due to an influence of an increased expiratory Ppl or Pga on venous return. The fall in Pga and more negative inspiratory Ppl with VolHyp most likely contribute to the return of CO to non-loaded values. Supported by the Mayo Foundation and United States Dept of Health and Human Services #M01-RR00585.

18P. PREVENTION OF CARBON MONOXIDE EXPOSURE IN GENERAL AND RECREATIONAL AVIATION

SANFORD D. ZELNICK, D.O., M.S., MICHAEL W. LISCHAK, M.D., M.S., DAVID G. YOUNG III, M.D., THOMAS V. MASSA, B.S.

Carbon monoxide exposure is an important public health issue that poses a significant, albeit uncommon risk in aviation. Exposure is most common in single engine piston-driven aircraft where air is passed over the exhaust manifold to serve as cabin heat. Effective primary prevention of this exposure is the regular inspection and maintenance of aircraft exhaust systems, as required by law. For situations at special risk should exposure occur, and where there is concern for the public safety, installation of active warning devices for CO intrusion into cockpits may improve secondary prevention. Modern studies should be performed of occupation-specific abilities to support the 50 ppm FAA CO exposure standard and 50-70 ppm FAA Technical Standard Order (TSO) for CO monitors alerting pilots to the possibility of exhaust gas intrusion into their cockpits.

19p. COMPARISON OF PHYSIOLOGICAL RESPONSES TO HYPOBARIC HYPOXIA AT ALTITUDES OF 33,000 AND 25,000 FEET.

DOSEL Petr, M.D., SAZEL Milos, M.D., Ph.D., CETTL Ludvik, Ing., Ph.D.

Introduction: The hypoxia tolerance of Czech Air Force (CAF) pilots is tested routinely in a hypobaric chamber at 25,000 ft. Military pilots can be exposed to more intensive hypoxia during emergency situations. CAF is currently re-equipping with a new subsonic combat aircraft, the L-159. Since this aircraft can operate at 33,000 feet, we were interested in examining changes in physiological responses and effective workload timing at 33,000 ft in comparison with the standard hypoxic demonstration (25,000 ft). Methods: 11 Czech Air Force pilots (age, 26 ± 5) were exposed to two steps of hypoxia at 33,000 and 25,000 ft in a hypobaric chamber. Duration of hypoxia was 90 and 300 seconds respectively. Heart rate (HR) and ECG were recorded. Oxygen saturation of capillary haemoglobin (%sO₂) was monitored using the Nonin pulse oxymeter. All pilots completed several simple psychophysiological tests during each exposure. Results: The drop of the %sO₂ curves during both loads was statistically significant. The final level of %sO₂ at 33,000 ft was substantially lower, i.e. 61% versus 92% at the end of the same interval (90 s) at 25,000 ft. The final value of %sO₂ at 25,000 ft was 65% (300 s). Differences of %sO₂ between both hypoxic loads were statistically significant during the fourth second. Early symptoms of altered cognition appeared at 44 seconds at 33,000 ft compared with 120 seconds at 25,000 ft. Significant cognitive impairment appeared after 72 seconds at 33,000 ft compared with 272 seconds at 25,000 ft. Conclusion: Adaptive possibilities of humans at 33,000 ft are very limited. Human efficiency drops very quickly because deterioration exceeds the time of useful consciousness (TUC). Slower desaturation of oxyhaemoglobin (longer time to reach 80 %sO₂) represents better hypoxic tolerance. The time to reach defined values of %sO₂ is three times shorter at 33,000 ft than at 25,000 ft.

20p. THE EFFECT OF HYPOBARIC HYPOXIA ON VISUAL CONTRAST SENSITIVITY ANDOR GRÓSZ,2,5 KRISZTINA BENEDEK,3 SZABOLCS KÉRI,1,4 ZSOLT TOTKA,5 ERIKA TÓTH5 AND GYÖRGY BENEDEK1

The effect of hypoxia on early visual functions remains a controversial area of research. To explore this question, we measured static and dynamic visual spatial contrast sensitivity in 14 healthy volunteers at a simulated altitude of 5500m. In comparison with the baseline condition (mean arterial oxygen saturation: 98.4%), contrast sensitivity significantly increased after 5, 10 and 15min of hypoxic exposure (saturation: 82.9%, 77.0%, 74.3%, respectively). After 10min, this enhancement was markedly pronounced under dynamic conditions. Returning to the baseline altitude (saturation: 97.7%), contrast sensitivity values decreased back the baseline. The recovery was almost complete at lower spatial frequencies. There was a significant negative relationship between arterial oxygen saturation and contrast sensitivity values at low- and medium spatial frequencies (0.5-4.8 c/deg). No such

correlation was found in the range of higher spatial frequencies. These results suggest that early visual processing maybe enhanced during short-term hypoxic challenge.

21p. EXPIRATORY MUSCLE FATIGUE DURING POSITIVE PRESSURE BREATHING.

J. ERNSTING, B. McCULLOCH, O.M. RUTHERFORD

INTRODUCTION To date there have been no published studies investigating the extent of expiratory muscle fatigue during pressure breathing. The purpose of this study was to investigate whether the increase in respiratory work was sufficient to induce expiratory muscle fatigue. **METHODS** Eight young healthy subjects underwent two periods of pressure breathing at 20 and 30mmHg (without counter-pressure) for 30 minutes. Four subjects were unable to complete the run at 30mmHg. The activity of the external oblique and rectus abdominis muscles was measured using surface EMG throughout the runs and for 30 minutes recovery. Maximal expiratory mouth pressure (PE_{max}) at total lung capacity (TLC) and functional residual capacity (FRC) was measured as an indicator of global expiratory muscle strength. This was measured immediately before the run and at intervals during recovery. **RESULTS** The EMG amplitude (RMS) showed that the expiratory muscles were relatively silent at rest, but their activity increased markedly on pressure breathing, rising to between 20-30% of that achieved during the PE_{max} manoeuvre. After the 20mmHg run PE_{max} was significantly reduced by 19% (TLC, p<0.05) and 14% (FRC, p<0.05). Pressures had returned to control by 20 minutes. After the 30mmHg run the PE_{max} was reduced by 31% (TLC) and 27% (FRC) and had not fully returned to control values by 30 minutes of recovery. **CONCLUSIONS** The increased expiratory muscle workload during pressure breathing induces fatigue that is greater at the higher pressure and can last for up to 30 minutes. With the advent of new agile aircraft and the potential that pilots may be exposed to pressure breathing for longer periods, this technique could be used to investigate expiratory muscle fatigue under +Gz.

22p. HEART RATE VARIABILITY SPECTRAL ANALYSIS APPLICATION IN CARDIOVASCULAR RISK PREDICTION – FIRST EXPERIENCE M.A.

Rada, M.D., P. Volek, PhD.

Introduction: Despite significant achievements in understanding and treatment of cardiovascular diseases, they are still the most frequent causes for disqualification of pilots. Therefore, many aerospace medicine specialists have been looking for new, more sophisticated methods (particularly non-invasive), for use in developing cardiovascular risk profiles. Spectral analysis of heart rate variability (SAHRV) is one such method. **Methods:** 49 military aviators were evaluated during their annual physicals at our Institute involving anthropometric data, risk factors questionnaire, laboratory screening, exercise test, SAHRV and psychophysiological testing. SAHRV was evaluated by the VariaCardio TF 4 system (SimaMedia, Inc). This equipment enables recording of beat-to-beat ECG recordings via bipolar electrodes placed on the chest. Data were analysed using the fast Fourier transformation algorithm. **Results:** Over a period of 8 months we evaluated 49 military pilots, mean age of 32 years (range 21-41yrs). A positive family medical history was present in 1 pilot (2%), 5 were smokers (10%), 11 had hyperlipidaemia (22%), 1 had hyperuricaemia (2%). 19 had a BMI over 25 (38%), 9 had sinus tachycardia (over 80 bpm) (18%), 9 had sinus bradycardia (less than 60 bpm) (18%), 31 had normal heart rate frequency (60-80 bpm) (63%). None suffered from diabetes mellitus, hypertension, or any form of coronary artery disease. Based on parameters analysed from psychophysiological assessment and SAHRV (including power spectral density (PSD), mean duration and standard deviation (SD) of all R-R intervals (R-R), and mean square successive difference (MSSD)), we created an individual risk profile (IRP) for each pilot. **Conclusion:** SAHRV in combination with other non-invasive test battery methods can be used to develop a cardiovascular risk profile for pilots, which may help in efforts to predict and prevent cardiovascular disease in pilots.

23p. IMPACT OF A MICROCLIMATE COOLING VEST ON PHYSIOLOGY AND FLIGHT PERFORMANCE IN A THERMALLY CONTROLLED HELICOPTER SIMULATOR.

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Introduction: Various studies have demonstrated that military nuclear, biological, and chemical (NBC) defense garments impair thermoregulation in hot environmental conditions. Due to evolving military requirements in the rotary-wing community, extended flights in Mission Oriented Protective Posture (MOPP) garments may become necessary. The current study evaluated the feasibility of a 5-hour flight with environmental conditions of 100°F, 50% relative humidity (RH). **Methods:** Eight volunteer pilots participated in a within subject, repeated measures design. The test conditions included 70°F without NBC gear (Cool Standard (CS)), 70°F with NBC gear (Cool MOPP (CM)), and 100°F with NBC gear and microclimate cooling (Hot MOPP (HM)). The test sessions consisted of an initial 20 minute warm up, two flight sorties and an intervening break (without NBC gear removal). Physiological parameters, flight performance, mood, and reaction time were measured during the test sessions. **Results:** The peak mean core temperature did not exceed 99.8°F. Mean core temperature in the HM condition was about 0.4°F higher than CM and about 0.6°F higher than CS. The absolute increase was quite modest compared to the approved upper

limit of 102.5°F. Mean percent dehydration was greatest for the HM condition despite the use of the cooling vest. However, the fluid deficit of approximately 300 cc per hour was a totally compensable rate. Effects on a composite measure of flight performance showed a modest decrement during the HM condition. Conclusions: The results indicated that the cooling vest was effective in preventing heat stress during an extended rotary-wing mission in hot, humid condition. However, the cooling vest did not totally prevent sweating and a mild degree of dehydration in the hot encumbered condition. Average flight performance scores were reduced in the HM and CM condition primarily by the encumbrance of the MOPP ensemble and only minimally by the heat stress itself.