

**PROGRAM AND ABSTRACTS**

**OF THE**

**53rd INTERNATIONAL  
CONGRESS OF AVIATION  
AND SPACE MEDICINE**

**WARSAW, POLAND**

**AUGUST 28 - SEPTEMBER 2, 2005**

# PROGRAM

## ORAL SESSIONS

<b>MONDAY, 29th AUGUST - THE JOHN ERNSTING PANEL</b>			
<b>CHAIRMAN – DR. A. J. BATCHELOR</b>			
<b>CO-CHAIRMAN – DR. A. WIELGOSZ</b>			
I	11:00 – 11:15	A. D. B. EVANS	THE NEW CARDIOVASCULAR STANDARDS OF THE INTERNATIONAL CIVIL AVIATION ORGANISATION
II	11:15 – 11:30	J. R. HICKMAN	AN AIRLINE PILOT WITH AN AUTOMATIC IMPLANTED DEFIBRILLATOR
III	11:30 – 11:45	A. J. BATCHELOR	BRUGADA PATTERN ELECTROCARDIOGRAMS IN PILOTS – THE AEROMEDICAL DILEMMA
IV	11:45 – 12:00	A. WIELGOSZ	METABOLIC SYNDROME AND FLIGHT SAFETY
V	12:00 – 12:15	A. J. BATCHELOR	HYPERTROPHIC CARDIOMYOPATHY IN A 46 YEAR OLD PILOT – EVALUATION OF AEROMEDICAL RISK

## SESSION 1

<b>MONDAY, 29th AUGUST - CLINICAL MEDICINE – AVIATION CARDIOLOGY</b>			
<b>CHAIRMAN – DR. J. R. HICKMAN, JR.</b>			
<b>CO-CHAIRMAN – DR. K. MAZUREK</b>			
1	13:45 – 14:00	J. ERNSTING	LIMITATIONS OF PULSE OXIMETRY IN AVIATION MEDICINE
2	14:00 – 14:15	D.G. NEWMAN	CARDIOVASCULAR DATA ACQUISITION USING IMPEDANCE CARDIOGRAPHY DURING SIMULATED FLIGHT
3	14:15 – 14:30	R. MAIRE, L. KAPPENBERGER, D. SHAH	FITNESS TO FLY IN PILOTS AFTER CATHETER ABLATION OF ATRIAL FIBRILLATION
4	14:30 – 14:45	S. A. SZABÓ, A. GRÓSZ, I. PÉTER, E. TÓTH	LONGITUDINAL IHD RISK FACTOR STUDY IN MILITARY PILOTS
5	14:45 – 15:00	F. S. PETTYJOHN, T. W. GREIG, J. S. MCGHEE	SHOULD STATINS BE IN AIRCREW WATER?

## SESSION 2

<b>MONDAY, 29th AUGUST - AIR TRAVEL</b>			
<b>CHAIRMAN – PROF. MICHAEL BAGSHAW</b>			
<b>CO-CHAIRMAN – DR. WIESŁAW KOWALSKI</b>			
6	15:20 – 15:35	A. RUGE	PASSENGER & CREW HEALTH IN AVIATION
7	15:35 – 15:50	P. W. FRANK	TO BE WELL INFORMED FOR TRAVELLER'S ADVICE
8	15:50 – 16:05	M. J. ANTUNANO	CURRENT TRENDS IN AEROMEDICAL AND HUMAN FACTORS RESEARCH AT THE FAA CIVIL AEROSPACE MEDICAL INSTITUTE (CAMI): OPPORTUNITIES FOR INTERNATIONAL COLLABORATION
9	16:05 – 16:20	O. LURIE, G. RAVIV, L. GOLDSTEIN	THE RETURN TO THE OLYMPUS SELF ADMINISTRATION KIT FOR AVIATOR FOLLOWING A SEVERE ACCIDENT
10	16:20 – 16:35	P. ARVA	HIV POSITIVITY AMONG PILOTS: DOES THE EVIDENCE SUPPORT THE FIT FOR FLYING ASSESSMENT?

**SESSION 3**

<b>MONDAY, 29th AUGUST - AVIATION PHYSIOLOGY</b>			
<b>CHAIRMAN – PROF. J-P. CRANCE</b>			
<b>CO-CHAIRMAN – PROF. K. KLUKOWSKI</b>			
11	16:45 – 17:00	M. ŻEBROWSKI, T. POWAŁOWSKI, Z. TRAWIŃSKI	VASCULAR IMPEDANCE TO ASSESS PREDISPOSITION TO +GZ TOLERANCE IN PILOTS
12	17:00 – 17:15	K. GHAZIZADEH, A. AKBARI, H. MOHSENZADEH, B. MONTAZERI, H. KANGARLU, M. PANJEHBAND, S. R. ABTAHI	COMPARISON OF BLOOD PRESSURE AND HEART RATE, BEFORE AND AFTER FLIGHT IN THE DECOMPRESSION CHAMBER OF IRIAF HEALTH ADMINISTRATION.
13	17:15 – 17:30	J. CROWLEY, G. LANG, M. ADAMS	AVIATION LIFE SUPPORT EQUIPMENT PERFORMANCE IN CURRENT MILITARY ROTARY- WING OPERATIONS
14	17:30 – 17:45	P. RENJHEN, K. K. TRIPATHI	EFFECT OF THE AVAILABILITY OF FOOT BOARD SUPPORT ON CARDIOVASCULAR RESPONSES TO ORTHOSTASIS
15	17:45 – 18:00	K. P. KOWALCZUK, W. KLUCH, R. KACZANOWSKI, R. MIKULISZYN	INFLUENCE OF HYPOXIA ON SPATIAL ORIENTATION

**SESSION 4**

<b>TUESDAY, 30th AUGUST - AEROMEDICAL EDUCATION AND TRAINING</b>			
<b>CHAIRMAN – DR. M. J. ANTUNANO</b>			
<b>CO-CHAIRMAN – DR. A. GROSZ</b>			
16	08:00 – 08:15	M. J. ANTUNANO	FAA GUIDANCE FOR MEDICAL SCREENING OF COMMERCIAL AEROSPACE PASSENGERS - PART 1: SUBORBITAL FLIGHTS.
17	08:15 – 08:30	M. J. ANTUNANO	FAA GUIDANCE FOR MEDICAL SCREENING OF COMMERCIAL AEROSPACE PASSENGERS - PART 2: ORBITAL FLIGHTS
18	08:30 – 08:45	L. P. KROCK	A CASE FOR ACADEMIC COMPLEMENTATION: A MODEL FOR SUCCESS
19	08:45 – 09:00	B. H. REED	RECENT ADVANCES IN USAF INTERNATIONAL AEROSPACE MEDICINE EDUCATION AND TRAINING
20	09:00 – 09:15	A. L. F. SPARENBERG, T. RUSSOMANO	THE ESTABLISHMENT OF TELE-ECG AND TELE-X RAY SYSTEMS IN SOUTHERN BRAZIL

**SESSION 5**

<b>TUESDAY, 30th AUGUST - ULTRA LONG RANGE FLIGHTS AND SPACE MEDICINE</b>			
<b>CHAIRMAN – DR. J. SINGH</b>			
<b>CO-CHAIRMAN – DR. W. WIELGOLASKI</b>			
21	09:35 – 09:50	J. SINGH	ULTRA LONG RANGE FLIGHTS: FROM CONCEPT TO REALITY
22	09:50 – 10:05	R. B. RAYMAN	FUTURE CHALLENGES OF SPACE MEDICINE
23	10:05 – 10:20	J. R. DAVIS	ADVANCES IN SPACE MEDICINE
24	10:20 – 10:35	I. M. HOSEGOOD	AN ASSESSMENT OF IN-FLIGHT TELEMEDICINE ON COMMERCIAL AIRCRAFT
25	10:35 – 10:50	M. MACRI, M. ANGHEL, S. T. TIRON, S. DUMITRACHE, D. MINCA, M. LACATUS, D.	RELEVANCE OF TISSUE MINERAL ANALYSIS IN MEDICAL EXPERTISE OF MILITARY AERONAUTICAL PERSONNEL

		POPESCU, E. COCHINO, S. BERBECAR	
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### SESSION 6

<b>TUESDAY, 30th AUGUST - ENVIRONMENTAL HAZARDS</b>			
<b>CHAIRMAN – DR. H. PONGRATZ</b>			
<b>CO-CHAIRMAN – DR. M. ZEBROWSKI</b>			
26	10:55 – 11:10	M. ZILBERBERG, A. DOR, D. JACUBOVICH, L. GOLDSTEIN, Y. BAR-DAYAN	HEAT STRESS DEVELOPMENT AND CARBON MONOXIDE EXPOSURE DURING VEHICLE TRANSPORTATION BY C-130 PLANE.
27	11:10 – 11:25	A. TARNOWSKI, J. ŁASZCZYŃSKA, O. TRUSZCZYŃSKI	EFFECT OF HOT ENVIRONMENT AND PHYSICAL EFFORT ON PILOT PERFORMANCE
28	11:25 – 11:40	A. S. WAGSTAFF, P. ARVA,	HEARING LOSS IN NORWEGIAN AVIATION PERSONNEL – AGE RELATED OR NOISE-INDUCED?
29	11:40 – 11:55	T. RUSSOMANO, M. DOS SANTOS, L. ANDRADE, D. F. G. DE AZEVEDO, F. PORTO, L. MARTINELLI	AN EVALUATION OF THE INTERACTION OF A CONTROLLED DIET WITH SCOPOLAMINE ON THE PREVENTION OF MOTION SICKNESS
30	11:55 – 12:10	L. J. PINTO, N. TANEJA	DETERMINATION OF RELATIONSHIP BETWEEN DESIGN EYE POINT AND NEUTRAL SEAT REFERENCE POINT IN A FIGHTER AIRCRAFT

### SESSION 7

<b>THURSDAY, 1st SEPTEMBER - AVIATION OPHTHALMOLOGY</b>			
<b>CHAIRMAN – DR. D. IVAN</b>			
<b>CO-CHAIRMAN – PROF. M. PROST</b>			
31	08:00 – 08:15	D. IVAN	THE USAF AVIATION REFRACTIVE SURGERY PROGRAM: AN OVERVIEW
32	08:15 – 08:30	D. IVAN	FEDERAL EXPRESS FLIGHT 1478: AN ANALYSIS OF COLOUR VISION FACTORS
33	08:30 – 08:45	F. R. TEJADA, B. P. ESPADA, J. A. L. LOPEZ, C. V. DIAZ, J. A. A. GARCÍA, J. B. DEL VALLE, P. V. DESVIAT, B. E. BENAVIDES	SAFETY, HUMAN FACTORS AND TRAINING CONSIDERATIONS IN CIVILIAN NIGHT OPERATIONS WITH NVG. A CHALLENGE.
34	08:45 – 09:00	M. PROST, K. STASIAK, M. JEZIERSKI, J. KULIŃSKI, M. GAŚIK, F. SKIBNIEWSKI	VISUAL FUNCTION IN MILITARY PILOTS WEARING NIGHT VISION GOGGLES
35	09:00 – 09:15	M. PROST, J. KULIŃSKI	EVALUATION OF RETINAL GANGLION CELL FUNCTION BY PATTERN ERG RESULTS DURING NORMOBARIC HYPOXIA

### SESSION 8

<b>THURSDAY, 1st SEPTEMBER - AVIATION NEUROLOGY</b>			
<b>CHAIRMAN – DR. SILVIO FINKELSTEIN</b>			
<b>CO-CHAIRMAN – PROF. ADAM STĘPIEŃ</b>			
36	09:35 – 09:50	P-E. BERTRAN, M. MONTEIL, J-P. GONZALEZ, J-P. TAILLEMITE, H. GOMMEAUX, B. OMNES, A. SEYNAEVE	CEPHALEES NON MIGRAINEUSES: COMMENT LES GERER EN MEDECINE AERONAUTIQUE?
37	09 :50 – 10 :05	M. MONTEIL, J-P. TAILLEMITE, P-E. BERTRAN, J-P. GONZALEZ, H. GOMMEAUX, B. OMNES, A. SEYNAEVE	LA MIGRAINE EN AERONAUTIQUE
38	10:05 –	P. NAVATHE, M. DRANE, C.	AEROMEDICAL DECISION MAKING IN TRANSIENT

	10:20	PREITNER, D. WATSON	GLOBAL AMNESIA
39	10:20 – 10:35	L. KOWALCZYK, E. ZALEWSKA, J. MISZCZAK, S. DEC	NEW CRITERIA FOR THE DIFFERENTIATION BETWEEN SPONTANEOUS EEG IN RECORDS WITH SEIZURE ACTIVITY IN HEALTHY SUBJECTS AND EPILEPTIC PATIENTS
40	10:35 – 10:50	J. D. HASTINGS	ANTICONVULSANTS IN AIRLINE MEDICAL KITS

### SESSION 9

<b>THURSDAY, 1st SEPTEMBER - MEDICAL PROBLEMS IN AVIATION</b> <b>CHAIRMAN – DR. Y. G. CAINE</b> <b>CO-CHAIRMAN –DR. K. KOWALCZUK</b>			
41	10:55 – 11:10	R. V. JOHNSTON	INSULIN TREATED DIABETIC AIRCREW: REVIEW AND DEVELOPMENT WORKING GROUP (REDWIG) PROTOCOL
42	11:10 – 11:25	W. TE-SHENG, L. TSAI-HWA	HIGH-SUGAR DIET INDUCES REBOUND HYPOGLYCEMIA
43	11:25 – 11:40	M. ŻEBROWSKI, R. MIKULISZYN, M. KŁOSSOWSKI, J. OBER, M. KRASSOWSKI	EYE FIXATIVE MOVEMENTS ASSESSMENT DURING A-LOC AND G-LOG
44	11:40 – 11:55	V. RAFNSSON, E. OLAFSDOTTIR, J. HRAFNKELSSON, G. DE ANGELIS, H. SASAKI, A. ARNARSON, F. JONASSON	LENS OPACIFICATION IN COMMERCIAL AIRLINE PILOTS ARE RELATED TO THEIR ESTIMATED EXPOSURE TO COSMIC RADIATION
45	11:55 – 12:10	Y. NOGUCHI, M. NUMATA, Y. HIJIKATA, N. MAKI, M. KADOKURA, Y. OKAWA, N. MATSUNAGA, H. OKOSI, H. MIYAZAKI, I. ASUKATA, M. KAJI	RECERTIFICATION OF FLIGHT CREW WHO UNDERWENT TREATMENT FOR MALIGNANT NEOPLASM

### SESSION 10

<b>THURSDAY, 1st SEPTEMBER - AVIATION PSYCHOLOGY</b> <b>CHAIRMAN – DR. A. BELLENKES</b> <b>CO-CHAIRMAN –DR O. TRUSZCZYNSKI</b>			
46	13:35 – 13:50	A. BELLENKES	HUMAN SYSTEMS INTEGRATION (HSI) IN THE ASSESSMENT OF HUMAN PERFORMANCE IN AIRCRAFT MISHAP INVESTIGATION AND PREVENTION
47	13:50 – 14:05	K. P. KOWALCZUK, M. GAŚIK, M. HAWRYLUK	INDIVIDUAL MOTORIC COORDINATION AND DISTRIBUTION OF ATTENTION PREDISPOSITIONS IN MALE AND FEMALE CANDIDATES FOR MILITARY AVIATION
48	14:05 – 14:20	N. KRAFT, J. ORASANU, U. FISCHER, Y. TADA, H. BINDER	TESTING COGNITIVE ABILITY AND PROBLEM SOLVING
49	14:20 – 14:35	O. TRUSZCZYŃSKI, A. TARNOWSKI, I. GRAY	PERSONALITY TESTING IN POLISH AIR FORCE. VALIDATION STUDY OF THE ALAPS QUESTIONNAIRE IN POLAND
50	14:35 – 14:50	O. TRUSZCZYŃSKI, K. RÓŻANOWSKI, A. DOMIN, Ł. DZIUDA, F. SKIBNIEWSKI	INTRODUCTION TO A MODELING OF DYNAMIC PHYSIOLOGICAL PROCESSES IN PILOTS SUBJECTED TO ALTERNATING ACCELERATIONS ALONG THE LONGITUDINAL AXIS OF THE BODY

**SESSION 11**

<b>THURSDAY, 1st SEPTEMBER – AIR CREW – CLINICAL ISSUES</b>			
<b>CHAIRMAN – DR. F. PETTYJOHN</b>			
<b>CO-CHAIRMAN – DR. D. BARTOS</b>			
51	15:00 – 15:15	A. GROSSMAN, E. BARENBOIM, B. AZARIA, Y. SHERER, L GOLDSTEIN	ORAL DRUG THERAPY FOR ERECTILE DYSFUNCTION: OVERVIEW AND AEROMEDICAL IMPLICATIONS
52	15:15 – 15:30	A. MUSZYŃSKI, E. MUSZYŃSKA – ROK	EVALUATION OF THE RISK FOR PREGNANT WOMEN TRAVELING BY PASSENGER FLIGHTS.
53	15:30 – 15:45	M-D. COLAS-BENAYOUN	LES ADDICTIONS COMPORTEMENTALES ÉTUDE EN MILIEU PROFESSIONNEL AÉRONAUTIQUE
54	15 :45 – 16 :00	C.F. GERK	ÉVOLUTION DE LA MÉDECINE AÉROSPATIALE AU BRÉSIL
55	16:00 – 16:15	V. BALOESCU	THE PREDICTIVE VALUE OF CENTRAL NERVOUS SYSTEM TONUS IN PILOTS PATHOLOGY

**POSTERS SESSIONS****SESSION 1**

<b>MONDAY, 29th AUGUST, 11:00 – 18:00</b>		
1p	J. MACIEJCZYK, M. BIERNACKI	THE PSYCHOLOGICAL METHODS OF MEASURES SPATIAL ABILITIES FOR HIGH MANEUVERABLES AIR CRAFT PILOTS
2p	O. TRUSZCZYŃSKI, L. MALINOWSKI, M. WOŁKANOWSKI, K. KLUKOWSKI, Z. ŻMUDZIŃSKI, H. SMOLIŃSKI, A. LESKI	RESEARCH AND TRAINING SAFETY FOR AVIATION MEDICINE SIMULATORS ON THE EXAMPLE OF WHIRLING ARM
3p	M. MACANDER, O. TRUSZCZYŃSKI, A. FLORKOWSKI, K. KOWALCZUK, B. BIERNAT, A. TARNOWSKI, K. ZBORALSKI, P. GAŁECKI, T. NOWAKOWSKI, B. BADEK	AIR ACCIDENTS RESULTING FROM AIR FORCE PILOTS' POST-TRAUMATIC STRESS DISORDERS
4p	K. KOWALCZUK, M. MACANDER, A. SAKIEWICZ, O. TRUSZCZYŃSKI	SPATIAL DISORIENTATION TRAINING – SUBJECTIVE ASSESSMENT OF PILOTS
5p	A. DOMIN, J. ŁASZCZYŃSKA	INFLUENCE OF HOT PREFLIGHT ENVIRONMENT ON SIMULATED AIR COMBAT MANEUVER PERFORMANCE
6p	A. GRÓSZ, J. HORNYIK, S. A. SZABÓ, E. TÓTH	AEROMEDICAL EVALUATION OF A COMPLEX (MEDICAL AND FLIGHT DATA) DATA RECORDING SYSTEM
7p	M. SAZEL, J. PAVLIK, J. PETRICEK, Z. SEDLATY	SPATIAL DISORIENTATION TRAINING
8p	D. BARTOŠ, J. ŠULC	WORKLOAD OF FLIGHT CREW ON LONG- DISTANCE GOVERNMENT FLIGHTS
9p	D. IVAN, R. TUTT	THE NEW USAF AIRCREW SPECTACLE FRAME PROGRAM
10p	J. R. DILLE	EARLY STUDIES OF REDUCED BAROMETRIC PRESSURE EFFECTS SHOWN ON POSTAGE STAMPS, POST CARDS AND ENVELOPES
11p	R. NANCHEVA, A. POPANDREEVA	WEB-BASED COURSE FOR PHYSICAL WORKING CAPACITY EVALUATION IN BULGARIAN AIR FORCE
12p	R. ZLATEV, R. NANCHEVA	A SHORT HISTORY OUTLINE OF AVIATION MEDICINE IN BULGARIA

**SESSION 2**

<b>TUESDAY, 30th AUGUST, 09:15 – 15:00</b>		
13p	A. CAPASSO	MOTION SICKNESS FOR FLIGHT PILOTS: STATISTICS AND THERAPEUTIC SOLUTIONS
14p	M. ANGHEL, M. MACRI, V. GREERE	THE STUDY OF HYPERTENSION IN MILITARY AERONAUTICAL PERSONNEL
15p	Y. OKAWA, H. OKOSHI, N. MATSUNAGA, M. NUMATA, Y. HIJIKATA, M. KADOKURA, N. MAKI, H. MIYAZAKI, Y. NOGUCHI, I. ASUKATA, M. KAJI	AN EXPERIENCE OF OVER AGE 60 COCKPIT CREW IN JAPANAIRLINES INTERNATIONAL
16p	A. NICODIN, M. MACRI	IS THE “DRY EYE SYNDROME” A PROFESSIONAL DISEASE FOR AERONAUTICAL PERSONNEL?
17p	M. MACRI, T. ADRIAN, M. BALASA, C. DOLINSCHI	POSTOTOTOXIC VESTIBULAR DYSFUNCTION
18p	M. ANGHEL, M. MACRI	THE STUDY OF PULSE PRESSURE AND CARDIOVASCULAR RISK IN MILITARY AERONAUTICAL PERSONNEL
19p	M. J. ANTUNANO	POST-DOCTORAL RESEARCH OPPORTUNITIES AT THE FAA CIVIL AEROSPACE MEDICAL INSTITUTE.
20p	A. OKIŃCZYC	TRANSFERING OF MODERN OCCUPATIONAL MEDICINE STANDARDS TO AVIATION MEDICINE

**SESSION – 3**

<b>THURSDAY, 1st SEPTEMBER, 09:15 – 16:15</b>		
21p	C.G. DE OLIVEIRA, S.L.O. RIBEIRO	THE USE OF PHYSIOLOGICAL MEASUREMENTS IN THE EVALUATION OF COCKPIT WORKLOAD: AN EXPERIMENTAL APPROACH
22p	C. PEI-YI, W. TE-SHENG	THE EFFECTS OF DIFFERENT LEVEL OF HYPOXIA ON PSYCHOLOGICAL PERFORMANCE
23p	P. DOSEL, J. HANOUSEK, J. PETRICEK, L. CETTL	RAPID ONSET OF LBNP EXPOSURE
24p	M. H. LI, C. M. CHANG, Y.C. WU, W. S. HUANG, Y. W. CHAUO, S. CHU	PRECONDITIONING ATTENUATED LOWER BODY NEGATIVE PRESSURE-INDUCED PRESYNCPAL SYMPTOMS AND COGNITIVE FUNCTION DISTURBANCES
25p	N. VUKOVIĆ DOJČINOVSKI, E. MISSONI,	PHYSIOLOGICAL PARAMETERS AND TRACE ELEMENTS BEFORE AND AFTER AEROBATIC FLIGHT
26p	C.G. RODRIGUEZ, M. A. E. SILVA, C.G. DE OLIVEIRA	A POSTURAL EVALUATION OF HELICOPTER PILOTS
27p	C. KAUR, V. SIVAKUMAR, J. SINGH	HYPOBARIC HYPOXIA AND VASOPRESSIN EXPRESSION IN THE HYPOTHALAMUS
28p	C. KAUR, V. SIVAKUMAR, J. SINGH	HYPOBARIC HYPOXIA INDUCED DAMAGE IN THE RETINA
29p	V. SIVAKUMAR, C.KAUR, J. SINGH	CALCIUM BINDING PROTEINS IN THE HIPPOCAMPUS FOLLOWING HYPOBARIC HYPOXIC EXPOSURE
30p	C. KAUR, V. SIVAKUMAR, J. SINGH	HYPOXIA INDUCED INCREASE IN VASCULAR ENDOTHELIAL GROWTH FACTOR EXPRESSION IN THE BRAINSTEM
31p	J. KULINSKI, M. PROST	CONTRAST SENSITIVITY TESTS IN NORMOBARIC HYPOXIA
32p	K. STASIAK, W. SKOWROŃSKI, J. KULIŃSKI, M. KRAJEWSKI, M. PROST	THE INFLUENCE OF ACUTE NORMOBARIC HYPOXIA EQUIVALENT TO THE ALTITUDE OF 4500 M A.S.L. ON RETINAL SENSIVITY IN COMPUTERIZED PERIMETRY
33p	G. KEMPA, J. ŁASZCZYŃSKA	PHYSIOLOGICAL INCIDENTS IN MIAM – POLAND

		SIMULATED HIGH ALTITUDE CHAMBER FLIGHTS
34p	J. ELIASZ, M. DEREŃ, M. RAKOWSKI, O. TRUSZCZYNSKI	ISOMETRIC FORCE LEVEL MEASURED ON THE RUDDER BAR AND +GZ TOLERANCE DURING CENTRIFUGE EXPOSURE
35p	J. MAREK, W. E. WIELGOŁASKI, G. MAREK	AEROMEDICAL EXAMINATION IN AVIATION SPORTS IN THE SCOPE OF THE MAIN AEROMEDICAL CENTRE OF THE POLISH AERO CLUB IN WROCLAW



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## **ORAL PRESENTATIONS**

### **THE JOHN ERNSTING PANEL**

#### **[I] THE NEW CARDIOVASCULAR STANDARDS OF THE INTERNATIONAL CIVIL AVIATION ORGANISATION**

A D B EVANS

*International Civil Aviation Organisation, Montreal,  
Canada*

**Introduction:** The bulk of the current (July 2001) International Civil Aviation Organisation (ICAO) cardiovascular Standards and Recommended Practices date from 1972 and therefore needed revision. An international study group reviewed the provisions in January 2005 and several important changes, particularly to the periodicity of medical examinations and electrocardiography, have been made. Such changes are based primarily on an improved knowledge of cardiovascular risk, especially in relation to age and following a cardiac event but also on the lower risk to flight safety from incapacitation in a two-pilot aircraft. **Results:** For Class 1 (professional pilot) applicants the validity of the routine medical examination for those over 40 years is increased from six to 12 months (except for single pilots carrying passengers). Electrocardiography is required less frequently in younger pilots. For Class 2 (private pilot) applicants the validity of the routine medical examination for those under 40 years is increased from 24 to 60 months. Electrocardiography becomes mandatory in those over 50 years (previously a non-mandatory Recommendation). For Class 3 (air traffic controller) applicants the validity of the routine medical assessment for those under 40 years is increased from 24 to 48 months. Electrocardiography becomes mandatory in those over 50 years (previously a non-mandatory Recommendation). For both Class 1 and Class 2 applicants a 'history of proven myocardial infarction' is no longer 'disqualifying'. **Conclusions:** Age specific cardiovascular morbidity and mortality rates have been declining in many states and the ability to more accurately stratify individual risk after a cardiac event has improved. Combining this with a greater emphasis in detecting pathology in older applicants (who are at increased risk) has resulted in ICAO provisions becoming more 'evidence-based'. The new provisions become applicable in November 2005 and will be discussed.

#### **[II] AN AIRLINE PILOT WITH AN AUTOMATIC IMPLANTED DEFIBRILLATOR**

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Diseases and Preventive Medicine, Mayo Clinic,  
Rochester, Minnesota.*

A 46-year-old male airline pilot, previously in good health, with 10,000 civilian hours and 1,500 military hours in fighters, had been a regular jogger of 40 minutes per day. He began to notice laboring and difficulty with completing his usual program, noting no symptoms except exercise intolerance without chest pain, palpitations, dyspnea, syncope, or presyncope. During an overseas layover, he experienced post-exercise lightheadedness, mild tunneling of vision, and mild orthostasis. He underwent a maximal treadmill thallium, with normal images and a borderline ST segment response with frequent ventricular ectopy. He returned to flying, and six months later had abrupt ventricular fibrillation on the treadmill at his hotel, which was witnessed, followed by very timely defibrillation. Angiography revealed a 70 percent proximal LAD lesion, which was successfully dilated and stented. An electrophysiological study was normal. He received an AICD, which has not fired since implantation six months ago. A follow-up treadmill study was completely normal.

Discussion of the case will revolve around the issue of sudden death caused by ventricular arrhythmia or other cryptic events versus ischemia, which has now been corrected. How should this controversy be evaluated? Does he, in fact, need the AICD? Should he ever be reconsidered for flying?

#### **[III]**

#### **BRUGADA PATTERN ELECTROCARDIOGRAMS IN PILOTS – THE AEROMEDICAL DILEMMA**

A. J. BATCHELOR

*Royal Centre for Defence Medicine, Birmingham, UK*

The case of a 40 year old symptom-free instructor pilot with a background in fast-jet flying, who had an abnormal routine electrocardiogram (ECG) demonstrating Type 1 Brugada pattern, is described. The subject was clinically normal, had no adverse previous medical history and there was no family history of sudden cardiac death (SCD). Non-invasive cardiac assessment with exercise testing, ambulatory ECG monitoring and echocardiography was normal and he was restricted to multicrew flying. At subsequent cardiac electrophysiological study he was found to have easily induced ventricular fibrillation on programmed electrical stimulation (PES), requiring cardioversion. An implantable cardiac defibrillator (ICD) was advised and he was grounded. In 1992, Brugada and Brugada described 8 patients, resuscitated from cardiac arrest, who had no structural

cardiac abnormality but who demonstrated a right bundle branch block pattern on ECG, with ST elevation in the anterior chest leads. After collecting further similar cases, they described an increased risk of ventricular arrhythmias and SCD in this group, and demonstrated an association between the syndrome and an abnormality of myocardial cell membrane sodium ion transport. The available evidence has, until recently, suggested that individuals with a Brugada pattern ECG who demonstrate the Type 1 variant spontaneously, without provocation using sodium channel blocking agents, carry a significant risk of cardiac arrhythmias and SCD. The provocation of significant ventricular arrhythmias by PES has been similarly regarded as associated with an enhanced SCD risk and ICDs have frequently been advised in such situations. The most recent available evidence is briefly reviewed, the rather limited and varied results of follow-up studies are highlighted and the dilemma of evidence based aeromedical decision making in pilots with this syndrome is discussed.

**[IV]  
METABOLIC SYNDROME AND FLIGHT SAFETY**

WIELGOSZ A.

*Cardiology Consultant Civil Aviation Medicine  
Transport Canada, Canada*

With an aging pilot population and an increasing prevalence of the metabolic syndrome, there is a need to identify affected individuals with a cost effective approach. The average age of Canadian pilots has been increasing steadily over the past 2 decades and is projected to increase further. A number of factors including age determine the prevalence of the metabolic syndrome.

Although several definitions exist, a common feature of the metabolic syndrome is the presence of central adiposity, which can be quantified by measuring waist circumference. Besides hypertension, the other key components ie dyslipidemia and dysglycemia require blood samples for their determination. Transport Canada recently addressed the issue of screening pilots for the presence of metabolic syndrome with the development of a simple diagnostic algorithm. The identification of metabolic syndrome will alert pilots to the need for appropriate preventative measures and guide further investigations to screen for the consequences of metabolic syndrome including cardiovascular disease.

**[V]  
HYPERTROPHIC CARDIOMYOPATHY IN A 46 YEAR OLD PILOT – EVALUATION OF AEROMEDICAL RISK**

BATCHELOR A. J.

*Royal Centre for Defence Medicine, Birmingham, UK*

Abnormalities on a routine screening electrocardiogram (ECG) led to the cardiological assessment of a symptom free 46 year old male military transport pilot. There was no relevant past medical history and the subject followed an athletic lifestyle. However, but the sudden death of a 38 year old brother had been certified as due to a diagnosis of hypertrophic cardiomyopathy. The individual's high level of aerobic fitness was confirmed on exercise testing, when a normal pattern of blood pressure progression was demonstrated, and no ECG changes or arrhythmias were observed. No arrhythmias were demonstrated on ambulatory 24 hour ECG monitoring, but echocardiography clearly showed marked asymmetric septal hypertrophy of the left ventricle. In the past a diagnosis of hypertrophic cardiomyopathy has usually been considered incompatible with certification for professional flying in view of the high and unpredictable risk of sudden cardiac death (SCD). In recent years, however, it has become clear that this genetically determined disorder is heterogeneous in nature and contains subgroups at various levels of risk. Significant risk factors for SCD have been identified and include a history of syncope, ventricular tachycardia on ECG monitoring, a family history of SCD due to hypertrophic cardiomyopathy, hypotension on exercise and, possibly, the degree of ventricular hypertrophy present. The current evidence is reviewed in an attempt to define a subset of subjects with hypertrophic cardiomyopathy who might meet acceptable levels of risk for professional flying.

**SESSION 1**

**[1]  
LIMITATIONS OF PULSE OXIMETRY IN AVIATION MEDICINE**

J. ERNSTING

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The development of finger mounted pulse oximeters, which provide a display of the oxygen saturation of the arterial blood (SaO<sub>2</sub>), has had a major impact on the practice of clinical medicine. This technique is also used in aviation as a means of the pilots of unpressurised aircraft monitoring the adequacy of their oxygen supply and in the formal assessment of the performance of oxygen systems e.g. drop-down masks for passengers. There are, however, significant physiological limitations to the use of SaO<sub>2</sub> to indicate the adequacy of the oxygenation of an individual. These will be discussed together with supporting experimental data. Hyperventilation has a major influence upon the relationship between the partial pressure of oxygen in the inspired tracheal gas (P<sub>I</sub>O<sub>2</sub>) and SaO<sub>2</sub> in mild/moderate hypoxia [breathing air at altitudes between 10,000 feet and 15,000 feet (P<sub>I</sub>O<sub>2</sub> between 80 and 100 mmHg)]. Thus, breathing air at

14,000 feet produces a SaO<sub>2</sub> of about 60% when the alveolar partial pressure of carbon dioxide (P<sub>A</sub>CO<sub>2</sub>) is 40 mmHg; mild hyperventilation which reduces the P<sub>A</sub>CO<sub>2</sub> to 30 mmHg increases the SaO<sub>2</sub> to 85%; and moderate hyperventilation producing a P<sub>A</sub>CO<sub>2</sub> of 20 mmHg raises the SaO<sub>2</sub> to 93%. Although hyperventilation markedly increases the SaO<sub>2</sub> the associated changes in cerebral blood flow decrease the PO<sub>2</sub> of the cerebral venous blood and hence intensify the cerebral hypoxia. Thus, the SaO<sub>2</sub> of an individual exposed to hypoxic hypoxia may be within acceptable limits (93% to 95%) when the P<sub>I</sub>O<sub>2</sub> of the inspired gas is that of air at an altitude as high as 15,000 feet and the delivery of oxygen to the brain is significantly impaired. Extreme caution should therefore be exercised in deducing the adequacy of the P<sub>I</sub>O<sub>2</sub> from the measurement of SaO<sub>2</sub> alone either in flight or in the assessment of oxygen delivery systems.

[2]  
**CARDIOVASCULAR DATA ACQUISITION  
USING IMPEDANCE CARDIOGRAPHY  
DURING SIMULATED FLIGHT**

D.G. NEWMAN

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**Introduction:** Impedance cardiography (IC) has long been used for the determination of key cardiovascular variables such as stroke volume and cardiac output. One of the benefits of IC is its non-invasive nature. This feature makes it potentially very useful for the in-flight acquisition of cardiovascular data in pilots. The purpose of this study was to evaluate the practical use of IC as a data acquisition technique during simulated flight. **Methods:** 5 subjects were recruited for this experiment. Each subject flew 2 sorties in a full-motion flight simulator. The sortie consisted of a standard take-off and departure, a normal circuit, a missed approach, some limited manoeuvring and then a final landing. Stroke volume and cardiac output were measured non-invasively via a small, subject-mounted IC device, with band electrodes fitted to the lower neck and lower thorax. The Kubicek equation was used to derive stroke volume from the ensemble-averaged data. **Results:** All of the subjects were able to complete the flying task with no detriment. They all reported that the impedance cardiography device did not interfere with their ability to manipulate the controls of the simulator. Furthermore, the IC device did not interfere with any of the electrical signals in the simulator. The physiological data collected were of high quality, and allowed the determination of stroke volume and cardiac output throughout each simulated flight. **Conclusions:** The results of this technical evaluation demonstrate that it is possible to use IC to determine important cardiovascular variables during full-motion simulated flight, with no adverse consequences to the pilot's ability to fly the aircraft.

Impedance cardiography thus has tremendous applications in the field of aerospace physiology research, particularly for in-flight acquisition of cardiovascular data.

[3]  
**FITNESS TO FLY IN PILOTS AFTER  
CATHETER ABLATION OF ATRIAL  
FIBRILLATION**

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**Introduction:** Atrial fibrillation (AF) presents one of the cardiological problems related with difficult licencing decisions. The recently introduced catheter technique with circumferential ablation of the pulmonary veins in patients with paroxysmal or persistent AF provides a promising therapeutic procedure. But follow-up data, including success rate and consequences for decision of fitness to fly, in pilots having undergone such a procedure, are lacking. **Methods:** The follow-up of all pilots, in whom a catheter ablation of the pulmonary veins (CA) had been performed by the same interventionist in two university hospitals between 2002 und 2004, was retrospectively analysed. **Results:** Six male subjects, 1 commercial and 5 private pilots, mean age 58.5 years (46-64), underwent CA. Four of them had paroxysmal and 2 persistent AF, 5 were unfit to fly. In all patients, no underlying cardiac pathology was present. The procedure CA was uncomplicated in 5 patients; in 1 patient a cardiac tamponade occurred, managed by pericardiocentesis. During the follow-up period until April 2005 there was no recurrence of AF in 3 pilots; 2 pilots had a second CA because of reoccurrence of AF, and this CA was successful in both; 1 pilot with previous persistent AF showed paroxysmal AF, he died in an aircraft accident, the cause of which was not medical\*. Another pilot stopped flying for nonmedical reasons; the 4 remaining pilots were declared fit to fly without restriction. **Conclusions:** 1) A curative success rate of CA has been achieved in 50% in this small group of pilots with AF; the rate was markedly increased by a second CA where necessary. 2) Most of these pilots could regain pilot's activity. 3) CA is a therapeutic procedure which may be considered in pilots with AF resistant to drug therapy, but the indication for CA should still be made on an individual basis.

\* Information received by Prof. U. Sigwart, Division of Cardiology, H.U.G., Geneva; Switzerland

[4]  
**LONGITUDINAL IHD RISK FACTOR STUDY  
IN MILITARY PILOTS**

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ILDIKÓ PÉTER,<sup>1</sup> ERIKA TÓTH

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**Introduction:** It is known that cardiovascular diseases are responsible for over 50% of total mortality in Hungary. Consequently, the early diagnosis of such diseases and detection of their risk factors is of fundamental importance in public health. Regarding that pilots are also part of the population, it is vital to clarify the respective risk factors in their cases as well. Cardiovascular diseases are among the causes of grounding of 10% of pilots. **Methods:** The individual and joint incidences of ischaemic heart disease (IHD) factors measured or taken during regular annual screening of fitness were determined in five age groups of a total of 250 active military pilots, on the basis of 10-year old (baseline), 5-year-old and current data. In addition, we determined the 5-year risk of coronary artery disease (CAD), and the risk of cardiovascular disease (CVD) for 10 years in comparison to individuals with normal risk. The IHD risk factors in the studied population were as follows: positive family history (taken during annual evaluation): 25%; smoking: 31%; physical inactivity: 24%; obesity: 40%; total cholesterol: 53%, HDL cholesterol: 13%; high total cholesterol levels associated to low HDL cholesterol levels: 5%; high blood pressure in 15%, pathologic ECG deviations: 1%. With ageing, incidence was constant or decreased for all risk factors, while the occurrence of more than one risk factors at a time is more frequent. **Results:** The 5-10-year risk of cardiovascular diseases (the 5-year risk of coronary artery disease [CAD], and the 10-year risk of cardiovascular disease [CVD]) is below 2.5% in 50% of pilots, and does not exceed 15-20% in the group with the highest risk either. The indices calculated by complex risk calculation methods are getting worse in the groups aged 25-50 years, but they improve with age over 50. **Conclusion:** The underlying causes probably are (1) the increasing role of a stricter check of physical condition within the evaluation of fitness for service in the army, (2), a change in lifestyle owing to effective propaganda, and (3) officially permitted use of medication to reduce lipid levels and blood pressure. Continuous monitoring of the risk of cardiovascular diseases is not only used in the evaluation of fitness for service, but also as a tool of prevention, because pilots with increased risk can be kept in service by appropriate drug therapy and, accordingly, by reducing the risk of actual occurrence of the cardiovascular disease.

[5]

**SHOULD STATINS BE IN AIRCREW WATER?**

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*Fort Rucker, Alabama, USA*

**Background:** The losses of trained aircrew due to coronary artery disease is significant for the individual and for military services. Aggressive treatment of risk factors such as smoking, hypertension, with exercise and diet have been implemented in most military and civilian aviation communities. The clinical impact of the statin class of drugs continues to expand. A particular risk is low HDL in the presence of normal or near-normal total cholesterol and LDL. In primary prevention of coronary artery disease, should aircrew with low HDL and slightly elevated cholesterol and LDL be placed on a Statin as first line treatment? **Methods:** The US Army database (AEDR) will search for aircrew with cholesterol of  $\leq 200$ ,  $LDL \geq 160$ , and  $HDL < 40$ . This review will encompass 85,000 aircrew in the database with lipids documented. A review of the cardiovascular status, to include drug therapy (niacin, fibrates, or statins) will be presented. Data is not available for aircrew intolerance to statins.

**Discussion:** Statens are known to have significant impact on the individual lipid profile. Pleiotrophic effects are rapidly being discovered ranging from improved endothelial function, prevention of Alzheimer's, an anti-inflammatory effect (hsCRP) and most recently colon cancer prevention. It would be suggested that statins be used in individuals with lipid profiles unresponsive to the usual risk factor modification. **Conclusions:** **1.** Critical review of lipid status of military and civil aircrew should be conducted to identify individuals with low HDL and normal or high LDL risk. **2.** Treatment utilizing a statin as primary prevention should be considered for aircrew at risk.

## SESSION 2

[6]

**PASSENGER & CREW HEALTH IN AVIATION**  
A RUGE

*Civil Aviation Authority, U K*

The House of Lords Report: "Air Travel and Health" was published in November 2000 after an extensive inquiry throughout the aviation community into the relationship between the various aspects of the cabin environment in commercial aircraft and the health of passengers and crew. One of the report's recommendations to Government was that a central source be given responsibility for advising government on the issues relevant to aviation health. The Aviation Health Unit (AHU) was formed on 1 December 2003 and is based at Gatwick within the CAA. The subject 'aviation health' encompasses a wide range of individual topics, such as deep vein thrombosis, cabin air quality, transmission of

infection, cosmic radiation, and occupational health. The objectives of the AHU are:

- Provide advice to Government on aviation health issues;
- Provide information to passengers, crew, and media;
- Investigate potential new aviation health concerns;
- Review research and other information on aviation health issues; and
- Liaise with the aviation industry and relevant organisations throughout the world.

During the first year of existence most passenger and crew questions related to the cabin environment such as cabin pressure, re-circulated air, and cabin air quality. Another concern is about the different standards of medical equipment that is available on board for acute medical emergencies. Research into aviation health is being carried out with regard to deep vein thrombosis and is presently being considered into the spread of infectious disease and cabin air quality.

**[7]  
TO BE WELL INFORMED FOR  
TRAVELLER'S ADVICE**

PETER W. FRANK

*SAME, Groebenzell, Germany*

Travelling around the globe is easy and fast possible nowadays. There is no age nor health restriction to fly to the edge of the world. Not all of those touring – you name them adventures, patients, passengers see a physician in advance to seek advice to prepare for the journey and for a safe return. But what training needs the physician to be able to advise and how can he inform himself about actual data on health risks at the individual destinations?

There are national and international training courses and diplomas for travel-medicine and various cd-rom-programs on the medical market as well as a few websites to be linked to with daily updates. The presentation is about to cover the training aspects and will compare the most common software programs in Germany and international websites.

**[8]  
CURRENT TRENDS IN AEROMEDICAL AND  
HUMAN FACTORS RESEARCH AT THE FAA  
CIVIL AEROSPACE MEDICAL INSTITUTE  
(CAMI): OPPORTUNITIES FOR  
INTERNATIONAL COLLABORATION.**

M.J. ANTUNANO

*FAA Civil Aerospace Medical Institute (CAMI),  
Oklahoma City, OK, U.S.A.*

CAMI scientists employ sophisticated equipment and facilities to focus on the bioaeronautical aspects of safety and security, including forensic toxicology, toxicogenomics, biochemistry, accident research, passenger and crew protection, survival research, environmental physiology, and vision research. There

are three main activities in the Aerospace Medical Research Program: 1) investigation of the injury and death patterns in civilian flight accidents along with meticulous analysis to determine cause(s) and prevention strategies; 2) development of recommendations for protective equipment and procedures; and 3) evaluation of options, on behalf of FAA regulatory and medical certification staff charged with the proposal of safety and health regulations addressing all aircraft cabin occupants. This research program identifies human tolerances, capabilities and failure modes (physiological, psychological, and performance) both in uneventful flights, and during civilian inflight incidents and accidents. The research results enable the FAA to utilize new and evaluate existing bioaeronautical guidelines, standards, and models for aircraft cabin equipment, procedures, and environments. CAMI scientists also study the skills, abilities, behavior, and performance of personnel involved in aerospace operations. Researchers look for ways to optimize human performance, efficiency and safety, through the introduction of new work station/cockpit displays and controls, and the effective selection and training of personnel operating in highly complex technological environments. CAMI's Aerospace Human Factors Research Division leads an integrated program of field and laboratory performance research in organizational and human factors aspects of aviation work environments. Research includes, but is not limited to, human performance under various conditions of impairment, human error analysis and remediation, agency work force optimization, training analysis and career enhancement, impact of advanced automation systems on personnel requirements and performance, human factors evaluations of performance changes associated with advanced multifunction displays and controls in general aviation and air traffic control, and the psycho-physiological aspects of workload and work scheduling on job proficiency and safety in aviation related human-machine systems.

**[9]  
THE RETURN TO THE OLYMPUS  
SELF ADMINISTRATION KIT FOR AVIATOR  
FOLLOWING A SEVERE ACCIDENT**

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*Israel Air Force, Surgeon general headquarters,  
Psychological branch.*

**Background:** In recent years joint work conducted by medical and psychological staff in squadrons has clearly shown that return to flying after an accident is more problematic than previously assumed. It turns out that despite the time that has passed since the occurrence of the accident and although it has been filed and made part of history, it continues to trouble the surviving crewmembers during air operations as well as on the ground. Lack of treatment may

aggravate legitimate symptoms, prolong their duration and generate delayed symptoms. **Objective:** To supply the aircrew members involved in the accident and their commanding officer with a "self help kit" to help them cope with the accident's potential negative consequences. **Method:** Self administered kit for aviator following a severe accident: The kit was written following interviews of dozens of aviators following severe accidents. The kit takes psychological intervention out of the clinic and entrusts it to non-professionals. It is based on Michenbaum's approach: "stress inoculation training" and Lurie's self-administration booklet for coping with stress. The purpose of the kit is to equip the individual with suitable coping skills that will enable him to control and minimize the negative consequences of the accident, in a manner which is not dependent on his immediate environment. The kit has two parts, one for the surviving aviators and the second for the squadron commander. Procedure: The current routine is that each Israeli aircrew member involved in an accident receives the kit. The commanders of the aircrew members are responsible for its administration. **Results:** Aviators that have used this kit have shown less PTSD symptoms in comparison to aviators that have gone through a similar occurrence, yet did not use the said kit. **Discussion:** Today, the kit is part of the Israeli Airforce rehabilitation process of aircrew members following an accident. In addition, it provides information directed at the unique difficulties of both the commanding officers' and other squadron members.

[10]

**HIV POSITIVITY AMONG PILOTS: DOES THE EVIDENCE SUPPORT THE FIT FOR FLYING ASSESSMENT?**

P. ÅRVA

*Civil Aviation Authority, Oslo, Norway*

The ICAO Annex 1 applicable in November 2005 contains a new paragraph which opens for fit assessment of HIV positive pilot applicants. The JAA JAR-FCL 3 medical requirements says that HIV positive pilots are disqualified at initial examination, but may be re-licensed when the pilot attracts HIV positivity during the career. The ICAO requirements do not distinguish between initial and renewal assessment. Antiretroviral treatment is available since 1996 and during this period the relative risk for developing AIDS has decreased. However, the HIV/AIDS epidemiological situation varies considerably throughout the world. In the presentation it will be discussed whether the HIV prevalence in a given population may have an influence on flight safety. The paper also describes a method how evidence can support fit for flying assessment in a given pilot population.

**SESSION 3**

[11]

**VASCULAR IMPEDANCE TO ASSESS +GZ TOLERANCE PREDISPOSITION IN PILOTS**

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**Introduction:** Brain circulation effectiveness under +Gz stress depends on sustaining systolic blood pressure at the required level. That in turn depends on the heart systole and blood vessels regulation in the jugular arteries basin.

Results of the peripheral vascular resistance (Rp) changes as well as changes in the resistance of non-resistant arterioles (Ro) during LBNP stimulus in military pilots displaying different G-tolerance (good or bad) assessed during centrifuge tests are presented.

**Material & methods:**

7 military pilots whose 4-year average G-tolerance assessed during the linear onset protocol (.1 G/s) in the centrifuge ranged between 5.8 and 7.7 +Gz took part in the study. All of them were subjected to the two stage negative pressure (LBNP): first the pressure was reduced from 0 to -15mmHg where it was sustained for 1 minute then it was further reduced to reach -50 mmHg over one minute. At this level it was sustained for one minute and final return to the 0 mmHg negative pressure over one minute.

Ro and Rp recordings were made continuously using a specialized ultrasound device devised by prof. Pawłowski's team on the left jugular artery.

**Conclusions:**

During exposure to -15 mmHg statistically significant ( $p < 0.01$ ,  $r = 0.94$ ) inversely related correlation between G-tolerance value as assessed in the centrifuge and Ro/Rp ratio was found. Results indicate essential role of the mechanoreceptors baroreflex on cardiovascular system compensation under acceleration and possible utilization of the above described method in the pilot candidates selection process.

[12]

**COMPARISON OF BLOOD PRESSURE AND HEART RATE, BEFORE AND AFTER FLIGHT IN DECOMPRESSION CHAMBER OF IRIAF HEALTH ADMINISTRATION**

K. GHAZIZADEH, A. AKBARI, H.

MOHSENZADEH, B. MONTAZERI, H.

KANGARLU, M. PANJEHBAND, S. R. ABTAHI  
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**Background:** Decompression chamber as an essential equipment in aviation medicine, is used to simulate hypobaric pressure in different altitudes. Ample attention to the first symptoms of hypoxia can prevent aviation accidents. This study was designed to investigate the effect of hypoxia in decompression chamber on blood pressure (BP) and heart rate (HR). **Materials & Methods:** In a cross-sectional study on a simple randomized group, consisting of 180 aviation personnel, BP and HR were recorded before and after the experiment of decompression chamber. Collected data were analysed using SPSS software. **Results:** Mean age of the studied individuals was 32 years. 23.3% of them were fighter pilots, 26.7% cargo pilots, 20% flight crew, and 30% flight students. Their mean flight hours was 1790 hours. No significant disease history was present and 73% had no history of being grounded. Changes in the first hypoxia symptom comparing to the last flight in decompression chamber was observed in 17.1%. Among hypoxia symptoms, dizziness was the most common one (24.4%). Differences between mean arterial BP, mean systolic BP, and mean diastolic BP, before and after flight in decompression chamber were investigated by paired t-test. None of these parameters had a meaningful change ( $p > 0.05$ ). Mean HR before and after this flight were also measured and compared, which were significantly different ( $p = 0.002$ ). **Conclusion:** Regarding that no meaningful changes in blood pressure occur after flight in decompression chamber and heart rate remains in a range not threatening life, it can be concluded that this level of experimented hypoxia in decompression chamber does not impact on these vital signs and in this view is a safe flight simulating.

[13]  
**AVIATION LIFE SUPPORT EQUIPMENT PERFORMANCE IN CURRENT MILITARY ROTARY-WING OPERATIONS**

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**Introduction:** Aircrew in the U.S. Army are provided a full complement of protective and survival gear that is intended for use in both peacetime and wartime. There is considerable interest in learning how this equipment is functioning in actual use, and whether policies governing its use are universally applicable to modern combat operations. **Methods:** Information was collected from a variety of sources regarding aviation life support equipment (ALSE) performance. In Fall 2004, a fact-finding team from the Center for Army Lessons Learned (CALL) was accompanied by a USAARL flight surgeon (G.L.). Surveys and interviews were conducted in-theater to solicit user

comments about the suitability and functionality of the provided ALSE. Separately, a review of US Army accident reports and mishap ALSE stored at USAARL from 2003-2005 was conducted with similar intent. **RESULTS:** The CALL team administered over 1400 surveys to deployed and redeployed Army aircrew. There were widespread human factors issues noted with multiple ALSE items, ranging from seat cushion comfort to aircrew helmet field-of-view limitations. Some operational units have made substantial investment into replacement or supplemental seat cushions out of concern for flight safety and mission effectiveness. A review of accident reports revealed patterns of post-crash survival and rescue that may contribute to personal equipment redesign and usage. The current US Army flight helmet (HGU-56/P) appears to be functioning very well in survivable helicopter mishaps.

**Discussion:** Human factors issues with the current ALSE appear to be most related to the prolonged mission length and the high operational tempo. Efforts are underway to devise a field-expedient method of assessing seat cushion safety that could provide rapid feedback to operational units as well. Aeromedical participation in "lessons learned" teams deploying into operational settings can provide invaluable drivers for applied research projects with real-world payoff.

[14]  
**EFFECT OF THE AVAILABILITY OF FOOT BOARD SUPPORT ON CARDIOVASCULAR RESPONSES TO ORTHOSTASIS**

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**Background and Introduction:** Despite availability of a number of protocols, the ideal duration and support remains debatable for tilt table studies. The study was conducted to examine 1) the effect of footboard support on cardiovascular responses to orthostasis and 2) progression of these changes during the initial 20 minutes & subsequent 25 minutes of head up tilt (HUT), using two widely accepted support devices (footboard support and saddle suspension). **Method:** Thoracic hypovolemia, myocardial functions and consequent HR & BP responses were measured in 17 healthy male volunteers (age- 22-36 yr) during 45 minutes of HUT with the two support devices. The results were analyzed using two way ANOVA with Tukey's HSD for individual comparisons. **Results:** HUT with either of the support resulted into comparable thoracic hypovolemia (evident from basal thoracic impedance) and compromises in cardiac function (reduction in contractility, SV and CO). However, a significant interaction was noticed between support device and posture for HR [ $F = 3.54$ ;  $p = 0.045$ ] and MAP [ $F = 5.97$ ;  $p = 0.008$ ]. Individual comparison of changes in these



variables showed small, yet significant, differences between the orthostatic maneuvers with the two support devices. These results submit an indirect evidence that the pre-load is not modified appreciably with the availability of footboard support. The subtle differences in HR, MAP responses on HUT with footboard support seem to be due to their modulation through reflexes originating from mechano-receptors/ metabo-receptors from the antigravity muscles. The difference is not associated with any variation between the two maneuvers in terms of a symptomatic outcome. **Conclusion:** The availability of a footboard support results into comparable haemodynamic perturbations and subsequent adjustments. Small, yet significant, differences in HR and MAP responses do not contribute to any appreciable difference in the symptomatic outcome. The choice between any of the two support devices is, therefore, more a matter of academic interest and administrative convenience than of any practical significance.

[15]  
**INFLUENCE OF HYPOXIA ON SPATIAL ORIENTATION**

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**Introduction:** Hypoxia is long time recognized factor compromising both sensory organs function and operators performance. So it is possibility that hypoxia influences pilot's spatial orientation both on sensoric and information processing level. We attempted to assess influence of normobaric hypoxia on spatial orientation.

**Material and Methods:** Experiments were conducted in Spatial Orientation Laboratory in Military Institute of Aviation Medicine. 16 experienced instructor pilots volunteered to participate in experiment. They were exposed to a flight profile demonstrating Coriolis illusion on GYRO Integrated Physiological Trainer breathing ambient air (control condition) and low – oxygen mixtures simulating altitudes of 5000 and 6000 meters a.s.l (1 and 2 experimental conditions). Blood oxygen saturation, heart rate, eye movement and flight parameters were continuously monitored and recorded during flights. Participants were also asked to fill subjective hypoxia symptoms questionnaire.

**Results:** In both experimental conditions we found statistically significant decrease in flight parameters return time. We also found that in both hypoxic conditions significant increase in nystagmus occurrence and time. Instrument scanning pattern was also less efficient. Even though some pilots showed low hypoxia symptoms (SaO<sub>2</sub>) saturation around 92%, they also had statistically significant decrements in both flight parameters and in eye movements

derived parameters. We did not found significant correlation between subjective hypoxia symptoms and performance decrement. **Conclusions:** Even short time mild hypoxia significantly increases possibility of spatial disorientation in pilots during Coriolis illusion flight profile. Increase (in some cases very high) of time needed to return to correct flight parameters poses serious threat to flight safety. Implications to middle altitude aerobatic flying should also be considered.

**SESSION 4**

[16]  
**FAA GUIDANCE FOR MEDICAL SCREENING OF COMMERCIAL AEROSPACE PASSENGERS - PART 1: SUBORBITAL FLIGHTS.**

M.J. ANTUNANO  
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This presentation will describe the general guidance developed by the FAA Office of Aerospace Medicine for operators of manned suborbital commercial space flights in the medical assessment of prospective passengers. This guidance identifies and prioritizes the minimum medical requirements to preserve the health and promote the safety of paying passengers who intend to fly onboard suborbital commercial space vehicles. This guidance helps identify those individuals who have significant medical conditions that may result in an inflight medical emergency or inflight death, or may compromise in any other way the health and safety of any occupants (crew members and passengers) onboard a commercial aerospace vehicle. The definition of these recommended medical requirements was influenced, among other things, by the various operational and environmental stress factors that represent risks (actual and potential) to the occupants of commercial suborbital space vehicles. Actual risks include exposure to high acceleration (supersonic and hypersonic speeds) and deceleration (atmospheric re-entry) forces, to microgravity or weightlessness (acute and repetitive/chronic effects), to solar and cosmic radiation (acute and repetitive/chronic), to noise and vibration, to unfamiliar motion (space motion sickness), and to a sealed cabin environment (cabin air quality). Of particular concern are the effects of exposure (short-term and repetitive) to microgravity on the cardiovascular, neurological, endocrinological, musculo-skeletal, and gastro-intestinal systems on both healthy and diseased prospective passengers. Other potential risks include exposure to very low or absent barometric pressure, to temperature extremes (heat and cold), and to a unique cabin environment influenced by the effects of microgravity on the distribution of contaminants (biological, chemical,

particulates, etc.) suspended in the air. Suborbital space flight exposes individuals to an environment that is far more hazardous than what is experienced by passengers who fly onboard current airline transports. With suborbital flights, pre-existing medical conditions can be aggravated or exacerbated by exposure to the above-mentioned environmental and operational stress factors.

[17]  
**FAA GUIDANCE FOR MEDICAL SCREENING OF COMMERCIAL AEROSPACE PASSENGERS - PART 2: ORBITAL FLIGHTS.**  
M.J. ANTUNANO

*FAA Civil Aerospace Medical Institute (CAMI), Oklahoma City, OK, U.S.A.*

This presentation will describe the general guidance developed by the FAA Office of Aerospace Medicine for operators of manned orbital commercial space flights in the medical assessment of prospective passengers. This guidance identifies and prioritizes the minimum medical requirements to preserve the health and promote the safety of paying passengers who intend to fly onboard orbital commercial space vehicles. This guidance helps identify those individuals who have significant medical conditions that may result in an inflight medical emergency or inflight death, or may compromise in any other way the health and safety of any occupants (crew members and passengers) onboard a commercial aerospace vehicle. The definition of these recommended medical requirements was influenced, among other things, by the various operational and environmental stress factors that represent risks (actual and potential) to the occupants of commercial suborbital space vehicles. Actual risks include exposure to high acceleration (supersonic and hypersonic speeds) and deceleration (atmospheric re-entry) forces, to microgravity or weightlessness (acute and repetitive/chronic effects), to solar and cosmic radiation (acute and repetitive/chronic), to noise and vibration, to unfamiliar motion (space motion sickness), and to a sealed cabin environment (cabin air quality). Of particular concern are the effects of exposure (short-term and repetitive) to microgravity on the cardiovascular, neurological, endocrinological, musculo-skeletal, and gastrointestinal systems on both healthy and diseased prospective passengers. Other potential risks include exposure to very low or absent barometric pressure, to temperature extremes (heat and cold), and to a unique cabin environment influenced by the effects of microgravity on the distribution of contaminants (biological, chemical, particulates, etc.) suspended in the air. Orbital space flight exposes individuals to an environment that is far more hazardous than what is experienced by passengers who fly onboard current airline transports. With orbital flights, pre-existing medical conditions can be aggravated or exacerbated

by exposure to the above-mentioned environmental and operational stress factors.

[18]  
**A CASE FOR ACADEMIC COMPLEMENTATION: A MODEL FOR SUCCESS**

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**Introduction:** “In a fast-changing global environment, the ability to exploit knowledge is what gives companies their competitive advantage.” This quote by the world-famous businessman, Peter Drucker, also applies directly to winning on the battlefield as well as in the challenging aerospace environment. Human knowledge is said to double approximately every thirty years; science knowledge in less than ten years. Competitive advantage is gained by learning faster than the competition. Educator time with Team Aerospace students is never sufficient; however, we have an obligation to prepare our warfighters as comprehensively and as quickly as possible. To accelerate intellectual achievement, the academic curriculum at the USAF School of Aerospace Medicine is constructed on a model relying upon the close relationship of three methods of conferring knowledge; didactics, research and practicum. Absence of one instructional constituent from any of the others reduces the efficiencies and effectiveness of the remaining elements.

**Methods and Results:** Review of the literature and observation of successful programs provides insight into the inherent value each component of the model brings to knowledge acquisition. Furthermore, evidence substantiates the combined value each confers upon the others. Harnessing the combined synergies generated by this model describes how complementation can achieve the goal of delivering a growing body of knowledge even in the presence of reduced student-professor contact time.

**Conclusions:** Exponential growth in knowledge, compounded by rapidly expanding technological gains, presents a cumbersome task for the educational community. Academic complementation provides opportunities for Team Aerospace to achieve goals of much higher level quality and safety than could be attained when any of the three are absent from the educational model.

[19]  
**RECENT ADVANCES IN USAF INTERNATIONAL AEROSPACE MEDICINE EDUCATION AND TRAINING**

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**Introduction:** The United States Air Force School of Aerospace Medicine (USAFSAM) provides education and training to over 7,000 aerospace medicine students a year, in 90 courses, from introductory courses to post-graduate fellowships. Officers, enlisted, and civilian personnel attend. Its goals include increasing international healthcare understanding and cooperation in support of military and humanitarian operations through education and training. The most popular international course is the flagship Advanced Aerospace Medicine for International Medical Officers (AAMIMO) course. In the past 40+ years, the AAMIMO course produced hundreds of graduates from 86 countries, more than 35 of whom have gone on to become their nation's equivalent to the Air Force Surgeon General. Other international courses have included the Aerospace Medicine Primary (AMP) course, as well as Aeromedical Evacuation, Hyperbaric Medicine, Aerospace Physiology. Additional courses provide training in medical surveillance, public health; detecting, identifying and assessing WMD threats to mention just a few. Recent changes in the USAFSAM curriculum offer great advances over the past, including an expanded list of training options open to AAMIMO students during their elective time. There are also major changes planned for the AMP course, including the significant use of Advanced Distributed Learning/web based training in the curriculum.

**Methods and Results:** Review of recent course content as well as proposed curriculum changes shows that USAFSAM continues to increase its attention to addressing the needs of the international aeromedical community.

**Conclusions:** USAFSAM now offers the majority of its courses to a broader based more international audience. There have been numerous changes in the curricula of several of the above courses that offer significant advancements in the quality of the training offered to international students. There has also been an increased effort to extend the majority of USAFSAM courses to the larger international community.

[20]

#### **THE ESTABLISHMENT OF TELE-ECG AND TELE-X RAY SYSTEMS IN SOUTHERN BRAZIL**

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**Introduction:** A pioneer Telemedicine Program has been established in Brazil, including a digital tele-ECG system (DES) and a tele-x ray system (DEX) that allow electronic data transmission to and

interpretation by a remote cardiologist and radiologist, respectively. **Method:** An urban and a rural hospital in Sao Lourenco do Sul city and an outpatient unit in Turuçu city have employed DES and DEX. DES includes a digital ECG machine, standard computers, a modem connection, internet facilities, telecommunication software and fixed or mobile phones. DEX includes an x-ray facility, a viewing box, a digital camera, standard computers, a 3:1 Mitchell algorithm compression protocol using the Easy Thumbnails software and internet access. Both systems allow data to be recorded, transmitted for immediate analysis (online) and stored for later retrieval (e-health). A remote specialist performs the data analysis via fixed or mobile phone, using specific telecommunication softwares and web based transmission with and without image compression protocols. **Results:** 1063 tele-ECGs were performed during 1 year: 622 online and 441 e-health. Mean time between data transmission and analysis was 8.1 ( $\pm 1.7$ ) min and up to 24h for the online and e-health tele-ECGs, respectively. The online results showed that 66 ECGs presented acute signs of myocardial ischemia and 39 ECGs had S-T elevation myocardial infarction. Sixty chest x-rays were randomly selected for a preliminary evaluation of DEX. A remote radiologist received the chest x-rays via e-health transmission for analysis. Lung and heart variables were compared using the on-site and remote interpretation. There was 81.7% agreement between the on-site and remote interpretation. Failure to identify pathological abnormalities only occurred in 3 of the 11 incorrectly interpreted x-rays. **Conclusion:** The low cost and the "user friendly" aspect of DES and DEX make them useful and appropriate for small cities and rural areas of developing countries.

#### **SESSION 5**

[21]

#### **ULTRA LONG RANGE FLIGHTS: FROM CONCEPT TO REALITY**

J. SINGH

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**Introduction:** Ultra-long range (ULR) flights are those that exceed 16 hours of flying time non stop. Current regulations world-wide permit flights with a duration of 16 hours or less. Singapore Airlines (SIA) submitted a request to the Civil Aviation Authority of Singapore (CAAS) in September 1998, to launch non stop flights to the west coast of USA which would exceed the 16 hour limit in place. A Task Force was formed to look into the issue and submit a set of rules that would permit such flights. **Methods:** A tripartite Task Force was formed. The project was conducted in 3 phases. The first phase was a computer modelling of the flights with assumptions obtained from SIA. The

results of the first phase were validated with data from a study carried out on current SIA operations (Phase 2). Provisional rules were drawn up to enable SIA to launch the flights. The 3rd phase consisted of validation studies on the actual ULR flights. The Task Force members also participated actively in 4 ULR workshops organised by the Flight Safety Foundation.

**Conclusions:**

The results from the validation studies indicate that the rules put in place for the ULR flights are holding up well. Results of the studies will be presented. Challenges for the future will be discussed.

[22]

**FUTURE CHALLENGES OF SPACE MEDICINE**

R.B. RAYMAN

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In 20 or 30 years, we will see a flight to Mars with a crew of 3 or 4 persons. The flight will be of 30 months duration and there will be no chance of rescue in event of an inflight emergency. This flight will be a great challenge in that there are many unresolved questions including the capability for medical diagnostics and therapeutic options. An autonomous system of medical care will be essential. Also, although we have well defined the physiological effects of micro-gravity, we cannot be certain that the countermeasures we have today would be effective on a 30 month mission. These questions and others including pharmacokinetics, inflight surgery, and human factors will be discussed. The promise of artificial gravity will be emphasized.

[23]

**ADVANCES IN SPACE MEDICINE**

J. R. DAVIS

*NASA Johnson Space Center, Houston, TX, USA*

**Introduction:** This presentation will cover three topics, returning the shuttle to flight, completing the International Space Station, and exploring the moon and mars. Since February 2003, activities have been focused on the safe return to flight of the Space Shuttle, including work on crew escape and safety. The Shuttle is integral to supporting the International Space Station (ISS). Since the first crew arrived at the International Space Station in 2004 through Expedition 10 in April 2005, there have been humans permanently in space for about 1630 days. Crewmembers have conducted 19 experiments in the human life sciences. This presentation will describe some of the results of these studies on physiological and psychological changes. In early 2004, the United States set a course for exploration that included the return to flight of the space shuttle, the completion of the International Space Station, and exploration of the

moon and Mars. The presentation concludes with our planning to support these exploration activities.

**Methods:** Nineteen experiments in the human life sciences have increased our knowledge base and provided technology demonstrations. Crewmembers conducted numerous experiments on multiple missions for a total of 66 experiments during increments 1 – 10. In the arena of exploration, the methodology is a building block approach to the safe and productive human exploration of space. To realize the new Vision for Space Exploration NASA will continue the building block approach. The paper discusses the exploration spirals leading to lunar and Mars surface exploration missions and the challenges of extending human presence across the solar system.

**Results:** Physiological changes include neurovestibular adaptations, cardiovascular alterations, muscle loss, and immunological and hematological changes. There are effects from exposure to environmental contaminants and alterations in pharmacodynamics and nutrition. The paper describes recent developments in space physiology. The building block approach for exploration includes spiral development, Spiral 1 (2008-2014) during which a transportation system for human space flight into low Earth orbit occurs; Spiral 2 (2015-2020) when extended duration human lunar exploration occurs; Spiral 3 (2020-TBD) when long-duration human lunar exploration will take place; Spiral 4 (~2025-TBD) for human exploration missions to the vicinity of Mars; and Spiral 5 (~2030-TBD) when the initial human Mars surface exploration missions occur. **Conclusions:** Results from shuttle return to flight work will benefit the design of future space vehicles. Knowledge gained from the ISS will enhance development of countermeasures and medical systems for long duration space flight.

[24]

**AN ASSESSMENT OF IN-FLIGHT TELEMEDICINE ON COMMERCIAL AIRCRAFT**

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**Introduction:** With the increasing duration of long-range flights and the imminent arrival of high capacity aircraft, combined with a rise in passenger demographics and litigation risks, airlines are investigating options to further improve the handling of in-flight medical incidents. In-flight telemedicine is one potential means of addressing such incidents but there is currently little commercial airline industry data available. **Methods:** In-flight telemedicine in this context is the transmission of medical data from an aircraft with a non-expert operator, such as a crewmember, to medical experts at another location using satellite communications. This presentation discusses an assessment of some of the key issues

associated with using telemedicine devices in the aircraft environment such as choice of medical parameters, potential impact on diversions, ease of use and training, communications issues, logistic and engineering issues, potential litigation issues and cost/benefit analysis. **Results:** Initial results from in-flight trials will also be presented. **Conclusions:** The presenter concludes that the assessment indicates that appropriately designed telemedicine solutions could prove an effective solution to improving the handling of in-flight medical incidents and decrease litigation risks, while improving the overall quality of both crew and passenger care. Telemetry will provide ground based experts with improved knowledge of the patient's status and allow more careful monitoring but the effect of this technology on the aircraft diversion rate is unknown and more data from in-flight use is required.

[25]  
**RELEVANCE OF TISSUE MINERAL ANALYSIS IN MEDICAL EXPERTISE OF MILITARY AERONAUTICAL PERSONNEL**

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<sup>1</sup>National Institute of Aerospace Medicine; <sup>2</sup>“Dr. Tiron” Medical Centre; <sup>3</sup>Public Health Institute; <sup>4</sup>“C Davila” University of Medicine and Pharmacy; Bucharest, Romania

**Introduction:** Hair tissue mineral analysis (TMA) is one of the most modern, complete and non-invasive laboratory test for evaluation of individuals' general health and diagnosis of certain pathological conditions. TMA is based on the most recent technology, developed by NASA: atomic absorption spectrophotometry. It evaluates the tissue level of 30 nutrient minerals and 6 toxic minerals. **Aim:** Improving the general health and enhancing professional performance of aeronautical personnel. **Methods:** We studied 32 consecutive subjects from military aeronautical personnel periodically examined at the National Institute of Aerospace Medicine. The studied lot was evaluated by clinical exam, psychological test, routine blood analysis, ECG, serological determinations of the main blood minerals and toxic blood minerals. Moreover, all subjects were studied by TMA at the initial moment and after 2 and 4 months of individualized therapy. **Results:** The patient population's mean age was 35.28 (CI 95% = 33.5 – 37). Mean body mass index was 24.64 (CI 95% = 23.8 – 25.5). All studied subjects were clinical normal. The initial results of hair AMT revealed high values of Na, K and minor changes for Ca, Mg, Cu, Zn, and Fe. Also, AMT revealed a high level of toxic minerals in 87.5% of the subjects, the most important were: Cd (62.5%), Pb (18.75%), As (12.50%).

Initially, all studied subjects were affected by stress, most of them (66%) being in the resistance stage, as shown by the AMT results. Monitoring the specific therapeutic response (individualized nutritive integrators) revealed a significant improvement of minerals' levels and a significant reduction of tissue stress in all studied subjects. **Conclusions:** The results of this study underline the necessity of periodical evaluation of aeronautical personnel by hair AMT, included in the medical expertise. The results of AMT allow the identification and elimination of causes that could interfere with neuropsychic functions, resulting in improved professional performance and enhanced flight security.

SESSION 6

[26]  
**HEAT STRESS DEVELOPMENT AND CARBON MONOXIDE EXPOSURE DURING VEHICLE TRANSPORTATION BY C-130 PLANE.**

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**Objective:** The study investigated the heat stress and carbon monoxide air pollution which can develop during transportation of vehicles with hot engine and corpus at tropical climate in C-130 airplane. **Methods:** Heat stress index (WBGT) and carbon monoxide air levels were measured during two nighttime and daytime flights that included vehicle transportation, which were performed during the summer period. The results were compared to limited exposure values. **Results:** Heat stress index was higher during the vehicles' transportation at all of the flights ( $p < 0.001$ ), with the 5.9 °C highest daytime difference from control flight. The number of transported vehicles affected the heat stress only at daytime. The WBGT levels exceeded the exposure limit only during daytime flights in 74% (28/38) cases. The time from the beginning of the transportation was found as strong predictor for increased heat stress. Carbon monoxide air levels were higher after the vehicle entrancing or exiting ( $p < 0.005$ ), during the transportation of three vehicles ( $p < 0.016$ ), and they did not affect the oxygen blood saturation among crew members. **Conclusions:** Vehicles transportation significantly add to heat stress development and increase carbon monoxide levels in C-130 airplane. Well-designed environmental control system is needed for reducing of heat stress and carbon monoxide exposure at C-130 planes.

[27]  
**EFFECT OF HOT ENVIRONMENT AND PHYSICAL EFFORT ON PILOT'S PERFORMANCE.**

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**Introduction:** Heat stress is rare subject of performance investigation in aviation. The data from other fields of psychology suggests, that human ability of adequate reacting in complex situation is seriously impaired in hot environment. Several factors are responsible for this effect. The effect of heat on human behaviour has been observed in many theoretical (Bourne, Yaroush 2003) and applied studies, including soldier's combat efficiency (Johnson, Kobrick 2001) and drivers behaviour (Kenrick, MacFarlane 1986). For pilots operating small civil or combat aircrafts high environmental temperature may become a problem. All above reasons implicated the aim of the presented study-developing a method for pilots' ability to work under heat stress. **Methods:** In the study, 60 pilots were tested in climatic chamber, allowing to control temperature, humidity and air pressure. During experiment the environment in a chamber was settled on temperature of 40 degrees, humidity level at 40% and normal atmospheric pressure. Performance measurement was constructed on the Vienna Determination Test base (see Prieler 2002). Several visual and acoustic stimuli were presented in three phases, with different speed of presentation. First and third phase were slow, the middle one was the fastest. Subject's stress tolerance was assessed on the base of comparison between scores (number of adequate reactions and errors) in fast and slow phases. The subjects were tested in three time points: Before entering the chamber; inside chamber, after 30 minutes of staying in chamber and gymnastic exercises inside and after 30 minutes resting outside the chamber. **Conclusions:**

Results showed the improvement of test scores in three experimental conditions, caused by learning of a motor task. However, the learning curves are different for the easy task (slow stimuli tempo) and for the difficult task (fast stimuli tempo). In easy task no progress has been observed between baseline level and test in chamber, and then a large progress between test in chamber and test after rest. For the difficult tasks improvements between three conditions are equal.

[28]

#### HEARING LOSS IN NORWEGIAN AVIATION PERSONNEL – AGE RELATED OR NOISE-INDUCED?

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**INTRODUCTION:** Norwegian Civilian Pilots and ATC personnel are regularly audiometrically

examined at the Institute of Aviation Medicine in Oslo for their medical certificates. In order to investigate possible noise-induced hearing loss following worries from personnel groups, a comparative analysis of ATC personnel, airline pilots and helicopter pilots was performed. **METHODS:** Male ATC, airline and helicopter pilots were selected randomly from the CAA medical files. Subjects with ENT diseases were excluded, likewise subjects where audiograms showed inconsistencies or obvious errors. 182 subjects were included in the study, 50, 81 and 51 for ATC, helicopter and airline pilots respectively. No audiograms taken outside the Institute of Aviation Medicine were included to ensure identical noise environments for the audiometric examinations. Age correction was performed using data from ISO 7129. The average of the 4KHz frequency left and right ear was examined in particular since this frequency often reveals occupational noise-induced hearing loss first. **RESULTS AND DISCUSSION:** For all three groups, mean hearing threshold levels were above (worse than) ISO 7129 predictions for most frequencies. As expected, hearing thresholds increased with age in the group as a whole. Looking at the 4 KHz frequency in particular, age correction revealed very little other effect than age. Separation into the three subject groups, helicopter pilots had lower (better) mean hearing thresholds in relation to age than their airline and ATC colleagues. However, the differences were non-significant. **CONCLUSIONS:** Differences in hearing levels were mostly related to age. Helicopter pilots had slightly better (non-significant) hearing thresholds than the other groups despite higher noise levels in helicopters. Hearing thresholds were generally higher (i.e. worse) than ISO 7129 predicts. This might have methodological implications since age (exposure) differences were not worse than the ISO prediction.

[29]

#### AN EVALUATION OF THE INTERACTION OF A CONTROLLED DIET WITH SCOPOLAMINE ON THE PREVENTION OF MOTION SICKNESS

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**Introduction:** This study aimed to evaluate the best time for the administration of scopolamine, a drug commonly used to prevent the symptomatology of motion sickness, and the effect of a meal on its action.

**Method:** Ten healthy subjects underwent to two randomized days of rotation tests starting at 8 AM, one day after 12 h of fasting and another day, in which the subjects ate a breakfast comprising coffee with sugar, bread, butter and cheese before the test session. On both occasions, the subject took 0.45 mg of scopolamine orally. The speed of the rotatory chair

was set at 25 rpm. The subject was instructed, by means of computerised voice program, to move his head 45°; forward, backward, left and right at 30 s intervals. The rotatory test sessions were conducted at 60 min, 90 min, 120 min and 150 min after the administration of scopolamine. Signs and symptoms of motion sickness and the side effects of the drug were evaluated by means of the Graybiel. Time of rotation was recorded for each session, which was terminated at 30 min of rotation or if the subject felt ill. **Results:** The incidence of symptoms was less when the meal was taken before the test. There was no significant difference in the rotation time within the fasting test sessions ( $p=0.81$ ) and controlled diet test sessions ( $p=0.23$ ). The test session performed 60 min after the drug intake showed that the meal increased time of rotation from 284s to 494s ( $p=0.0002$ ). Results did not show any significant difference at 90 min ( $p=0.07$ ), 120 min ( $p=0.08$ ) and 150 min ( $p=0.09$ ) when both groups were compared. **Conclusion:** The results suggested that taking the meal enhanced the action of scopolamine. Further tests using a larger number of subjects are required.

[30]

#### **DETERMINATION OF RELATIONSHIP BETWEEN DESIGN EYE POINT AND NEUTRAL SEAT REFERENCE POINT IN A FIGHTER AIRCRAFT**

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**Background:** The Naval variant of the Indian Light Combat Aircraft (LCA) required the pilot to have Over the Nose Vision (ONV) increased from the original 15° to 21° degrees. This was due to the lower approach speeds and thus high angle of attack. Computer simulation using anthropometric mannequins in Auto CAD<sup>®</sup> indicated an alteration in Seat Back Angle (SBA) along with an increase in height of Neutral Seat Reference Point (NSRP) would be adequate to attain the required ONV. However exact relation between the Design Eye Point (DEP) and NSRP was not known for this SBA and thus had to be determined. Two methods of determining this relationship were used, one using photography and the other direct measurements of the eye from two known points. **Materials and Methods:** The front cockpit of the LCA trainer mock up was used, as its structure forward of the front cockpit was similar in construction to LCA (Navy). A photographic method of location as well as a method of locating DEP by measurement of the eye from two known points was used. Aircrew close to 50<sup>th</sup> percentile sitting height, attired with full flying clothing, were used. With the harness locked and tight and the subject in normal flying posture, photograph was taken and

measurements made of the eye to two known points on the headrest. **Results:** Results were analysed statistically as well as by plotting the center of the best fit ellipse. Using photography and the statistical average, absolute values of x and z was 3879.14 and 835.29. The centre of the best fit ellipse was at x 3870.82 and z 835.47. When using measurements the average x and z were 3886.84 and 833.03 and the centre of best fit was at 3876.17 and 828.99 respectively. The absolute Mean DEP coordinates were subtracted from NSRP coordinates (x 3880.24 z 77.3) to arrive at their relationship which was found to be x 105.36 and z 756.11 **Discussion:** Mil Specs 1333B specify the forward (x) displacement of DEP from NSRP for seat back angles from 10° to 15°, in ½ degree increments. The vertical displacement (z) is kept constant at 31" (787.4 mm). Seat back angles more than this require that the relationship between these two points to be defined as both x and z would vary. Moreover with different populations having differing mean eye level height the value of z would also change. Both photography as well as measurement from a known point are relatively easy to perform and accurate methods of determining DEP NSRP relationship.

#### **SESSION**

[31]

#### **THE USAF AVIATION REFRACTIVE SURGERY PROGRAM: AN OVERVIEW**

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The USAF Aviation Photorefractive Surgery Program was initiated in 2000 following an extensive research program to validate photorefractive keratectomy (PRK) in USAF aircrew, The USAF PRK Study, completed at USAFSAM. Later the program was expanded to allow laser in situ keratomileusis (LASIK) in some aircrew under certain flight restrictions. Since the program began, over 600 aircrew, including 125 pilots and boom operators, have undergone elective PRK. This presentation will present the fundamental lessons learned from the original USAF PRK Study and present current details with respect to high contrast and low contrast visual performance outcomes in USAF aircrew under the current program. Pertinent aeromedical recommendations will be presented.

[32]

#### **FEDERAL EXPRESS FLIGHT 1478: AN ANALYSIS OF COLOUR VISION FACTORS**

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On July 26, 2002, a Fed Ex 727-232 aircraft impacted the ground short of the runway during a PAPI directed night visual approach in Tallahassee, Florida. The subsequent NTSB post-mishap investigation

determined that one of the factors contributing to the mishap was the mishap pilot's pre-existing colour vision deficiency. This paper will present the results of a comprehensive colour vision evaluation of the mishap pilot conducted at USAFSAM and an analysis of how his colour vision deficit impacted interpretation of the PAPI system. In addition, the paper will present USAFSAM's experience with the effectiveness of the Farnsworth Lantern as a screening colour vision test for military aircrew applicants as related to this mishap.

[33]  
**SAFETY, HUMAN FACTORS AND TRAINING CONSIDERATIONS IN CIVILIAN NIGHT OPERATIONS WITH NVG. A CHALLENGE.**

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**Introduction:** The availability of the latest generation of image intensifiers for night air operations such Night Vision Goggles (NVG) and Forward looking Infrared (FLIR), has meant a great advantage for military operations. Nowadays most of the air combat operations are sustained during the night. For the last few years research and development in that field has been fully forwarded in the military community, but interest for potential applications in the civilian aviation is a fact around the world. Nevertheless the use of NVG is not an easy task, and eventually can lead to problems if appropriate use and training is not provided. A wide number of facts such technical requirements (crew certification, cabin compatibility, inside and outside lightning, filters, instrument integration, operational limits etc..) and human factors requirements (visual field, workload, weight of the systems, ergonomics etc.). In this paper we review the experience of the training provided to military personnel in the Nite Lab installed in the CIMA, for further discussion and potential use in the civilian aviation. **Methods:** Experience of 32 pilots of the Spanish Armed Forces who currently received instructional training in the use of NVG has been reviewed by following a complete survey where experience, flight time, physiological trends and course objectives accomplishment are enclosed. Pilots were divided in three groups (cargo, helicopters and fighter pilots). **Results:** Training feedback, lab methodologies and appropriate training resources are key factors for results. **Conclusions:** Human factors can be minimized by using corrective and instructional methodologies which definitively leads to better performance during night operations and better flight safety standards. Methodology can be applied to the

civilian use of NVG mostly in specific environments such search, patrol and police.

[34]  
**VISUAL FUNCTION IN MILITARY PILOTS WEARING NIGHT VISION GOGGLES**

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**Introduction:** Night vision goggles (NVGs) improve the ability of military pilots to operate in low vision conditions. Despite these advantages, this technology has its limitations. So in the paper different parameters of vision in pilots wearing night vision goggles were studied and compared with the vision in normal light conditions and in low light conditions. **Methods:** The studies have been performed in 11 pilots experienced in the use of NVG. In all pilots distant visual acuity, visual field, contrast sensitivity, contrast sensitivity after glare and stereopsis were studied in normal vision conditions, low vision conditions and in low vision conditions during use of night vision goggles. Visual acuity was also measured during the use of night vision goggles in high air temperature (barothermal chamber) and in hypobaric hypoxia (low pressure chamber at a simulated altitude of 5000 meters above sea level). **Results:** The results of the paper indicate that night vision goggles change visual function of pilots. Comparing with normal light conditions visual acuity is diminished 2,2-4 times, visual field 3,5-4 times, contrast sensitivity 2 times, contrast sensitivity after glare 3 times and stereopsis 10 times. Comparing with low light conditions wearing night vision goggles visual acuity improved significantly (from no optotype recognition to 0,36 – 0,64), visual field 2,5-3 times, contrast sensitivity 2 times, contrast sensitivity after glare 3 times and stereopsis 10 times. Hypobaric hypoxia and high air temperature did not cause diminishing of visual acuity in pilots using NVG. **Conclusions:** Military pilots should pass special training before using night vision goggles because of differences in visual functioning in normal light conditions, low light conditions and during wearing of NVGs.

[35]  
**EVALUATION OF RETINAL GANGLION CELL FUNCTION BY PATTERN ERG RESULTS DURING NORMOBARIC HYPOXIA**

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**Introduction:** Blood pressure perfusion is very important factor for functioning of the retinal ganglion cells, because blood flow in the eye depends on the intraocular pressure. In hypoxia, when the compensatory mechanisms are inefficient, co-regulation of intraocular and intravascular pressure fails. Therefore the aim of the present study was to evaluate ganglion cells functioning under normobaric pressure, basing on the pattern electroretinogram (PERG) results. **Methods:** The study included 30 healthy young men of mean age 20.4 years, who breathed with low oxygen gas mixture – 9.6% of oxygen in nitrogen. PERG of transient-type has been carried out in the 10th, 20th, and 30th minute of hypoxia as well as prior to and after breathing with low oxygen gas mixture (minutes 0 and 35) (Tomey). Hemoglobin oxygen saturation and HR have been monitored with pulseoximeter (Protocol System). Visual acuity was examined using standard illuminated chart after each test. The obtained results have been analyzed statistically with Statistica v 5.1 program with T-Student test for dependent variables. The studies were authorized by ethics committee. **Results:** Statistically significant ( $p < 0.05$ ) decrease of the P wave amplitude in the 20th and 30th with a prolongation of this wave latency in the 30th minute and a decrease of the N<sub>2</sub> wave amplitude during the whole hypoxia (10, 20, and 30 minute) with a decrease of this wave latency in the 30th minute have been noted. Simultaneously ( $p < 0.05$ ), a decrease in hemoglobin saturation with oxygen, corresponding to 5,000 m above sea level, with accompanying HR acceleration have been noted. All these parameters have normalized during a consecutive breathing with atmospheric air. Visual acuity has been normal study. **Conclusions:** The obtained results confirm a partial disturbance of ganglion cells in hypoxia in range of incomplete compensation (4,000 – 6,000 m. above the sea level). In healthy individuals visual disorders may appear, depending on ganglion cell functioning in the range of contrast sensitivity, movement perception, visual field and color perception. The obtained results may also explain ischemic pathomechanism of the retinal and optic nerve diseases, especially glaucoma.

## SESSION 8

[36]

### **CEPHALEES NON MIGRAINEUSES: COMMENT LES GERER EN MEDECINE AERONAUTIQUE?**

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**Introduction :** Les résultats d'une enquête multicentrique, réalisée chez des personnels navigants (PN) français, sont présentés et confrontés à la littérature, débouchant sur une conduite à tenir.

**Méthode :** Un auto-questionnaire anonyme a été proposé à 2000 PN professionnels vus en visite révisionnelle aux CEMPN de Bordeaux et de Toulon au premier semestre 2004. Cette étude avait pour objectif principal les migraines et pour objectif secondaire l'évaluation des céphalées non migraineuses. 1859 questionnaires récupérés ont pu être exploités (soit 93 %). La population, de 38 ans d'âge moyen, comporte une majorité d'hommes (90 %). Toutes les spécialités aéronautiques sont représentées dont 68,3 % de pilotes. Les effectifs de PN militaires et civils sont du même ordre.

**Résultats :** Une céphalée chronique non migraineuse est signalée par 34,3 % des PN, avec un pourcentage équivalent chez les migraineux et non migraineux. La fréquence est un peu plus forte chez les femmes et dans certaines spécialités (contrôleur aérien, personnel navigant commercial). Les résultats concordent dans les 2 centres ayant participé. La cause des céphalées n'est pas connue par 76 % des navigants et 82 % des céphalalgiques recourent à un traitement médicamenteux. **Conclusion :** Compte tenu de leur fréquence, les céphalées non migraineuses sont volontiers banalisées par les navigants et les médecins : elles ont peu d'impact sur l'aptitude et débouchent rarement sur des conseils de prévention voire une enquête étiologique. Elles génèrent pourtant une automédication donc un risque iatrogène. De plus, une céphalée en vol, par son intensité, peut se révéler handicapante. Enfin, l'éventualité de certaines étiologies (tumorales, vasculaires) doit être envisagée. Les auteurs proposent un arbre décisionnel permettant, en visite d'expertise aéronautique, de prendre en compte les céphalées non migraineuses (l'évaluation clinique détermine l'intérêt d'examen complémentaires et oriente les conseils).

[37]

### **LA MIGRAINE EN AERONAUTIQUE**

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**Introduction :** Les auteurs étudient la migraine au sein d'une population de Personnels Navigants (PN).

**Méthode :** Un auto-questionnaire anonyme, se référant aux critères cliniques de l'*International Headache Society*, a été distribué à 2000 PN

professionnels (civils et militaires de toute spécialité) vus en visite révisonnaire au CEMPN de Bordeaux ou de Toulon au cours du premier semestre 2004. Le taux de retour exploitable est de 93 %. L'échantillon étudié est composé d'une majorité d'hommes. L'âge moyen est de 38 ans et 4 mois. L'activité aéronautique est harmonieusement répartie entre militaires et civils. La fonction «pilote» prédomine.

**Résultats :** Une pathologie migraineuse est déclarée par 12,1 % des PN. Elle est significativement plus fréquente à Toulon qu'à Bordeaux et chez les femmes que chez les hommes. Aucune différence significative n'est retrouvée selon le type d'activité (militaire ou civile) ou selon la classe d'âge.

Peu de personnes utilisent un traitement de fond médicamenteux (3,6 %). Le traitement des crises fait essentiellement appel aux antalgiques non spécifiques. Seulement 8,5 % des migraineux ont recours à un triptan. Des thérapeutiques potentiellement dangereuses pour la sécurité aérienne sont fréquemment notées.

La migraine est ressentie comme une affection invalidante dans deux tiers des cas. Un migraineux sur deux a déjà présenté des migraines lors des activités aéronautiques. La sécurité des vols est alors jugée comme ayant été compromise par un PN migraineux sur sept (soit 1,7 cas rapporté pour 100 PN interrogés).

**Conclusion :** Les auteurs discutent de la prise en charge optimale de la migraine. La place et le choix d'un triptan en pratique médico-aéronautique sont abordés. Des conseils pratiques pour les PN migraineux sont donnés. Enfin dans le cadre de l'expertise, des arbres décisionnels sont proposés.

[38]

#### **AEROMEDICAL DECISION MAKING IN TRANSIENT GLOBAL AMNESIA**

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Transient global amnesia represents a difficult problem for the person making an aeromedical decision. The etiology of the syndrome is not well understood and there is considerable difference of opinion about its recurrence. There is also disagreement as to its risk of recurrence, and as to the performance of a person who is having such an episode. This paper presents a case of transient global amnesia, and describes the efforts made by the Civil Aviation Authority of New Zealand to make an evidence based decision about medical certification in this case. Policies of other jurisdictions are presented and a paradigm for assessment of such cases described.

[39]

#### **NEW CRITERIA FOR THE DIFFERENTIATION BETWEEN SPONTANEOUS EEG IN RECORDS WITH**

#### **SEIZURE ACTIVITY IN HEALTHY SUBJECTS AND EPILEPTIC PATIENTS**

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**Introduction:** EEG pattern of generalized discharges over spontaneous activity was recorded in healthy subjects, candidates for aviation, with negative medical history and without medicines. Evaluation of these cases is a very difficult diagnostic problem in medical certification procedure in aviation. **Aim:** The aim of our study was to develop a method for the analysis of spontaneous EEG activity that would allow to detect any differences in signal characteristics in healthy subjects and patients.

**Material and methods:** Using *Neuroscan 4.3* system EEG recordings in groups of healthy subjects and patients suffering from epilepsy were carried out and analyzed. During recording several types of stimulation have been applied.

In time domain the similarity of signals was evaluated using the following methods: correlation, morphological correlation, time warping, and our own multi-similarity method. Basing on the similarity criteria the representative segments of spontaneous activity before discharge were found and used as a pattern in further analysis. In frequency domain the coefficients such as: mean frequency, global spectrum power, width of the spectrum and correlations of FFT spectra before and after seizure activity were evaluated. Significance of the changes in the characteristics of the spectrum was statistically verified. **Results:** Spectral analysis coefficients have shown significant changes in spontaneous activity after discharge in patients whereas this was not the case in healthy subjects. Our own multi-similarity method for the evaluation of signal similarity has detected analogous differences that have not been shown before using other methods. **Conclusions:** The results suggest that a discharge does not change significantly spontaneous EEG activity in healthy subjects while it does so in patients. These changes could be detected using multi-similarity method and also using some coefficients of FFT spectrum. These methods might be helpful in the diagnosis of epileptiform activity as well as in clinical seizure prediction.

[40]

#### **ANTICONVULSANTS IN AIRLINE MEDICAL KITS**

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By age 80 31 persons in 1000 will have or will have had a diagnosis of epilepsy at some period of their

lives (cumulative incidence 3.1%). Seizures are yet more common, with a cumulative incidence of 110 per thousand (11%). The number of active cases (prevalence) of epilepsy ranges from 1 in 125 to 1 in 200 persons (prevalence .5-.8%). Annual airline passenger enplanements in the U.S. surpassed the 600 million mark some time ago and are ever increasing. Long duration flights with attendant sleep deprivation, circadian rhythm changes, and other features of worldwide air travel increase the likelihood of in-flight medical events. A large aircraft capable of transporting 600-800 passengers has recently made its first flight. These factors serve to increase the likelihood of seizures occurring in flight in susceptible individuals. Aircraft diversions due are costly and disruptive. National and international standards for inclusion of anticonvulsants in airline medical kits do not exist. Some air carriers carry anticonvulsants; others do not. Current constraints against inclusion anticonvulsants in airline medical kits include the use of benzodiazepines (controlled substances) for treatment of acute seizures, route of administration (intravenous access and the necessary equipment), and potential side effects of intravenous administration including respiratory suppression and lingual hypotonia, and the need for on board expertise in intravenous administration of the agent... Though orally administered benzodiazepines (liquid preparations delivered to the oral mucosa by an eyedropper) have been available for home use in individuals with epilepsy for some time, need for refrigeration has precluded their use in airline medical kits. There now exists an inexpensive liquid preparation of diazepam with a shelf life of two years that can be stored at room temperature. Ease of delivery via eyedropper to the oral mucosa warrants consideration of this agent for inclusion in airline medical kits.

## SESSION 9

### [41] **INSULIN TREATED DIABETIC AIRCREW: REVIEW AND DEVELOPMENT WORKING GROUP (ReDWIG) PROTOCOL**

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**Introduction:** Diabetes mellitus treated with insulin precludes professional certification in the majority of regulatory authorities. The Federal Aviation Administration (FAA) has certified approximately four hundred pilots for private flying and to date has had no accidents attributable to diabetes or its complications. Transport Canada, however, has certified approximately twenty-five professional aircrew since 1993 without significant problems by using evidence based risk assessment. It is appropriate to construct a protocol for evaluation

throughout Europe in a robust manner. **Methods:** The ReDWIG has been set up to evaluate the risk of certifying insulin treated aircrew. A systematic review of the literature has been carried out to assess this risk. **Results:** The risks in diabetes are a) those intrinsic to the disease, primarily vascular in nature and b) iatrogenic, mainly hypoglycaemia, which becomes the rate limiting step. From a review of the literature it is apparent that the prevalence of hypoglycaemia differs in type 1 diabetes from that in type 2. The Diabetes Control and Complication Trial (DCCT, 1993) showed the rate of severe hypoglycaemia to be 0.17 episodes/patient/year in the conventionally treated group and 0.54 episodes/patient/year in those treated intensively. These data would preclude certification in type 1 diabetes at the present time. The United Kingdom Prospective Diabetic Study (UKPDS 57, 2002) however has confirmed the perception of a lower rate of severe hypoglycaemia in type 2 diabetes as 3.2% per annum. Using selection criteria (which will be presented in detail) similar to those used by Transport Canada, to predict a low risk of hypoglycaemia, it is proposed to carry out a multicentre study within Europe to confirm the safety of the is approach in such a highly selected group who are well controlled, well motivated and educated in diabetic management. Using this approach will allow retention of highly competent aircrew at an acceptable risk.

[42]

### **HIGH-SUGAR DIET INDUCES REBOUND HYPOGLYCEMIA**

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**Introduction:** Regular feeding is essential for maintaining the stable blood sugar level and normal physiological function. Carbohydrates are the main fuel used by the muscles and the only fuel that can be used by the CNS. Sugar is a carbohydrate and is also a rapid source of energy. However, the quantity eaten far more than is required may lead to rebound hypoglycemia in which the blood sugar will drop within 2~4 hours below the level of fasting. When occurring in flight, it will probably cause incapability of pilots and even mishap. **Methods:** Twenty-three healthy volunteers (21 males, 2 females, 22~42 years old) with normal body weight participated this study. They were instructed to ingest three different breakfasts in three separated days, including control meal (hamburger + 350 ml milk), high-sugar meal A (cakes +350 ml bean milk), and high-sugar meal B (chocolate + instant coffee 350 ml). On the experimental day, blood samples were taken before and after feeding every hour and for 5 hours by finger picking. The blood glucose level was determined immediately. In the last hour, we had the subject

perform 30-sec anaerobic exercise on a bicycle ergometer every 10 minute for three times. The resistance was selected as 50 % of body weight. Three minutes after the last pedaling, we took two blood samples for blood sugar and blood lactate analysis respectively. **Results:** The results showed that blood glucose level declined much more when ingested high-sugar meal than control meal at the end of this study, i.e.,  $92.57 \pm 10.68 < 93.1 \pm 8.00$  mg/ml for control meal,  $86.43 \pm 9.55 < 90.87 \pm 9.01$  mg/ml for meal A ( $p < .005$ ),  $88.70 \pm 8.01 < 89.57 \pm 6.62$  mg/ml for meal B. Besides, the blood sugar levels began to drop below the baseline after 4 hours of feeding both meal A and B. Obviously, the difference of dietary content had demonstrated the rebound hypoglycemia of high-sugar meal. **Conclusions:** Considering the flying safety, high-sugar meal should be limited for pilots who are going to engage high-G maneuver.

[43]  
**EYE FIXATIVE MOVEMENTS ASSESSMENT DURING A-LOC AND G-LOG**

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A-LOC and G-LOC anticipation there is the one of most important problem in aviation medicine. This abstract present results of assessments of eye movements during centrifuge exposure type SACM (4,5 and 7 +G) which was A-LOC or G-LOC ended. Eye movements were recorded using “Jazz” device invented by Ober Consulting Poland, Ltd. 14 volunteers with no previous flying experience were subjected to one week centrifuge training. Six of them had a full G-LOC symptoms, and eight of them – A-LOC symptoms. Average time between eye fixative movements decay and G-LOC onset was 5 sec. and average time without eye movements was 22,5 sec. In A-LOC group there was suitably - 6,2 and 14,7 sec. There was no G-LOC and A-LOC without decay of fixative eye movements before. The shortest time between fixative eye movements and G-LOC or A-LOC symptoms was 3,5 sec., the longest – 9 sec. **Conclusion:** Eye fixative movements tracking may be useful for A-LOC or/and G-LOC anticipation during real fly.

[44]  
**LENS OPACIFICATION IN COMMERCIAL AIRLINE PILOTS ARE RELATED TO THEIR ESTIMATED EXPOSURE TO COSMIC RADIATION**

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**Introduction:** Nuclear cataracts have been associated with ionising radiation exposure in previous studies. Today’s aviation involves exposure to ionising radiation of cosmic origin. The objective was to investigate whether employment as a commercial airline pilot and the resulting exposure to cosmic radiation were associated with lens opacification. **Methods:** Cases of opacification of the ocular lens were found in surveys among pilots and a random sample of the population of Reykjavik. Altogether 445 male subjects underwent a detailed eye examination and answered a questionnaire. Information from the airline company on the 79 pilots’ employment time, annual hours flown per aircraft type, the timetables and the flight profiles made calculation of individual cumulated radiation dose (mSv) possible according to CARI-6 software. Lens opacification were classified and graded according to WHO simplified cataracts grading system using slit lamp. **Results:** The odds ratio from logistic regression of nuclear cataracts risk among cases and controls was 3.02 (95% CI 1.44 to 6.35) for pilots compared with non-pilots, adjusted for age, smoking and sunbathing habits. The odds ratio of cortical cataracts, central optic zone involvement, and posterior subcapsular cataracts risk among cases and controls was lower than unity and was not significant for pilots as compared with non-pilots in logistic regression analyses adjusted for these same factors. The odds ratio for nuclear cataracts associated with cumulative radiation dose to 40 years of age, adjusted for age, smoking and sunbathing habits, was 1.06 (95% CI 1.02 to 1.10). **Conclusions:** The association between the cosmic radiation exposure of pilots and the risk of nuclear cataracts, adjusted for age, smoking and sunbathing habits, indicates that cosmic radiation may be a causative factor in nuclear cataracts among commercial airline pilots. This may have implications on cancer risk among aircrews and frequent flyers.

[45]  
**RECERTIFICATION OF FLIGHT CREW WHO UNDERWENT TREATMENT FOR MALIGNANT NEOPLASM**

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**Introduction:** Although a cure rate for cancer has been increased and more people return to their premorbid work, treatment for cure does not necessarily mean complete cure of the disease. This study was conducted to retrospectively review the outcome of JAL flight crew who underwent oncological treatment for malignant disease.

**Methods:** Over the past 19 years between 1985 and 2004, eighty-four crews were found to have a variety of malignant neoplasm. Their data on treatment, sick leave, resumption of their duties and recurrence were retrospectively reviewed from their medical records.

**Results:** Most frequent site of malignancy was digestive tract 53.6%. Seventeen cases of colon cancer, 14 cases of stomach cancer and 8 cases of rectal cancer were included. Their average age was 51. Fifty-four crews (64.3%) were re-certified for a flight duty. Frequencies of resuming their duties were higher in those with colon cancer (82.4%), while only 50% of those with gastric cancer resumed their flights. Average observation periods (AOP; duration from the initial diagnosis to re-certification) were  $335 \pm 305$  days, ranging from 41 to 1,679 days. Eighteen out of 53 resumed their duties within 6 months and 73.6% within 1 year. A disease specific AOP was 277 days for those with gastric cancer, 243 days for colon cancer, 192 days for lung and rectal cancer. During this observation period, seven crews had to hold their duties again, four with recurrence, 3 colon and 1 each of rectum, and renal cancer. Those included a case that lost a license because of the 2<sup>nd</sup> primary cancer (prostate) 18 months after the colon cancer and a case of esophageal cancer, who had troubled with dumping syndrome. **Conclusions:** Careful evaluations of the initial stages and meticulous follow-up programs allow flight crew to safely resume their flight duties after curative treatment of malignant disease.

## SESSION 10

[46]

### **HUMAN SYSTEMS INTEGRATION (HSI) IN THE ASSESSMENT OF HUMAN PERFORMANCE IN AIRCRAFT MISHAP INVESTIGATION AND PREVENTION**

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**Introduction:** Aircraft mishap investigative processes have traditionally followed a linear, hierarchical "stove-piped" approach whereby causal factors are identified and separately assessed for their effects (if any) on performance (human and/or

machine). Human Systems Integration (hereafter, HSI) - a novel systems engineering process - rejects the stove-pipe approach and describes human performance as a product of the seven primary domains that characterize HSI (human factors engineering, safety, manpower, personnel, survivability, habitability and training), the interactions between all of which influence overall system (including human) performance. HSI stresses the interactive effects of these domains; that is, the influence of one domain will necessarily impact most if not all of the others. It is herein proposed to employ the HSI process in the mishap investigative process, and more generally, to better understand how causal factors interact in such a way as to result in a mishap. **Methods:** This presentation will describe the HSI process, showing how it is employed to minimize human error from the inception of initial system conceptualization and design, and in doing so, help prevent mishaps after the system is in operation. It will also illustrate how HSI can be used as a tool during the investigative process, so as to better identify those interactive processes leading to a mishap. **Discussion:** The HSI approach to understanding human performance in aviation systems and investigating and preventing mishaps does not preclude the use of other established processes; rather, it is another tool in the human factors mishap investigation toolkit, as well as a critical extension of the knowledgebase in human error causality.

[47]

### **INDIVIDUAL MOTORIC COORDINATION AND DISTRIBUTION OF ATTENTION PREDISPOSITIONS IN MALE AND FEMALE CANDIDATES FOR MILITARY AVIATION.**

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**Introduction:** Complexity of modern military aircraft flight missions demands from aircrew special predispositions. Jet fighter pilot is subjected to dynamic changes of physical flight parameters and high load of sensoric stimuli. Most important part of military aviation candidates selection is to choose individuals who can cope with such workload. Introduction of possibility to become fighter pilot for women in Poland few years ago has created a need to examine operator possibilities and introduction of female candidates into objective candidates assessment system for specific kinds of military aviation. **Material and Methods:** For selection of candidates we use set of five flight missions on „Japetus” flight simulator on medically pre-screened individuals. For purpose of this research we selected groups of 20 female and randomly chosen 20 male candidates (we had much more male than female candidates). All candidates have undergone same

testing procedure to assess distribution of attention, visuo- motoric coordination, learning ability and resistance to fatigue. **Results:** Female candidates have shown less fatigue resistance ( $P \leq 0,05$ ). No statistically significant differences were found in distribution of attention measured as complex flight elements precision. As far as visual – motoric coordination is concerned female candidates had longer mean time of flight parameters stabilization (no statistical significance).

#### **Conclusions:**

Differences obtained in experiment are of small importance in terms of overall candidates performance. Therefore there is no evidence of significant difference in male and female candidates as far as entry to Aviation Academy is concerned. Further research based on results of practical training and aviation career is needed.

[48]

#### **TESTING COGNITIVE ABILITY AND PROBLEM SOLVING**

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**Introduction:** This study had two purposes: to determine whether two cognitive ability tests (WinScat and Minicog) correlate with each other, and whether both tests correlate with performance on a computer task. Performing highly (achieving high points) on this particular computer task requires strategic and creative problem solving. “High order” cognitive abilities necessary for this task- which both cognitive tests are designed to measure- include holding information in one’s memory to manipulate and reason with it to solve the problem. **Methods:** Teams of four ( $n=78$  total participants) worked on a computer task over a four day period. Participants engaged in the computer task twice daily. The WinScat was administered twice daily; the Minicog was administered on the fourth day only. The Minicog consists of 14 subtests, and the WinScat consists of 4 subtests. An individual’s total result on WinScat and Minicog is a function of their timing and accuracy in responding to all test tasks. **Results:** All subtests of the Minicog and WinScat were correlated with each other. Then, both Minicog and WinScat were correlated with each individual’s performance as measured by the total number of points they achieved over the four days on the computer task. All WinScat subtests were significantly correlated with all Minicog subtests:  $r=0.525$ ,  $p<0.001$  for strongest correlation in the subtest list,  $r=-0.257$ ,  $p<0.025$  for weakest correlation in the subtest list. Two subtests of WinScat and two subtests of Minicog were significantly correlated with the total number of

performance points ( $r=-0.353$ ,  $p<0.005$ ,  $r=-0.338$ ,  $p<0.007$  for WinScat;  $r=0.458$ ,  $p<0.001$ ,  $r=0.400$ ,  $p<0.002$  for Minicog). **Conclusions:** The significant correlations with each other indicate that WinScat and Minicog measure the same cognitive abilities. Additionally, both tests significantly correlate with performance on our computer task. Therefore, WinScat and Minicog might be useful individual selection tools for strategic and creative problem solving tasks.

[49]

#### **PERSONALITY TESTING IN POLISH AIR FORCE. VALIDATION STUDY OF THE ALAPS QUESTIONNAIRE IN POLAND.**

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**Introduction:** ALAPS questionnaire (The Armstrong Laboratory Aviator Personality Survey) is a large personality inventory dedicated to investigate features critical for predicting career in aviation. There are 15 scales, describing subject’s personality, psychopathology and crew interactions. The test items were translated into Polish independent by two authors, and next the common version has been established. Next, the translation has been validated by bilingual retest procedure. **Methods:** In the validation study 90 cadets- students of the Military Aviation Academy completed ALAPS, NEO-FFI and polish questionnaire FCZ KT. FCZ-KT is an original method, developed in Poland by Zawadzki and Strelau. Temperamental traits in this theory are grouped into two categories- energetic and temporal characteristics of human behaviour. **Conclusions:** Results of the study are well fitted to original American data. Nearly all the scales achieved a good reliability. In comparison with American sample Polish cadets achieved some differences in raw test scores. Polish cadets have higher scores in socialness, depression and deference scales. In Anxiety, Team orientation, organization, impulsivity and Alcohol abuse scales scores achieved by Americans are higher. Replication of American correlations between personality ALAPS and NEO FFI scales confirms generally the test validity. There is a significant negative correlation between Confidence scale and Neurotism and Socialness is positively linked with extraversion. Aggressiveness is negatively connected with agreeableness, orderliness is strongly correlated with conscientiousness, and negativity is linked with neurotism. Psychopathology and crew orientation scales are also similarly connected with NEO FFI scales in both populations. There are also many correlations between ALAPS and FCZ scales, confirming validity of the investigated questionnaire. For example, Emotional Reactivity (Most diagnostic

variable of FCZ) is positively correlated with Negativism, Affective Lability, Anxiety, Depression, Dogmatism, and Impulsivity. The scale is negatively linked with Confidence, Socialness, and Organization.

[50]

**INTRODUCTION TO A MODELING OF DYNAMIC PHYSIOLOGICAL PROCESSES IN PILOTS SUBJECTED TO ALTERNATING ACCELERATIONS ALONG THE LONGITUDINAL AXIS OF THE BODY**

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**Introduction:** Numerous aviation medicine centers perform research aiming at improving the pilot's efficiency and reliability of his performance. In Poland, within periodic acceleration tests given to military pilots, no push-pull tests have been carried out so far, though it is a part of F-16 pilots training. This work includes results of the research on the pull-push effect performed on a group of Polish military pilots with description of dynamic parameters and specification of possibilities of constructing dynamic models representing this effect. **Methods:** For measuring signals in the experiments both a measuring apparatus (acceleration centrifuge), as well as the GERP-system (applied mostly in a real flight environment) have been used. The research profiles consisted of both classical acceleration profiles (interval – INT) and acceleration expositions specially developed for the research purposes that include negative (PP) accelerations. **Results:** The results were divided into four categories concerning: (1) reactions to light stimuli, (2) fixed statistic parameters, (3) indicators showing the dynamics of signals, (4) dynamic modeling. In these categories comparisons within the framework of the PP-experiment: between two types of profiles – 2 Gz and 1 Gz; and between the results of the INT and PP research have been made as well as an attempt to compare physiological reactions recorded by the acceleration centrifuge and in a real flight.

**Conclusions:** The results confirm the negative influence of -Gz acceleration on +Gz tolerance. This was already observed in the exposition to relatively weak +Gz accelerations. Reduction of the accelerations tolerance, regarded as an absolute difference of arterial pressures between the signals gained in the INT and PP research is not constant and depends on the values of positive accelerations. An analysis of the parameters specifying reactions of pilots to light stimuli has shown a clearly different character of their changes for the INT and PP research. The appearance, during performing of an

aviation task, of an acceleration of -1Gz is as dangerous as the appearance of short-lived accelerations of lower values. A discrimination analysis shows that seizing the dynamic properties by means of the discussed parameters enables to differentiate all expositions.

**SESSION 11**

[51]

**ORAL DRUG THERAPY FOR ERECTILE DYSFUNCTION: OVERVIEW AND AEROMEDICAL IMPLICATIONS**

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Approximately 150 million men worldwide experience erectile dysfunction, whereby they are unable to maintain an erection adequate for satisfactory sexual performance. This population is projected to more than double in the next 25 yr. Introduction of the phosphodiesterase inhibitors has revolutionized the management of this common problem, encouraging many more men to seek treatment. The issue of erectile dysfunction treatment is a growing concern in the aviation community as well. This is particularly relevant in civil aviation, as this population is older and has co-morbidities that may contribute to the development of erectile dysfunction. In this article we will review the available options for oral treatment of erectile dysfunction and discuss implications regarding their use in aviators based on the information available in the literature.

[52]

**EVALUATION OF THE RISK FOR PREGNANCY IN WOMEN TRAVELING BY PASSENGER FLIGHTS**

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**Methods:** We evaluated amount of obstetric complications in pregnant women, who travelled by passenger flights from 1 to 13 times during pregnancy. We evaluated 56 pregnant women (group A) between 8 and 33 pregnancy week. We excluded from group A women:

1. In which other illnesses or pregnancy pathologies, which could have influence on pregnancy or birth, were diagnosed.
2. Patients which in previous pregnancy had illnesses which could influence current pregnancy or birth.
3. Who flew by passenger plane not knowing about pregnancy (2 cases of early pregnancy – suspicion of bad medical care)

Control group (group B) consisted of 134 women, who did not flew by passenger plane during whole pregnancy. The exclusion criteria were the same as for group A. The base for trial was medical documentation. We analyzed the number of complications during the pregnancy and labor (up to 4 days after birth it means till sign out from hospital). Above obstetric complications we analyzed wellbeing of neonate after labor (Apgar scale) and amount of bloodless.

**Conclusions:** We did not confirmed negative influence of passenger flights on healthy pregnant women. We did not discover also difference in neonate condition between groups.

[53]  
**BEHAVIOURAL ADDICTIONS. STUDY IN PROFESSIONAL AERONAUTICAL ENVIRONMENT**

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The main objective of the study was to determine the place of behavioural addictions among a population at work. Methods: 250 aviators evaluated in the aeromedical center of Clamart (France) have been included in an investigation from May to September 2003. Results: in this healthy population, 26,8% are at risk to become dependent to work and 8% are so. 26,8% are dependent to Internet, 10,4% to jogging, 5,2% to compulsive shopping and 0,8% to pathological gambling (12,4% have a probable gambling problem). Conclusions: these results have to be considered with precaution. They depend on tools of assessment and on their validity among a population at work. The statistical analysis of the sociodemographic factors' influence contrasts with current data. In the individual sphere, the dynamics of behaviours (sometimes added to dependence) is bound to the environment and to the personality. Among aviators of this study, behavioural addictions have no impact on their professional life.

[54]  
**ÉVOLUTION DE LA MÉDECINE AÉROSPATIALE AU BRÉSIL**

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**Le résumé:** la Médecine Aérospatiale a été restreinte au milieu militaire jusqu'à 2001. Avec la création, à travers loi, de l'Agence Nationale d'Aviation Civile le Département d'Aviation Civile a embauché des Docteurs pour préparer la transition. Chaque structure d'Inspection de Santé est liée à la Gestion de Santé de l'Ordre des Aéronautique. C'était initié un Cours de Spécialisation dans Médecine Aérospatiale dans l'Universidade Gama Filho avec le premier groupe en

2002. La Société de Médecine Aérospatiale de l'État de Rio de Janeiro a été créée et a enregistré dans l'Association Médicale brésilienne afin que la spécialité soit reconnue. Il a été résolu qu'était nécessaire de créer une chaise dans le cours du degré de physiologie aéronautique et de l'altitude afin que ce thème ait été diffusé parmi les étudiants. Un livre a été publié. **La conclusion:** peu de docteurs ont l'intérêt dans ils se soit spécialisé dans Médecine Aérospatiale car ils n'ont pas connaissance le thème pendant le cours du degré. Il a satisfait pour publier le thème avant la formation du docteur.

[55]  
**THE PREDICTIVE VALUE OF CENTRAL NERVOUS SYSTEM PATTERN IN PILOTS PATHOLOGY**

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**Objective:** Discussion of a possible relation between the type of CNS (Central Nervous System) pattern and psychosomatic diseases. **Methods:** Depending on the CNS pattern (tonus) the sample (87 military pilots) assessed in military academy and after 20 years of work., was divided: Sub sample A (n=42) characterized by an rapid  $\alpha$  electroencephalographic rhythm of 11-12 c/s, low amplitude - 10-25  $\mu$ v, low incidence, especially present on posterior derivations, combined with rapid  $\beta$  frequencies and a prompt  $\alpha$  rhythm stop reaction to light and sound stimuli. These characteristics of functional excessive tonus of the reticulate activator ascendant system (RAAS) correspond to the irritative pattern. Sub sample B (n=45) characterized by a slow  $\alpha$  rhythm- 9-10 c/s, dominant on all derivations, ample, of 50-75  $\mu$ v, with a slower stop-reaction to stimuli and sometimes even lacking the  $\alpha$  rhythm stop-reaction. This pattern is defined as functional inhibitor of the RAAS tonus. It was studied blood pressure, heart rhythm on rest, Broca weight curves, the values of serum cholesterol and serum triglyceride. **Results:** Medium values BP on rest: sub sample A = 156 $\pm$ 2,3, sub sample B = 122 $\pm$ 1,5 (p<0.001); medium values heart rhythm on rest: sub sample A = 88 $\pm$ 2,4, sub sample B = 66 $\pm$ 1,8 (p< 0.001); average value of cholesterol along the entire carrier with sub sample A = 324 $\pm$ 0,06, sub sample B = 202 $\pm$ 0,06 (p<0.001); triglyceride medium values with sub sample A = 280 $\pm$ 1,2, sub sample B = 160 $\pm$ 0,9 (p<0.001); somatometric data with sub sample A = + 14,3 $\pm$ 0,9 kg, with sub sample B = - 0,6  $\pm$ 1,2 kg (p <0.001). The morbidity over the last 20 years of work: CVD – 90% with sub sample A (hypertension, EKG abnormalities, ischemic heart disease); digestive diseases (gastritis, duodenal ulcer) – 70% with sub sample B. The first signs for CVD were at 40 $\pm$ 1,2 years; for digestive disease were at 30 $\pm$ 1,2 years. **Conclusions:** 1) The CNS pattern could be considered as a predictive marker in



psychosomatic pathology, the most frequent in pilots. 2) The comparison of data in time with the same sample of pilots, more exactly after a 20 year long period of activity, confirms different responses to similar stress in relation with the CNS pattern. 3) Knowing the CNS pattern at the beginning of a pilot carrier, should require some prophylactic measures.

## **POSTER SESSIONS**

### **SESSION 1**

[1p]

#### **THE PSYCHOLOGICAL METHODS OF MEASURES SPATIAL ABILITIES FOR HIGH MANEUVERABLES AIR CRAFT PILOTS**

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**Introduction:** Psychologists in Polish Air Force are introducing new methods of measure pilot's spatial abilities in range of visualization and space orientation. It is the consequence of armament Polish Airforce in high maneuverable planes, F-16. The F-16 aircrews must be characterized in high level of flight performance as velocity, accuracy in orientation processes. **Methods:** The aim of this study is presentation a few methods to measure these abilities: 1. The double labyrinth test (B-19). 2. The peripheral perception test (PP). 3. The pilot's spatial test (PST). 4. The sensorimotor co-ordination test (SMK). 5. The time-movement anticipation test (DEST). Above methods are part of Vienna Test System. The group of 50 military fighter pilots was taken into study.

**Results:** These methods are verifying on polish pilots population of high maneuverable planes. Therefore the main point of analysis is to specify the utility value of these methods (e.g. static spatial ability and dynamic spatial ability). Preliminary results confirms the validity of proposed test battery.

[2p]

#### **RESEARCH AND TRAINING SAFETY FOR AVIATION MEDICINE SIMULATORS ON THE EXAMPLE OF WHIRLING ARM**

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**Introduction:** Aviation medicine simulators (AAS) used in Air Forces of many countries (also in Poland), are complicated equipment with price comparable to modern aircraft. In case of implementation of new aircraft to exploitation, costs of purchasing new generation AAS is huge. From that reason, if basic operational parameters of used AAS allow for

necessary modifications, that makes possible to accommodate used equipment to required demands. Implementation of new procedures, according to NATO-STANAG is connected with exploitation AAS on higher level parameters as at present. In that case, AAS should satisfy new requirements connected with safety and reliability. **Methods:** To ensure correct exploitation, reliability and especially training and researches safety on AAS, it was necessary to develop and implement complex control systems. These systems must make possible constant monitoring and hazards detection, depending on technical condition of AAS. This is relevant, because AAS and especially whirling arm are working with extreme conditions, suitable for pilots work environment (high acceleration, rapid pressure changes, hypoxia, etc.). Whirling arm is the most critical device for mechanical damages. Health and life of pilots who are under test, are depending on technical condition of AAS. Broad variety of possible techniques of maintenance and repair according to technical condition, are possible to joining in two basic groups: 1)reliability level control; 2) exploitation parameters control.

Putting into the use those new methods of maintenance and repair, required to be familiar with reliability characteristics for functional systems of technical objects. **Results:** During that project, identification of exploitation object was completed and technical condition changes of that object was described. Moreover connections exploitation process with object technical condition changes process was also described. At present following activities has been made: Mathematical analysis of force measurement. Developed: 1)Idea of generalized forces and stress measurement; 2)Idea of strain gauges distribution on object, for generalized forces and direct strain measurement.

[3p]

#### **AIR ACCIDENTS RESULTING FROM AIR FORCE PILOTS' POST-TRAUMATIC STRESS DISORDERS**

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**Introduction:** Appearance and dynamic development of planes noticed and appreciated by people dealing with planning of strategic missions in the range of military campaigns. Each task taken by a pilot was connected with a risk of damage in the result of his own disability or plane equipment imperfections Each task of a pilot as an operator is connected with possibility of making a mistake. Each mistake may be

corrected by a pilot provided that he has got suitable knowledge. If he is not able to solve the problem, plane can easily crash. Although plane crashes can be different (serious and less serious), they all influence pilots' mental states. The aim of the study was to analyze the influence of ejection's and serious life threats on appearing stressful disorders after injuries of military aircraft pilots. **Material and Methods:** 161 pilots were qualified in the study. The pilots had been involved into different plane crashes that were threatening their lives. The pilots were divided into two research groups. The group of control consisting of 100 pilots (from different air squadrons) with no personal experience of plane crashes. The research was connected with analysis post – factum of air medical documents, psychological and medical tests' results. **Results:** There is a very interesting dependence between the pilots who had ejected and those who had had air incidents not finished by leaving air ships in alarm system. There is only a little difference between two groups but statistically significant ( $p < 0,05$ ). Important enough roles in the research were "human factor". In the first group of ejecting pilots it was 45% and in the group of with other air incidents it was 83% of all incidents.

Air accidents were connected with different type of somatic and mental disorders. Most of pilots who had ejected, reported the disorders of the nervous 97% and musculoskeletal 86% systems.

However, in the group of pilots who had been involved in other air incidents, 91% reported various nervous system disorders.

**Conclusions:** Ejecting and serious life threats cause emotional and somatic disorders. Statistically they are more often if concerns ejecting pilots than pilots that had other air incidents. The biggest influence on such situations as concerns ejecting pilots had environmental conditions, body injuries and blaming themselves for the air incidents.

[4p]

#### **SPATIAL DISORIENTATION TRAINING – SUBJECTIVE ASSESSMENT OF PILOTS.**

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**Introduction:** Military Institute of Aviation medicine had introduced spatial disorientation training for Polish AF pilots. We were interested in pilots subjective opinion on training value, illusions experienced and feeling of disorientation. **Material and Methods:** 16 experienced instructor pilots volunteered to participate in experiment. They undergone training consisted of 10 flight scenarios on GYRO-IPT spatial disorientation simulator. After that they were asked to fill a questionnaire of subjective training assessment. As a part of another experiment pilots have possibility to take part in training three

times in ~10 day intervals so we have also possibility to assess changes in their opinions. **Results:** All training profiles were highly valued by participants (around 80 – 90% of maximal value, depending on training profile). This opinion remained stable during repeated expositions. We have observed decrease in feeling of disorientation in concurrent expositions ( $p \leq 0,05$ ), but no statistically significant decrease in illusion occurrence. **Conclusions:** Spatial disorientation training program used in Military Aviation Institute of Aviation Medicine is highly valuable in subjective opinion of pilots. During research we also gathered some indications from pilots how to improve further our training program. These will be incorporated in the near future in pilots training routine.

[5p]

#### **INFLUENCE OF HOT PREFLIGHT ENVIRONMENT ON SIMULATED AIR COMBAT MANEUVER PERFORMANCE.**

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**Introduction:** Aircrew is often exposed to extreme environmental conditions. In aviation it is common to encounter high cockpit temperature, hypoxia, acceleration, excessive noise and vibration. Excessive temperature can cause problems during preflight operations as well. Heat strain can result in temporary impairment of physiological functions and even lead to the loss of consciousness. It is very important to understand response mechanisms to develop strategies to prepare individuals prior to stress, so that they can better cope with extreme conditions. **Methods:** In this study 10 healthy volunteers response of acceleration tolerance after heat stress (1h in 55°C with relative humidity 30% in thermal chamber) was observed. They were subjected to acceleration tolerance test consisting of simulated air combat maneuver (intervals of 15s 5,5 Gz acceleration) in three situations: a) normal thermal conditions - control; b) after thermal strain without rehydration; c) after thermal strain with rehydration. Before and after expositions was performed body composition test and blood samples taken. During heat strain skin and tympanic temperature were monitored. During acceleration tolerance test heart rate, ear lobe pulsation, breathing pattern and ECG were monitored. Test was ended by subjects after reaching 50% peripheral light loss. Performance was assessed by number of errors in response to visual stimuli during peak acceleration. **Results:** In blood test results there was shift in electrolytes amount and hematocrit that indicated moderate dehydration. In average tympanic temperature has risen approximately 1°C. During acceleration tolerance tests HR was higher by 20 bpm on average, after both heat strains in comparison with control ride. Number of tolerated intervals was lowest

after heat strain without rehydration. It was also characterized by highest number of errors in response to visual stimuli. **Conclusions:** Simulated preflight hot climate conditions lead to dehydration, that can cause changes in acceleration tolerance. It seem to mainly influence cardiovascular system. The importance of rehydration in hot climate should be stressed in aircrew briefings.

[6p]

#### **AEROMEDICAL EVALUATION OF A COMPLEX (MEDICAL AND FLIGHT DATA) DATA RECORDING SYSTEM**

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The increasing of flight safety necessitates the analysis of physiological reactions of air pilots and other flight personnel who work in the aviation system, the standardisation of selection requirements, the determination of acceptable emergency reaction levels in respect of tone changes in the nervous system associated to psychic stress, and ECG deviations.

Our objective was to test an in-service on-board flight technical data recording system (“technical black box”) as a combined on-board data recording system in-flight and in simulated earthly stress situations in which the biomedical parameters of the person on board and the technical parameters of the flight are recorded and processed simultaneously.

As a first step, the system, installed in a MI-24 combat helicopter, was tested with military pilots. We found that the unit was able to provide evaluable, real-time ECG records even in extreme flight situations (route flight, extreme circumstances of following the terrain, thermal stress).

In the second step, the device was tested in ground-based laboratory circumstances, in aeromedical stress situations (hypobaric hypoxia, rotating chair, weightlessness model using tilt table). We found that the flight physiological records taken provide a good signal/noise ratio and give high fidelity ECGs, with proper sampling speed. The two ECG channels can be analysed visually considerably well on a computer screen, and recording of data in tabular form and statistical processing of the same data enable us to perform further data analysis, frequency, trend and variability analyses. The recording of reactions specific to each person and the forming of standards for the given test tasks and stress situations contribute to building a selection database. During real flight, the device allows proper interpretation of the recorded psychophysiological values (against flight technical data), and a better description of the psychic stress accompanying the pilot’s actions in complex or emergency situations.

[7p]

#### **SPATIAL DISORIENTATION TRAINING**

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SD is one of causes of military air mishaps. Czech AF mishaps reports (1991-2002) were evaluated. SD as a potential cause was found in 30% cases. No difference was between Cz and US AF incidence of SD.

Ability to solve pilot spatial disorientation problems during flight is trained in CzAF by different ways: IFC and simulator flying (at AB), aero medical training – initial and continuation courses (since 2001 under NATO STANAG 3114 AMD: Aeromedical Training of Flight Personnel - all pilots, max. 5 years period) before SD demonstration on a trainer (at IAM Prague).

SD trainer – GYRO IPT II (ETC USA) was installed in the Institute of Aviation Medicine last year. It is an interactive, multifunctional training system (Motion base (4 + 2 degrees of freedom); Cockpit: closed-loop interactive flight controls, forward out-the-window visual display, front panel instrumentation gauges, aircraft sounds; Modes: flight, profile, replay, manual; Flight characteristics: L-159, Z-142, MiG-21, single rotor generic helicopter with reversible blade). Till now it has only been used within preliminary work because of a lot of problems. It seems that some of original profiles of flight illusions have to be modified. Some of them are over performed, some have no influence etc. The whole system of the true SD aero medical training will be established.

Physiological limits for training of SD should also be found out (potentials unfavorable effects - vertigo, motion sickness). Vestibular after-effect has been searched by stabilometry. Recommendation of NATO RTO HFM-118/RTG-039 (Ground Based Spatial Disorientation Training) will also be taken into account.

This work summarizes our results of introducing CzAF SD training. An interesting change of postural stability after SD training is also presented.

[8p]

#### **WORKLOAD OF FLIGHT CREW ON LONG-DISTANCE GOVERNMENT FLIGHTS**

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The Czech Air Force Government Flying Service (CAFGFS) provides various forms of transport flights for superior governmental representatives. Until quite recently there was a lack of objective knowledge on actual occupational load of flight crew, mainly during

long-haul flights. According to circumstantial references they were supposed to be essentially different from common long-haul flights, performed by civilian air carriers.

Based on a multiyear experience with monitoring of crews in the course of commercial long-haul flights, a group of IAM specialists was established and set for aero medical check of CAFGFS flight crewmembers on exceptionally demanding government flights. In the course of three long-distance flights a goal-directed attention was addressed to the most critical assignments during preparatory, flight and residential stage of flight-operational phases.

Despite an apparently satisfactory leeway crews were pressed for time to get the completion of vaccination. With difficulties the optimum time for thorough travel advice of flight crew was sought out and in some cases it was supplemented by AM examiner as late as on official business trip. The duty and flight time periods, flight time on partial legs, as well as the rest periods sub served entirely to the schedule of mission agenda. Their formation diverged substantially from scheduled flights. Captains were not yielded on any leg of entire route, despite the augmentation of crew. Rest requirements following time zones crossing could not be observed.

Government flights impose on flight crew substantial psychological load. The signs of physical/psychical fatigue were more apparent on captains. Therefore before and after each leg the flight crew subjected to regular aero medical check.

The main source of specific workload on long-range government flights are as follows: enduring psychological strain as a consequence of high responsibility, readiness for solving of emergent situations and readiness for improvisation.

[9p]

### **THE NEW USAF AIRCREW SPECTACLE FRAME PROGRAM**

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As a consequence of deficiencies identified with the long standing USAF aircrew HGU-4/P spectacle frame, the USAF/SG directed that an improved combat spectacle frame be developed and fielded that would provide enhanced protection and performance characteristics for USAF aircrew. Following a comprehensive USAF development and testing program, a new spectacle frame manufactured by Artcraft Inc. was selected based on that program as the next generation aircrew flight frame. This poster will illustrate the advanced features of the new frame and depict its related new optional choices.

[

10p]

### **EARLY STUDIES OF REDUCED BAROMETRIC PRESSURE EFFECTS SHOWN ON POSTAGE STAMPS, POST CARDS AND ENVELOPES**

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Aviation Physiology is the basic science for aerospace medicine. There is a rich 400-year history of altitude physiology beginning with Father Jose de Acosta's description of the distress at 4,500 – 4,800 meters in the Andes Mountains published in 1590. Paul Bert's Barometric Pressure (1878) contains hundreds of references. One enjoyable way to discover the contributions of Otto Von Guericke, Antoine Lavoisier, J.A.C. Charles, Joseph Gay-Lussac, Claude Bernard, Joseph Priestley, Etienne Robertson, Constantin von Economo and other scientists is through collecting postage stamps that honor them. Balloonists immortalized for balloon flights include Pilatre de Rozier (the first to fly and the first to die) and American physician John Jeffries who carried water survival gear, scientific instruments and an airmail letter on the first flight across the English Channel. Jeffries flew with French aeronaut Jean Pierre Blanchard who later would make the first U.S. balloon flight in the presence of President Washington, collect air samples and heart rates for scientists and carry the first U.S. passport and wine to appease a farmer. Russian aeronauts Fedoseenko, Usyskin and Vasenko died in 1934 when their balloon collapsed at 72,000 feet while reportedly trying to beat a U.S. altitude record. Reports that patients were carried by balloon from Paris during a siege in 1870-71 have never been confirmed. Airplane pilots contributed, too. Schroeder set altitude records in 1918, 1919 and 1920 (33,114 feet) and demonstrated the need for oxygen. Wiley Post developed a pressure suit, discovered the jet stream and used coping methods for fatigue and time zone changes on two world flights, one solo, all with only one eye. Post cards as early as 1911 show the tragic results of disorientation during a spiral death dip from 3,000 feet. Studying aviation physiology can be valuable and, for some, more fun when combined with a hobby.

[11p]

### **WEB-BASED COURSE FOR PHYSICAL WORKING CAPACITY EVALUATION IN BULGARIAN AIR FORCE**

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**Introduction:** Web-based course is designed for integration with traditional teaching. With information technology assistance new manner of education in particular subject is proposed.

**Results:** The course consists of lecture notes, exercises, tests, references and web links. The content of the course is stored in a relational database. The educated person reads information from Web-pages. Apache server, MySQL database server, script language PHP and HTML are used for creation the software application.

The work in Web-base course begins with registration or authentication check for the user. The information is visualized in the central frame of the WWW page. The left frame of the page contains the buttons for navigation through the course contents. Tests are organized in two ways. The first manner is: questions with some alternative answers. The second manner is: questions with ability to enter answers in a text box.

**Conclusions:** Developed Web-based course can be use for self-education, as a part of traditional education or as a part of distant education. It is an approach for applying new ways of education delivery and new pedagogic strategy.

[12p]

### **A SHORT HISTORY OUTLINE OF AVIATION MEDICINE IN BULGARIA**

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Aviation medicine is a science, arisen with the appearance of arial navigation and flying. The ancient flying impetus has been inspired in Bulgarians with the dream called master Manol and myth has turned into reality with the flight of the first pilots as Vasil Zlatarov, Radul Milkov, Georgi Ivanov and thousands of known and unknown Bulgarians, who had associated and dedicated their life to the Bulgarian aeronautics. The start is brought into existence with the first selection of pilots in 1911 when 21 applicants were medically examined. In 1912 during the Balkan war at the airport "Mustafa Pasha" by Odrin was organized for the first time a Medical service at a battlefield airport. In 1924 was established a medical service headed by Boris Velchev. He is the initiator of Bulgarian aviation medicine. In 1935 was established a Health Center which is the prototype of the Aeromedical Institute, established at the airport "Vrajdebna" in 1937. In that year started the installing of a new altitude chamber. During the period 1956-59 it has been started with the building up of a centrifuge, which is still functioning. According to the resolution of Bulgarian Government from 20.02.1973 was established an Aeromedical Research Institute in service to the whole aviation in Bulgaria. In 1994 was approved a program for aviation medicine specialization.

## **SESSION 2**

[13p]

### **MOTION SICKNESS FOR FLIGHT PILOTS: STATISTICS AND THERAPEUTIC SOLUTIONS**

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Flight pilot schools observe a smaller graduation rate for students that encounter motion sickness problems. This study concerns tests, on student pilots with airsickness symptoms during flight, with transdermic use of Scopolamine 1.5g and psychiatric support. We have selected 100 first-time flight pilot students who regurgitated during or soon after flights concluded. The test was conducted specifically to monitor the ability of the selectd subjects to finish the flight test series successfully after transdermic scopolamine treatment (1.5g twice a week for the month of the test series). A psychiatric support was also given to monitor student's success levels. Furthermore, it is necessary a strict precaution for the collateral effects due to safety reasons. The tests that we conducted were in compliance with the highest safety requirements and in supervised flights. All the subjects eat a light meal with no alcohol consumption prior to testing. The subjects understood the rudimentary elements of flying, such as controlling air pressure in the cabin. The subjects treated with the transdermic Scopolamine 1.5g were found to have a significantly higher success rate than the non-Scopolamine subjects. Of the 100 selected students, 70 successfully concluded their test flight series without regurgitating (70%, P<0.001). Further improvements were also noted due to psychiatric support for the students. By contrast, those subjects (69%) did not treated with scopolamine but only with the psychiatric support, regurgitated. Because there could be certain unascertainable issues with the administration and collateral effects of drugs, we recommend first attempting psychiatric counselling (helping the student to solve his problem or to create conditions that will induce him to improve his behaviour, character or values) or using the modern rehabilitation programs (no drug programs used for pilots in Italy, USA, UK, Netherlands, Canada, etc.) that can have high therapeutic results.

[14p]

### **THE STUDY OF HYPERTENSION IN MILITARY AERONAUTICAL PERSONNEL**

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**Introduction:** Hypertension (HT), one of the most important risk factors for cardiovascular diseases, is not uncommon in young and middle-aged aircrew. The cardiovascular risk is significantly increased in the presence of traditional risk factors. Our study

evaluated the evolution of the risk factors associated with established (EH) and white coat hypertension (WCH) in military aeronautical subjects, on their periodical medical control, during 40 months.

**Methods:** After one-year assessment of the prevalence of HT and associated risk factors in aeronautical personnel, we continued to study the selected subjects on their periodical medical control. We have studied 215 consecutive patients with HT, comparatively with a group of 94 subjects with normotension. The hypertensive pts have been diagnosed using the JNC 7 criteria. At follow-up, a fasting blood sample was analyzed for total cholesterol, LDL, HDL, triglycerides, glucose. The stress status was evaluated by psychological examination. We studied the independent risk factors associated with HT using multiple logistic regression analysis (SPSS v.11). **Results:** The patients' population was aged mean  $42.5 \pm 8.4$  years. The majority was male (88.37%). One third of all HT pts (32.55%) had WCH, with at least one major risk factor. More than two thirds (67.44%) of HT pts had one or more associated risk factors. In univariate analysis, the following parameters were significantly associated with HT: age ( $p < 0.01$ ), body mass index-BMI ( $p < 0.01$ ), total cholesterol ( $p < 0.01$ ), LDL cholesterol ( $p < 0.01$ ), cholesterol/HDL ratio ( $p < 0.01$ ), LDL/HDL ratio ( $p < 0.01$ ), fasting plasma glucose ( $p < 0.05$ ), smoking ( $p < 0.05$ ), specific professional stress ( $p < 0.05$ ). In multiple linear regression analysis total cholesterol, triglycerides/HDL ratio, fasting plasma glucose and professional stress were found to be significant independent determinants of HT.

**Conclusions:** This study underlines a significant prevalence (12.89%) and an early onset of HT in the military aeronautical personnel. The specific professional stress is significantly associated with HT. The majority of the studied subjects significantly associated more independent cardiovascular risk factors. After more than 3 years, WCH pts had an unfavorable metabolic risk profile, WCH also having an increased risk of cardiovascular morbidity and mortality. Continuing monitoring of total cardiovascular risk profile in all HT pts is very important in aeronautical personnel.

[15p]

AN EXPERIENCE OF OVER AGE 60 COCKPIT CREW IN JAPAN AIRLINES INTERNATIONAL  
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Introduction: **In August 2004, the Civil Aviation Bureau in Japan lifted up the upper limit of age restriction for airline crewmembers from 62 to 64, but they should meet the strict additional medical**

**requirements. We studied the failure ratio of the former additional examination and the disqualifying reasons retrospectively in order to review our health management.** Methods: Objectives are 152 cockpit crewmembers who took the additional examination from April 1996 to March 2004. We reviewed the failure ratio and the disqualifying reasons at the first examination and at the termination of their contracts. Results: Seventeen (11%) applicants were disqualified at the first additional examination in rest ECG, TMT, echocardiogram, EEG, brain CT or color vision test. In 84 crewmembers who passed the first examination from April 1996 to March 2001, fifty nine (70%) could continue their flight duties for 3 years until the former upper limit of age 62 under careful health management. Five (6%) discontinued their duties because of medical reasons; malignancy (3), digestive (1) and ophthalmologic disease (1), while the other crewmembers because of personal (8) or termination of their contracts (12). Conclusions: **Majority of over age 60 cockpit crewmembers could continue their flight duties until the former upper limit of age 62 under the strict medical examination and careful health management.**

[16p]

**IS THE "DRY EYE SYNDROME" A PROFESSIONAL DISEASE FOR AERONAUTICAL PERSONNEL?**

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**Introduction:** "Dry eye syndrome" is a common disorder of the tear film that is caused by inadequate tear production, excessive tear evaporation or abnormality in mucin or lipid components of the tear film. The purpose of this study is to analyse the eye comfort of the aeronautical personnel. **Material and Method:** This study has been conducted in ophthalmologic offices of the National Institute of Aeronautical and Space Medicine, for 68 patients (group 1), men and women, active aeronautical personnel, between 35-55 years old, apparently ophthalmologically normal subjects. First the patients were subjected to a questionnaire that was meant to provide the subjective evaluation as such included: biomicroscopy, fluorescein stain, tear break up time (BUT), rose bengal stain, Schirmer tear test with and without anaesthesia. There have been found medium and mild dry eye; tear substitutes have been prescribed. The patients were checked up every 3 months, for a period of 9 months. Results were compared with those obtained from a control group – 20 people (group 2), women and men, with ages in the same range, people not involved in the aviation field who requested ophthalmologic examination for optical correction. **Conclusions:** The results raise the

question: can the „Dry eye syndrome” be considered a work-related disease? During the flight the aeronautical personnel should use tear substitutes, because of the low humidity of the air inside the craft.

[17p]

### **POSTOTOTOXIC VESTIBULAR DYSFUNCTION**

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**Introduction:** Ototoxicity results from the action of certain drugs or chemicals, causing hair cell injury to the labyrinth. The list of substances suspected of being ototoxic is prodigious. Amino glycoside antibiotics and loop diuretics are two of the most commonly encountered and potentially dangerous classes of ototoxic drugs. **Material and Method:** 53 years old woman with postototoxic vestibular dysfunction caused by gentamicin administration – Clinical case. **Results:** Disequilibrium of ototoxic origin is most often associated with the administration of gentamicin and streptomycin. Its outset is insidious with the severity being directly proportional to the duration and quantity of the drug given and to the status of renal function.

**Conclusions:** Tinnitus, hearing loss and vertigo are the cardinal symptoms of ototoxicity. Bilateral hearing loss predominates, but unilateral loss is not rare. Ototoxic hearing impairment is exclusively sensorineural. Permanent ototoxic hearing loss may even be delayed days, weeks or months after completion of therapy.

[18p]

### **THE STUDY OF PULSE PRESSURE AND CARDIOVASCULAR RISK IN MILITARY AERONAUTICAL PERSONNEL**

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**Introduction:** Pulse pressure (PP), defined as the difference between systolic and diastolic blood pressure, was recently shown to be an important risk factor for cardiovascular, particularly coronary, disease. The aim of our study was to investigate the relationship between PP and major atherosclerosis risk factors in military aeronautical personnel.

**Methods:** A total of 156 consecutive subjects (aged 25 to 55 years) were studied on their periodical medical control at the National Institute of Aerospace Medicine. We performed the measurements of: weight, height (from which we calculated the body mass index – BMI), systolic (SBP) and diastolic blood pressure (DBP), and a standard biochemical workup, including blood fasting glucose, serum triglycerides, total cholesterol, HDL cholesterol, LDL

cholesterol. Moreover, the smoking habit has been evaluated. The results were statistically analyzed using univariate and multiple logistic regression analysis (SPSS v.11). **Results:** Among the examined subjects, 14.10% had a medical history of hypertension (HT), 7.69% had a history of coronary artery disease (CAD), and 16.02% had glucose abnormalities. Out of those who considered themselves as “non-hypertensive”, 12.5% had an increased blood pressure on the day of the examination. PP was significantly correlated with age ( $r=0.294$ ,  $p<0.001$ ), male sex ( $r=0.163$ ,  $p<0.001$ ), BMI ( $r=0.358$ ,  $p<0.001$ ), fasting plasma glucose ( $r=0.374$ ,  $p<0.001$ ), total cholesterol ( $r=0.526$ ,  $p<0.001$ ), LDL-cholesterol ( $r=0.128$ ,  $p<0.05$ ) and HDL-cholesterol ( $r=-0.384$ ,  $p<0.001$ ). In multivariate analysis PP along with age, BMI and smoking status was found to be a significant risk factor for CAD. In multiple linear regression analysis, age, BMI, total cholesterol, fasting plasma glucose and history of CAD were found to be significant independent determinants of PP. **Conclusions:** Our study demonstrates that pulse pressure is a significant risk factor for cardiovascular diseases in military aeronautical personnel and its major determinants are age, BMI, history of impaired glucose tolerance/diabetes mellitus and hypercholesterolemia.

[19p]

### **POST-DOCTORAL RESEARCH OPPORTUNITIES AT THE FAA CIVIL AEROSPACE MEDICAL INSTITUTE.**

M. J. ANTUNANO

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The FAA Civil Aerospace Medical Institute (CAMI) offers post-doctoral research opportunities to national and international scientists through the U.S. National Academy of Sciences’ National Research Council Resident Research Associateship Programs (RRA). Since 1954, the RRA programs have provided more than 11,000 research stipends to postdoctoral and senior scientists and engineers. The objectives of the RRA programs are: 1) To provide postdoctoral scientists and engineers of unusual promise and ability opportunities for research on problems, largely of their own choice, that are compatible with the interests of the sponsoring laboratories, and 2) To contribute to the overall efforts of the Federal laboratories. Participating laboratories receive a stimulus to their programs by the presence of bright, highly motivated, recent doctoral graduates and by senior investigators with established records of research productivity. New ideas, techniques, and approaches to problems contribute to the overall research climate of the laboratories. Indirectly, RRA programs also make available to the broader scientific and engineering communities the excellent and often unique research facilities that exist in Federal laboratories. The RRA program at CAMI provides

research opportunities in the following general areas: Human Error Associated with Aviation Accidents, Advanced Flight-Deck Systems and Flight-Crew Performance, Information Complexity and Performance in Air Traffic Control, Personnel Selection for Safety-Sensitive Jobs, Aerospace Medical Research and Mathematical Modeling for Protection and Survival, Radiobiology in Aerospace Environments, Aerospace Vision Research, Applied Biochemistry and Genomics, and Toxicological Analysis and Interpretation of Results from Transportation Accidents. Specific areas of research will be discussed during the presentation. Information on the application process will also be provided.

[20p]

### **TRANSFERRING OF MODERN OCCUPATIONAL MEDICINE STANDARDS TO AVIATION MEDICINE**

ANDRZEJ OKIŃCZYC

*Lim Medical Centre, Warsaw, Poland*

The scope of our presentation is to demonstrate the interdependency between the development of modern health care services in Poland and providing the appropriate care meeting the special requirements of aviation staff.

After the transformation in Poland a number of professionally staffed companies, developing and maintaining high service standards, were established on the Polish market. These offer was addressed primarily to international corporate customers, starting their activities in Poland. The standard of occupational medicine has been significantly raised and the employees of these corporations were covered with health protection both within and outside the workplace, observing the diverse circumstances of respective employer. The poor medical care offered by state institutions was extended as a kind of additional medical insurance granted to the workers. After obtaining a license of Aviation Medicine Center one of leading companies providing occupational medicine care, the LIM Medical Center, adjusted its services to meet the high requirements regarding the maintenance of the health and safety of air crews and related staff. The designated Aviation Medical Examiners, being also qualified occupational physicians, benefit from their experience by their efforts to protect the health of employees and prevent occupational injuries and diseases.

### **SESSION 3**

[21p]

### **THE USE OF PHYSIOLOGICAL MEASUREMENTS IN THE EVALUATION OF COCKPIT WORKLOAD: AN EXPERIMENTAL APPROACH**

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The interest in determining pilot's workload (PW) has increased, mainly regarding certification issues of new aircraft, where the high insertion of automation devices tends to decrease the physical and increase the mental PW. The methods applied for such evaluation are based on subjective assessment. Thus, this study investigates the potentiality of using heart rate (HR) and heart rate variability (HRV) in the evaluation of PW. This was performed in a simulator (8 pilots) and during real flights of the certification process of a new aircraft (2 pilots). Six tasks were applied in the simulator, and six real flights in abnormal conditions were evaluated. All pilots assumed the pilot flying (PF) and pilot monitoring (PM) position in different times. The pilot's ECG was registered in a computer, and the HR and HRV processed for each task. Both HR and HRV were analyzed as the ratio of the values obtained during a rest test. A subjective assessment was conducted through the NASA-TLX test. HR of PF was higher than PM in all tasks and flights ( $p < 0.05$ ) and higher during landing than take-off. PM presented higher HRV than PF ( $p < 0.05$ ) in the simulator, but this was not observed in real flights. The data from the simulator tasks suggests the mental demand of NASA-TLX to be related to HRV. Surprising, while the NASA-TLX showed almost the same results for the six real flights, the HR and HRV presented different values for different flights, suggesting as being a better discriminator of PW. Although HRV has been proposed as sensitive to mental workload (Psychosom Med, 54, 462-470) a standard gold for measurements of overall workload is not well established. The results of the present study suggest that the use of both HRV and HR is a potential and sensitive tool in the evaluation of PW in particular.

Acknowledgement

This study was sponsored by Brazilian Technical Cooperation Program of ICAO.

[22p]

### **THE EFFECTS OF DIFFERENT LEVEL OF HYPOXIA ON PSYCHOLOGICAL PERFORMANCE**

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**Introduction:** The effectiveness of physiological compensation to hypoxia is known to be limited above 15,000 feet. Beyond this altitude intellectual impairment will develop progressively. On the other hand, carbon monoxide (CO) produced in cigarette smoking presents a degree of hypemic hypoxia. The purpose of this study is to compare the effects of cigarette smoking on mental task at three selected altitudes. **Methods:** One hundred male volunteers (50 nonsmokers, 50 smokers) participated this hypoxic



experiment at 18,000 feet (N=44), 25,000 feet (N=32), and 30,000 feet (N=24) respectively. The tidal breath CO of them was measured and expressed as HbCO% previously. The smokers were allowed to have one cigarette 10 minutes before hypobaric chamber flight. After ascending to the specified altitude, they removed the oxygen mask and started to circle the number (3 and its multiples) printed on a random number list for a predetermined time period. The score was expressed as the correct percent of task (correct circles / total circles). This mental task was also conducted on ground as control. The blood oxygen saturation (SaO<sub>2</sub>%) and heart rate were monitored through the hypoxic exposure. **Results:** In habitual smokers, the score was observed higher at both 18,000 feet and 25,000 feet than that of nonsmokers. But this unpredictable result was not seen at 30,000 feet. Mostly, the HbCO% of subjects was negatively correlated to their SaO<sub>2</sub> %.

**Conclusions:** The pharmacological effect of nicotine may enhance the concentration or alertness of subjects and thence improve the psychomotor activity at lower altitude. However, the synergism of cigarette smoking and acute hypoxia do produce an overwhelming risk to human performance at higher altitude.

[23p]

#### **RAPID ONSET OF LBNP EXPOSURE**

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An LBNP (Lower body negative pressure) examination technique is applied in our case as one of the possibilities for preliminary indirect individual estimation of the pilot's positive gravitational acceleration (+Gz) tolerance. It partly replaces demanding and expensive examinations in a human centrifuge. LBNP exposition is also used as a method of drill in anti-g manoeuvres. This exposition is an important training stage before the centrifuge training. Current LBNP examinations are accomplished with one-step exposure to the negative pressure level of -70 mmHg with achievement of this value in one second. Pilots are examined in the sitting position with the possibility to tilt the device backward. Results of the test depend on exposure time duration. It is determined by subjective and objective tolerance and values of physiological data of the examined pilots. Objective stop criteria were assessed pursuant to statistical evaluation of blood pressure (BP) and heart rate (HR) behaviour. Otherwise the total collapse of the examined subject might easily occur. Cardiovascular reaction is characterized by gradual unstable reduction of the systolic, diastolic and pulse BP, followed by gradual increasing of HR during an LBNP load. Drop of BP and acute decreasing of HR represent insufficient

results of the examination. Changes of monitored physiological data manifest the effectiveness of the anti-g manoeuvres training. LBNP examinations allow to evaluate entirely the orthostatic part of the actual cardiovascular response as the basic part of the complex resistance to overloading. Although the LBNP load represents a principally different load than +Gz overloading, possibilities of the prediction of the low level of +Gz tolerance using an LBNP method were proved. The LBNP examination method was developed for pre-selection of the applicants' with low level of +Gz tolerance. We compared pilot's physiological responses to the LBNP, flight and centrifuge load before now. Physiological responses from the blood pressure and heart rate point of view are in LBNP examination are similar to those +3.5 Gz in a human centrifuge and mostly correspond to the gravitational acceleration +4.5 Gz during flights in aircraft.

[24p]

#### **PRECONDITIONING ATTENUATED LOWER BODY NEGATIVE PRESSURE-INDUCED PRESYNCOPE AND COGNITIVE FUNCTION DISTURBANCES**

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**Background:** Fighter pilots are routinely exposed to high levels of repetitive +Gz acceleration. The highly maneuverable property of jet fighter could let physiological tolerance of human to acceleration (+Gz) be easily exceeded, resulting in G-induced loss of consciousness (G-LOC) due to insufficient cerebral blood flow. The impact of G-LOC was severe to the pilot and flight safety. Some studies had showed that experienced pilot had higher tolerance to G-force. However, the mechanism was unclear. Lower body Negative Pressure (LBNP) has been used to study the effect of G-force on human. In this project, Presyncope was induced by the exposure of Lower body Negative Pressure (LBNP) in adult healthy man. Presyncopal symptoms were observed and the impact of LBNP on cerebral function was also quantified. We also evaluated the effect of ischemic precondition on LBNP-induced presyncope and cognitive function disturbance. **Methods:** Nine healthy male were exposed to LBNP (-40 mmHg) until presyncope. Presyncopal criteria included: 1) a sudden drop in heart rate of more than 15 bpm; 2) a drop systolic BP of 25 mmHg or between consecutive measurements; 3) a drop in diastolic BP of 15 mm Hg or between consecutive measurements; or 4) sudden dizziness, nausea, sweating, pallor, or clammy skin. Ischemic precondition was performed via the exposure of short period of LBNP(-40 mmHg, 30 sec) for twice with

interval 5 min. Ten min after preconditioning, the subjects were then exposed to -40 mmHg. The exposed duration was the same as that of previous syncopal test. The cerebral cognitive function was evaluated by Wisconsin precortex test (WCST) after LBNP exposure. **Results:** LBNP resulted in presyncopal symptoms including dizziness, nausea, sweating, pallor, or clammy skin. Cognitive function quantified by WCST test was impaired after LBNP exposure. Ischemic precondition decreased LBNP-induced presyncopal symptoms. Precondition also attenuated the cerebral cognitive function disturbance induced by LBNP. There were significant differences between groups of LBNP and Precondition in sub-items of WCST-CV3, including Trial Administered, % Errors, % Nonperseverative Errors, and % Conceptual Level Response ( $p < 0.05$ ). **Conclusion:** Ischemic precondition can protect subjects from LBNP-induced presyncope and cerebral cognitive function disturbance.

[25p]

#### **PHYSIOLOGICAL PARAMETERS AND TRACE ELEMENTS BEFORE AND AFTER AEROBATIC FLIGHT**

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The purpose of this study was to determine how physiological factors such as HR, RR, EKG, blood sugar, cholesterol and some trace elements (Cu and Zn) change during acrobatic flight. Applicants had significantly changed blood sugar and Zn concentration after flight, but other physiological parameters remained practically unchanged. **Introduction:** Aerobatic flying demands the best of both, aircraft and pilot. The pilot must possess skill and physiological stamina. The most important biomedical factor is the pilot's response to acceleration (G loading). The major physiological affects of G loading vary from reduced vision to loss of consciousness. During the early years of aerobatics no physiological effects of G loading were reported, because aircraft power and speed were limited. With increased military use of aircraft, there was and increased interest in the effects of G's on pilots. **Methods:** The subject of investigation were ten male pilots between 31-50 years, participants in aerobatic competition on 24 June 2004 at the airport Divača in Slovenia. All subjects were fully briefed on the scope of the experiment and served voluntarily. Flight lasted 7 minutes. There were not medical contraindications for this kind of activity. Samples of blood were collected ten minutes before and ten minutes after flight. In the same time we made EKG report and measurement of heart rate and blood pressure. **Results:** Blood

**sugar: Before: 5,08 After: 6,11 Cholesterol: Before: 4,3 After: 4,3 Zn: Before: 11,1 nmol/l After: 9,8 nmol/l Cu: Before: 13,6 nmol/l After: 13,5 nmol/l HR: Before: 68 /min After: 71 /min RR: Before: 115/75 mm Hg After: 120/75 mm Hg EKG: Before and after flight: regular, no interval between beats. Discussion: G may be thought of as the force or 'pull' gravity upon a body. On the earth, this pull causes the body to have a certain weight. Changes in direction occurring in speeding up (acceleration) or slowing down (deceleration) may be referred to as G's. The amount of G experienced by the pilot depends on how vigorously the pilot pulls back on the controls and how readily the aircraft responds. On notational system for describing G's is based of reference to the direction of acceleration of the pilot as he sits in the cockpit. Fore and aft acceleration (G<sub>x</sub>) and lateral acceleration (G<sub>y</sub>) have little effects on our physiology and can be tolerated better than had to foot acceleration (+G<sub>z</sub>) and reverse, foot to head (-G<sub>z</sub>). The main effects of G<sub>z</sub> acceleration are upon the blood in blood vessels. +G<sub>z</sub> effects will impel the fluid columns of blood toward the lower portions of the body, the output of blood from the heart will be reduced. This can lead to disturbances of vision, inability to coordinate muscular activity and unconsciousness. In the situation of negative G<sub>z</sub> forces blood is pushed toward the heart and the amount of blood returning from the head is diminished. The blood tends to stagnate particularly in the head. In some individuals there is a marked slowing of the heart and irregularities of beats. It appears that the greatest threat from -G<sub>z</sub> is the loss of consciousness from the slowing of the heart, irregularities of the heartbeats, and stagnation of blood in the head. One little known but important aspect of tolerance to G's is the effect of rapid changes from +G<sub>z</sub> to -G<sub>z</sub> of viceversa. Because aerobatics induce such rapid changes, tolerance to changes could be highly significant. When one is subjected to -G<sub>z</sub>, blood pressure receptors in the head and chest respond to the increased pressure and cause a reflex slowing of the heart. A rapid change to +G<sub>z</sub> would suddenly drop blood pressure in these receptors and there would be a rapid speeding up of the heart to maintain pressure, but because the reflex system requires some time to sense the need, the heart could be delayed in responding to this demand and blood flow to the brain might suddenly decrease. Some persons can withstand greater G's than others. Seasoned acrobatic pilots may represent a selected group, because persons with less physiological resistance probably drop out of aerobatics before reaching the highest levels of performance. **Conclusions:** Flight stress test causes pilot participants to change levels of blood sugar and blood Zn in situation that induces hormonal**

changes. Increased blood sugar is a result of adrenalin response to physical and psychological stress, but decreased blood Zn suggested that circulatory Zn is sequestered by the liver. There are thousands of known Zn proteins, such as metallothioneines, whose synthesis is induced by infection, inflammation of stress factors.

[26p]

#### A POSTURAL EVALUATION OF HELICOPTER PILOTS

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**High prevalence of backache in Helicopter Pilots (HP) has been reported, and attributed to the in-flight pilot posture (IPP) and vibration, conducting to muscle fatigue. Conversely, low activity of back muscle during flights was found (J Biomech;43(10):1309-1315), and no fatigue observed due to any of these factors (Aviat Space Env Med;75-317-322). Although the IPP is considered as being asymmetrical, few if none report is found of the consequences of this posture in the HP posture while not flying. This study performs a postural evaluation of 41 civil HP (41.9±9.7 years old, 69.6±12.7 kg, 1.74±0.07 m) in their regular upright, and relaxed posture. A computerized system performed the analysis through 13 marks attached to anatomical sites of the body of the HP. The results showed that 66% of the HP presented neutral shoulder alignment in the frontal plane and 27% had it bent to the left. 75% presented neutral pelvis inclination, and 18% had it leaned to the left. 8% presented an elevated right and left scapulas, while 68% and 71% presented a depression of right and left scapulas respectively, being the remaining normal. No HP presented adduction of the scapula, but abduction was observed in 82% and 66% of the sample, on right and left respectively. 61% presented valgus, and 20% varus knee. 76% of the HP presented gibosity (observed through clinical test), being more frequent on right (81%) than on left (19%) side. The HP in-flight pilot posture (IPP) is described as "helicopter hunch" (the pilot remains with the trunk leaned forward and to the left), but its consequence in the pilot regular posture, which might cause pain is not well documented. The abnormalities found in this study appear to be related to this IPP, mainly while considering the high prevalence of gibosity. The relationship between the IPP and the HP regular posture should be further investigated.**

[27p]

#### HYPOBARIC HYPOXIA AND VASOPRESSIN EXPRESSION IN THE HYPOTHALAMUS

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**Introduction:** The hormones arginine vasopressin (AVP) and oxytocin (OXT) are synthesized by neurons in the supraoptic and paraventricular nuclei (SON and PVN) of the hypothalamus. Changes in the distribution of body water and electrolytes take place following exposures to high altitude. AVP is thought to be responsible for this change. Many studies have reported raised levels of plasma AVP following exposure to the stress of hypobaric hypoxia at high altitude. The aim of this investigation was to examine the expression of AVP and OXT in neurons of SON and PVN following exposure to hypobaric hypoxia. **Methods:** Adult Wistar rats weighing 250 gm were exposed to an altitude of 7000m for 2 hours in an altitude chamber and were sacrificed at 1-24h and 2, 4 and 7 days after the exposure. Normal rats of similar weight were used as controls. The hypothalamus was removed and processed for immunohistochemistry to detect the expression of AVP, and OX. **Results:** In control rats, weak expression of AVP and OXT was observed in the neurons of SON and PVN. The expression was markedly upregulated at 1-24h and 2d following the altitude exposure but was comparable to control levels at 4 and 7d. **Conclusions:** It is concluded from this study that an acute exposure to hypobaric hypoxia could lead to marked but transient upregulation of AVP and OXT expression in the SON and PVN indicating increased synthesis of these hormones as an adaptive physiological response under hypobaric hypoxic conditions.

[28p]

#### HYPOBARIC HYPOXIA INDUCED DAMAGE IN THE RETINA

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**Introduction:** Hypobaric hypoxia is thought to be the predominant factor responsible for causing retinal hemorrhages and visual disturbances at high altitude. Vasodilatation and increased blood flow in response to hypoxia occurs in many tissues. The pathophysiology of hypoxic retinopathy is not understood completely. The aim of this study was to examine the involvement of nitric oxide (NO) and increased vascular permeability in the development of hypoxic retinopathy in adult rats. The expression of endothelial, neuronal and

**inducible nitric oxide synthase (eNOS, nNOS, iNOS) and vascular endothelial growth factor (VEGF) was carried out in the retina following the hypoxic exposure.** Methods: Adult Wistar rats weighing 250 gm were exposed to an altitude of 7000m for 2 hours in an altitude chamber and were then sacrificed at 3h, 1, 3, 7 and 14 days after the exposure. Normal rats of similar weight kept at ground level were used as controls. The eyes were removed at various time intervals and processed for protein, mRNA and cellular expression of eNOS, nNOS, iNOS and VEGF by western blotting, RT-PCR and immunohistochemistry. Results: Upregulated protein, mRNA and cellular expression of eNOS, nNOS, iNOS and VEGF was observed in the retina in response to hypoxia at 3h -7d, the expression was comparable to the controls at 14d. Conclusions: The results of this study suggest involvement of NO in retinal changes in response to hypoxia. Increased expression of eNOS and VEGF in response to hypoxia is indicative of vasodilatation and increased permeability of retinal blood vessels.

[29p]

#### **CALCIUM BINDING PROTEINS IN THE HIPPOCAMPUS FOLLOWING HYPOBARIC HYPOXIC EXPOSURE**

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**Introduction:** Hypoxia is an important factor which affects memory and cognitive functions. Hippocampus, the brain region which controls this function, is highly susceptible to damage in hypoxic conditions. Although a growing number of cellular and molecular pathways are believed to be involved in hypoxic damage to the hippocampus, the role of calcium binding proteins in the development of above complications following hypoxic injury has not been investigated. This is especially important as hypoxia results in increased calcium (Ca<sup>2+</sup>) influx in neurons and generation of nitric oxide (NO) which can be damaging to the neurons. In view of the above, we investigated the expression of calcium binding proteins such as calbindin and parvalbumin as well as neuronal nitric oxide synthase (nNOS) in the hippocampus of adult rats subjected to hypoxia. **Methods:** Adult Wistar rats were exposed to hypoxia in a hypobaric chamber for 2h and were sacrificed at 1-24h, 3 and 7days after the exposure. Normal rats of similar weight were used as controls. Coronal sections of the brain containing the hippocampus were cut and processed for immunohistochemistry to detect calbindin, parvalbumin and nNOS expression. **Results:** The hippocampal neurons showed decreased

immunoreactivity for calbindin and parvalbumin following hypoxic exposure as compared to the controls. Increased expression of nNOS was observed at 1h-3d after the hypoxic exposure. **Conclusions:** Since calbindin and parvalbumin are known to have a buffering action against excess calcium, their downregulation could have led to accumulation of excess calcium in the neurons. It is concluded from these findings that decreased calbindin and parvalbumin expression may lead to failure of calcium buffering or intraneuronal calcium homeostasis, which contributes to calcium-mediated cytotoxic events during hypoxic conditions. Increased production of NO through nNOS could also have damaging effects. It is suggested that these changes may be responsible for an impaired memory and learning function.

[30p]

#### **HYPOXIA INDUCED INCREASE IN VASCULAR ENDOTHELIAL GROWTH FACTOR EXPRESSION IN THE BRAINSTEM**

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**Introduction:** Alterations in cardiorespiratory functions occur as a result of sudden exposures to high altitude. Hypobaric hypoxia developing at high altitude is considered as the cause for these changes. Since hypoxia leads to vasodilatation and increased vascular permeability, we sought to examine whether the cardiorespiratory regulation centers in the brainstem would show any alteration in the expression of endothelial nitric oxide synthase (eNOS) and vascular endothelial growth factor (VEGF) following a high altitude exposure. **Methods:** The nucleus tractus solitarius (NTS) and the ventrolateral medulla (VLM) in adult rats exposed to an altitude of 7000m for 2h and in the corresponding control rats were examined for expression of eNOS and VEGF at 3h, 24h and 3d and 7d following the altitude exposure. **Results:** The expression of eNOS in the blood vessels in the NTS and VLM was increased at 3h, 24h and 3d after the exposure whereas VEGF expression was increased upto 7d after the exposure. **Conclusions:** It is concluded from the results of this study that the increased expression of VEGF following hypoxic exposure may be involved in increased permeability of the blood vessels. The increased expression of eNOS indicates excess production of nitric oxide (NO) which may be involved in vasodilatation and vascular leakage in hypoxic insults. The increased leakiness of the blood vessels may lead to the entry of serum derived substances in the brainstem and cause tissue damage leading to alterations in cardiorespiratory functions.

[31p]

CONTRAST SENSITIVITY TESTS IN  
NORMOBARIC HYPOXIA  
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**Introduction:** Disorders of the contrast sensitivity have been noted in the hypobaric chamber at the altitude of about 4,500 – 5,000 m above the sea level. Moreover, changes in visual acuity, color vision, and field of vision may additionally develop under such conditions. Above mentioned visual changes may be related to the functioning of various retinal structures, especially ganglion cells. The aim of the paper was to evaluate changes in the contrast sensitivity tests in normobaric hypoxia related to breathing with low oxygen gas mixture. **Methods:** Thirty healthy men, non-smokers and non-drinkers, aged between 19 and 22 years (mean age 20.4 years) without marked visual disturbances have been examined. Contrast sensitivity has been measured with the aid of BA-4 (Tomey) device. Examined subjects breathed with a low oxygen gas mixture, containing 9.6% of oxygen in nitrogen through the mask (simulation of the altitude hypoxia). Tests of the contrast sensitivity (contrast sensitivity without glare, with glare, adaptation test following glare, test for red color) were measured after 10, 20, and 30 minutes of breathing with low oxygen mixture as well as prior to and after hypoxia. Visual acuity, using standard charts, has been examined after each test. Hemoglobin saturation with oxygen and HR with pulseoxymeter (Protocol System) have been monitored during the study. The obtained results have been analyzed statistically with Statistica v 5.1 program with T-Student test for dependent variables. The studies were authorized by ethics committee. **Results:** Statistically significant changes in the contrast sensitivity ( $p < 0,05$ ) have been obtained in all measurements correlated with the decrease of hemoglobin saturation with oxygen and compensative increase of HR. Consecutive breathing with atmospheric air has led to normalization. No decrease in visual acuity has been noted under study conditions. Hypoxic effect, expressed as hemoglobin saturation with oxygen, corresponded with that seen in the hypobaric chamber at altitude of about 5,000 m above the sea level, i.e. zone of incomplete compensation. **Conclusions:** The results of the study have shown diminished sensitivity in the simulated altitude hypoxia. It confirms the results of our previously performed studies which revealed low contrast sensitivity in pilots examined in hypobaric chamber. Contrast sensitivity test is valuable in the aviation-medical certification and may be useful in diagnosis of early stages of visual disturbances of ischemic pathomechanism with normal visual acuity.

[32p]

THE INFLUENCE OF ACUTE NORMOBARIC  
HYPOXIA EQUIVALENT TO THE ALTITUDE  
OF 4500 M A.S.L. ON RETINAL SENSIVITY IN  
COMPUTERIZED PERIMETRY

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**Introduction:** Hypoxia is a very important part of aviation medicine. As of today, there has been little scientific news concerning the effect of acute hypoxia on visual performance. One of the subjective methods of evaluating the retinal functions is computerized perimetry. It determines the threshold sensitivity of various parts of the retina to light stimuli. The objective of this work was to evaluate the changes in retinal sensitivity to light stimuli following the exposure to acute normobaric hypoxia equivalent to the altitude of 4500 m a.s.l. **Methods:** 25 healthy volunteers, male 29-23 years of age, were examined. The subjects were breathing the oxygen depleted gas mixture, 9,6 % of oxygen, in KP-28 masks used on military aircraft. The field of vision was examined by ways of computerized perimetry performed on Humphrey Field Analyzer 750. The subjects were divided into 5 groups, assessing retinal sensitivity separately in central 5° to white-on-white and blue-on-yellow strategies, as well as white-on-white strategies in 5°-30°, 30°-60° and 60°-90° in temporal region. Each group consisted of 15 person in each examination. The examinations were performed before the exposure to hypoxia, and 10 and 25 minutes after the exposition. At the same time the heart rate and peripheral blood saturation were monitored. The mean retinal sensitivity of examined area and mean retinal sensitivity for one point in four quadrants of the field of vision in subsequent examinations were tested. The study were authorized by ethics committee. **Results:** On the examination of the central field of vision up to 30° retinal sensitivity was found to be decreased by 5-8 % in the 10<sup>th</sup> minute in all three groups. In the examination involving blue-on-yellow strategy the retinal sensitivity continued to be statistically significantly decreased in the 25<sup>th</sup> minute by c.a. 3-5 %. In the examination of the field of vision between 30°-90° the changes of retinal sensitivity were statistically insignificant. Statistically significant decrease of oxygen saturation of hemoglobine in 10<sup>th</sup> and 25<sup>th</sup> minute associated with increased heart rate was served. **Conclusions:** 1) In conditions of acute hypoxia pilots experience decreased retinal sensitivity in the central field of vision, which can be significant for visual perception. 2) The oximetric disturbances noted in peripheral blood are equivalent to hypoxic effect of the altitude of c.a. 4500 m a.s.l.

[33p]

## PHYSIOLOGICAL INCIDENTS IN MIAM – POLAND SIMULATED HIGH ALTITUDE CHAMBER FLIGHTS

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**Introduction:** High altitude flights are a part of flying personnel annual medical examination under authority of aeromedical board. Since we started hypobaric exposures some of flying personnel have suffered from physiological incidents. In this paper we will characterise physiological incidents in Military Institute of Aviation Medicine (MIAM) during last 12 years. **Methods:** Hypoxia tolerance test was performed at simulated altitude 5 000 m a.s.l. during 30 min. Exposition was realized in the high altitude chamber in steady ascent and descent conditions. Oxygen blood saturation and heart rate were continuously measured. Just before and after every exposition physical examination was performed to eliminate any existing decompression sickness symptoms. All available examination records string from 1992 were reviewed and the frequency of physiological incidents counted and analyzed. **Results:** Total number of exposures were 11 414. Overall frequency of physiological incidents was 1.1 %. Physiological incidents included ear pain, paranasal sinus pain and hypoxia. We did not have decompression sickness cases in our 12 years history of hypobaric exposures. We observe same frequency of ear or paranasal sinuses pain – 48.5% and hypoxia – 51.5 % of all physiological incidents. Hypoxia cases percentage (0,6 % of all expositions) decreased in comparison to previous periods of high altitude flights in MIAM (2%). **Conclusions:** Decompression sickness has not been a problem during our hypobaric exposures. The percentage of ear pain and hypoxia cases was similar to the previous periods. Similar frequency of ear/paranasal sinuses pain and hypoxia is not consistent with other High Altitude Training Centres due to different chamber flight profile and hypoxia degree probably.

[34p]

## ISOMETRIC FORCE LEVEL MEASURED ON THE RUDDER BAR AND +GZ TOLERANCE DURING CENTRIFUGE EXPOSURE

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**Introduction:** The pilot's work environment aboard the high-performance aircraft requires protection and special training in order to obtain optimum performance and safety, especially in respect to the +G<sub>z</sub> acceleration. In situation of high +G<sub>z</sub> exposure the most effective manoeuvre will be that which results in decreasing to the least extent the blood

pressure at the head level with the minimum fatigue. The forceful contraction of the lower limb muscles probably is an important factor, which allows the pilot to raise the blood pressure during AGSM. The aim of the study was to evaluate the isometric force exerted on the rudder bar during centrifuge rotation (interval profile) and to find the relationship between +G<sub>z</sub> tolerance and physical effort of the pilot's lower limbs. **Methods:** Subjects were 14 male aircraft pilots (age 33.8±6.8 yr, body mass 80.8±9.0 kg, body height 1.77±0.04 m), who performed interval test on the human centrifuge (radius 9.0 m) at the PAFIAM. The measurement system forces exerted on the rudder bar were installed on the centrifuge. All pilots participated in periodic routine tests (full profile: start at 4 G<sub>z</sub> for 5 s, return to 1.5 G<sub>z</sub> for 15 s, 5 G<sub>z</sub> for 15 s, 1.5 G<sub>z</sub> for 15 s, next respectively 5,5 G<sub>z</sub>, 6 G<sub>z</sub>, 6.5 G<sub>z</sub>, 7 G<sub>z</sub>; all 3 G<sub>z</sub>/s). The value foot force-pressures against the rudder bar have been recorded during each of the exposure profiles. In the analysis, apart descriptive statistics and Student-T test (p<0.05) correlation was used. **Results:** Average values of the relative force were analysed (for 4 ÷ 6 G<sub>z</sub>) respectively: for all pilots (15.9±3.25, 17.7±3.32, 17.1±2.74, 17.2±2.80 N/kg), and next divided for two groups: Gr1; pilots who have completed full programme and Gr2; the others who have completed it partially. The Gr1 pilots achieved significantly lower values press-force (15.2±3.64, 16.9±3.52, 16.6±3.09, 16.7±3.39 N/kg) then the Gr2 subjects (16.6±3.06, 18.4±3.32, 17.5±2.63, 17,7±2.44 N/kg). A strong correlation (r=0.85) was found between force exerted on the rudder bar and the level of acceleration (+G<sub>z</sub>) during centrifuge rotation. **Discussion and Conclusions:** The results of Mac Dougall's studies suggest that contraction of the lower body muscles is one of the most important factors of the AGSM, especially during instances of the sustained +G<sub>z</sub>, which might lead to a fatigue. The pilots who have completed the centrifuge tests pressed on the rudder bar with a significantly lower value of forces as compared to those who partially completed the test. Our findings suggest that the physical effort of pilot's lower limbs leading to fatigue could be the factor limiting performance during the test on human centrifuge with interval profile, especially on high acceleration (above +6G<sub>z</sub>). These studies will serve for preparing a special training of the pilots lower limb muscles according to the profile of the physical effort on human centrifuge.

[35p]

## AEROMEDICAL EXAMINATION IN AVIATION SPORTS IN THE SCOPE OF THE MAIN AEROMEDICAL CENTRE OF THE POLISH AERO CLUB IN WROCLAW

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**Introduction:** Aviation sports are still more elite than common activity in Poland. However, during the last 10 years there was a dynamic growth and development in this discipline. Increasing number of candidates for aviation sports creates certain problems concerning aeromedical examining. In Polish Aero Club there is the Main Center of Aeromedical Examinations (GOBLL) in Wrocław, which has the largest experience in qualifying applicants, and periodic medical examinations for aviation sports.

The implementation in 2001 of JAR-FCL Part 3 Requirements in Poland, and introducing the new Aviation Law in 2002 has had significant influence on the aeromedical assessment. There also has been a change in profile of disqualifying conditions and health disorders affecting aviation sports applicants.

**Methods:** Data of all aeromedical examinations of the subpopulation of sports aviation pilots and parachutists, performed in GOBLL in the years 1991-1994 and 2001-2004 were analyzed. These years were chosen because in the first four-year period the aeromedical examinations were performed according to the older national regulations and the latter period includes the examinations done according to JAR-FCL Part 3. The examinations were divided into groups: initial and renewal, with respect to gender. In the two time periods the reasons for considering unfit for flying duties were analysed and compared. A number of disqualifications in different disorder groups were counted in both periods. **Results:** In the period 1991-1994 there were total of 11 202 aeromedical examinations performed in GOBLL, including 3306 initial and 7896 renewal ones. In 371 initial examinations the verdict unfit was placed. In renewal examinations there were only 29 unfit cases. In the period 2001-2004 the total number of aeromedical examinations amounted to 15 679, including 3 682 initial and 11 997 renewal ones. In these years the unfit decision was given in 67 initial cases and 27 renewal ones.

In the second analysed period we found a significant decrease in the number of “unfit” decisions. Most frequent in the first period, disqualifying neurological condition - pathological trace of EEG, dropped over threefold, and the only increased number of “unfit” conditions related to aviation psychology.

**Conclusions:** The results of the statistical analysis indicate the fact that even though there has been a certain change in the profile of most common disorders which were disqualifying for applicants and pilots in the aviation sports, the most important changes occurred in the regulations when implementing the JAR-FCL 3. The more “friendly”

approach especially towards the candidates, proved that more sport pilots can be considered “fit” without jeopardizing flight safety. Never the less certain issues especially in aviation neurology still require a careful investigation, among them: the problem of so called “brain bioelectric immaturity” in aviation sports applicants, and the concurrent deviations in EEG, mainly because of the possible functional repercussions are still waiting for a solution.