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**Poster Presentation Abstracts**

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**001**

**ANALYSIS OF SYNTHETIC DATA FOR CALCULATION OF RISK OF TYPE 2 DIABETES**

*ANALYSE D'UN RÉSUMÉ DES DONNÉES POUR LE CALCUL DU RISQUE DE DÉVELOPPER UN DIABÈTE DE TYPE 2*

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**Introduction.** The mechanisms that play a role in the onset of type 2 diabetes (T2D) in absence of familiarity are not well defined. For this reason, research has shifted toward contemporary observation of several factors reflecting the multifactorial nature of the disease. The "Multi-scale Immune System Simulator for the Onset of Type 2 Diabetes" (MISSION-T2D), is a bioinformatics, multi-level, and patient-specific model that integrates genetic, metabolic and nutritional data in order to simulate and predict metabolic and inflammatory processes underlying the development of T2D. The VitaDock+ app from the German company Medisana includes a dedicated feature of MISSION-T2D for mobile devices, developed to record daily calories intake and sports activities, and providing guidance for a healthy lifestyle. Worth to mention is that T2D is also an important medical condition possibly leading to an unacceptable risk of cardiovascular accidents in flight personnel.

**Methods.** A group of 1368 computer generated subjects was investigated with MISSION-T2D and VitaDock+. The results were analyzed with R, the statistical environment for data analysis, specifically with k-means, the unsupervised clustering algorithm. The combined use of R and k-means identified the main causes of T2D in the synthetic data set available.

**Results.** 47% of subjects resulted at low risk of T2D, while 53% was at high risk. The proportion of subjects performing regular physical exercise was higher in the subgroup at low risk (80% vs. 31%). The proportion of subjects following a balanced diet was also higher in the subgroup at low risk (69% vs. 23%). BSS/TSS >0.8 for all comparisons.

**Conclusion.** A dedicated algorithm developed to predict the onset of T2D could be helpful in assessing the risk of cardiovascular accidents in flight personnel. Moreover, individuals at high risk can receive benefit from changes in lifestyle, if promptly advised.

**002**

## **IATROGENIC CLAUDE BERNARD-HORNER SYNDROME IN A CABIN CREW APPLICANT: A MULTIDISCIPLINARY APPROACH**

*SYNDROME DE CLAUDE BERNARD-HORNER IATROGÈNE CHEZ UN DEMANDEUR DE CERTIFICATE DE MEMBER D'EQUIPAGE DE CABINE: UNE APPROCHE MULTIDISCIPLINAIRE*

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**Introduction:** Claude Bernard-Horner syndrome is characterized by the typical triad of ipsilateral partial ptosis, miosis and loss of hemifacial sweating (anhidrosis). The damage involves the nerves of the sympathetic trunk at different levels, from the origin in the chest to the face. This condition may be congenital, acquired or iatrogenic. The iatrogenic type has been reported as a complication of a variety of chest, neck, and otolaryngologic procedures.

**Case report:** We present the case of a 32-year-old male, who received a diagnosis of a superior mediastinal schwannoma. This tumor was an incidentaloma, without clinical symptoms or signs, found incidentally during a MRI for shoulder pain. After diagnosis he underwent schwannoma excision and then developed an iatrogenic Claude Bernard-Horner syndrome. He came to our attention three months later, applying for a cabin crew certificate. The investigation performed implicated aeromedical examinations and assessment to evaluate the specific medical requirements for cabin crew.

**Discussion:** Clinical history of this patient, postoperative complications and requirements for medical fitness, needed a multidisciplinary approach. We worked in a team made up aero-medical professionals: an oncologist, a neurologist and an ophthalmologist. Our guideline was EASA Acceptable Means of Compliance and Guidance Material to Part-MED Ed 2011, Subpart C. According to neurologic examination this patient showed the typical signs of the syndrome, but not in the complete form. In particular he showed slight miosis and moderate ptosis, overall compatible with his specific work activities. From an oncologic point of view we were aware that schwannoma is the most common mediastinal neurogenic tumor. The treatment based on a complete surgical resection remains the only guarantee of a good prognosis.

**Conclusion:** In cabin crew with this diagnosis, a fit assessment may be considered after successful treatment and with adequate follow-up. Ophthalmological evaluation including an extended eye examination detected compatibility with medical requirements and main cabin crew duties.

## DIVERTICULOSIS - AVIATION MEDICINE ASPECT. CASE STUDY

*MALADIE DIVERTICULAIRE – MÉDECINE AÉRONAUTIQUE ASPECT: À PROPOS D'UN CAS*

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Background: Diverticulosis of the colon is one of the most common disorders of gastrointestinal tract in the Western Europe. Studies show that diverticulosis prevalence increases with age. Due to this fact, this pathology is relatively rare in the age group of active highly maneuverable aircraft pilots. The issue raised is of particular importance with regard to pilots, who are exposed to hypoxia, high-altitude gas expansion, acceleration, anti-G straining maneuvers and high pressure breathing. So, this is connected with flight safety.

Case: We report a unique case of a 49-year-old supersonic aircraft pilot suffering from nonspecific symptoms and unexpectedly diagnosed with diverticulosis 19 years ago. He was allowed to continue flying once the symptoms subsided. In February 2013, he was hospitalized due to clinical manifestation of diverticular disease. Six months later, he was hospitalized once again due to pain in the left iliac fossa without fever or elevation in laboratory markers of inflammation. Colonoscopy discovered multiple diverticula in the descending colon and sigmoid, along with discrete signs of inflammation. A computed tomography performed after 2 weeks of anti-inflammatory therapy, revealed numerous diverticula without signs of inflammation.

Discussion: In the course of diverticulosis, the greatest risk of complications associated with supersonic flight is due to increased pressure throughout the intestines and the abdominal cavity. This may cause structural changes within the diverticula, increase their numbers and progression of the disease forced by flight factors.

Conclusion: Diverticulosis is an extremely important case law subject and an equally important ethical and medical issue. There is no doubt that the extreme flight factors are one of predisposing elements in the progression of morphological changes in diverticulosis of the bowel. Considering the above findings we hypothesize that the pilots of supersonic aircraft with a documented diverticular disease should not be allowed to continue to fly.

**004**

## **AEROMEDICAL ASSESSMENT OF AN AIR TRAFFIC CONTROLLER (ATCO) AFFECTED BY SPINOCEREBELLAR ATAXIA TYPE 2 (SCA2)**

*EVALUATION AEROMEDICALE D'UN CONTROLEUR DE LA CIRCULATION AERIENNE SOUFFRANT  
D'ATAXIE SPINOCEREBELLEUSE TYPE 2 (SCA2)*

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Introduction: Spinocerebellar ataxia 2 (SCA2) is an Autosomal Dominant inherited disorder characterized by progressive cerebellar ataxia, dysarthria, cognitive impairment, pyramidal features and peripheral neuropathy. Genetic testing detects an abnormal CAG trinucleotide repeat expansion in ATXN2 gene. Clinical onset is in the third or fourth decade of life although childhood onset and late onset have been reported. Anticipation is observed.

Case: The case involves an Italian Air Traffic Controller (ATCO), 46 years old man, for revalidation of his class 3 medical certificate. He stated both personal and family history negative for neurological diseases. Neurological examination showed mild dysarthria and ataxia, increased deep tendon reflexes of lower limbs and bilateral Babinsky sign. During the medical examination, the applicant denied any abnormalities of his physical condition.

A brain MRI showed an atrophy of the cerebellum and brainstem (pons). A neuropsychological evaluation revealed cognitive dysfunction (executive functions). Molecular genetic testing detected an abnormal CAG trinucleotide repeat expansion in ATXN2 gene, suggestive for SCA2.

Conclusion: The most important qualities for the safe exercise of the privileges of the ATCOs license are communication skills (listen to pilot's request and respond by speaking clearly), concentration, decision making (they must make quick decisions) and problem solving skills. Cognitive dysfunction and speech disorders could compromise the work-related skills and therefore the flight-safety. The AME (Aeromedical Examiner) referred the decision on fitness to the Aeromedical Section (ENAC), according to Eurocontrol documents. The ATCO was declared unfit.

## RELATIONSHIP BETWEEN FLIGHT DURATION AND BONE MINERAL DENSITY IN CHINESE CIVIL AVIATION PILOTS

*RELATION ENTRE LA DURÉE DU VOL ET LA DENSITÉ MINÉRALE OSSEUSE DANS LES PILOTES DE L'AVIATION CIVILE CHINOISE*

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**Introduction:** The relationship of flight duration with bone mineral density (BMD) has been rarely investigated in civil aviation pilots. The goal of this study was to characterize the relationships of flight duration with BMD in Chinese pilots.

**Methods:** A total of 200 healthy male Chinese pilots and 180 healthy male controls were randomly selected, and were divided into four different age groups (20~, 30~, 40~ and 50~ years old). Dual-energy X-ray absorptiometry (DEXA) was used to assess the BMD of lumbar spine (L1-L4), femoral neck (FN), total hip (TH) and total body. The correlation between the age, BMI, cumulative flight hours, flight hours in the past year and BMD were analyzed by using Pearson correlation and stepwise linear regression.

**Results:** There were no significant differences in BMD at all sites except for the total body BMD in the age group of 30~ ( $1.26 \pm 0.08$  g/cm<sup>2</sup> vs  $1.21 \pm 0.09$  g/cm<sup>2</sup>,  $P=0.003$ ) between the pilots and controls. L1-L4 BMD were positively related with BMI ( $r=0.156$ ,  $P=0.028$ ). FN BMD and TH BMD were negatively related with age ( $r=-0.305$ ,  $P=0.007$ ) and cumulative flight hours ( $r=-0.256$ ,  $P=0.006$ ). Total body BMD were negatively related with BMI ( $r=-0.237$ ,  $P=0.001$ ).

**Discussion:** There was no significant difference of flight hours in the past year in BMD at all sites. Regression analyses confirmed BMI as the influencing factor for BMD at all sites, and age as the influencing factor for FN BMD. However, the cumulative flight hours and flight hours in the past year did not significantly affect BMD at all sites.

**Conclusion:** The present study demonstrated that flight duration did not affect the BMD in Chinese civil aviation pilots.

006

## STUDIES ON THE DISTINGUISHING HEROIN ABUSE FROM THE TRADITIONAL CHINESE MEDICINE PRESCRIPTIONS ADMINISTRATION

*ÉTUDES SUR LA DISTINCTION ENTRE L' 'ABUS DE HEROINE E L'ADMINISTRATION DES MÉDICAMENTS CHINOISES TRADITIONNELLES*

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**Introduction:** To help prevent accidents and injuries resulting from the use of prohibited drugs by employees who perform safety-sensitive functions in civil aviation, we conducted drugs screen testing. However, 104 kinds of Traditional Chinese Medicine prescriptions (TCMPs) contain pericarpium papaveris, which administration would cause positive results of opiates. It's a problem to distinguish opiate abuse from the TCMPs administration.

**Methods:** Among above 104 kinds of TCMPs, 47 kinds contained licorice. A strategy was proposed to compare the PK profiles of heroin and FuFangGanCaoKouFuRongYe in rats. An UPLC- MS/MS method was developed to simultaneous quantification of opium alkaloids and characteristic compounds of licorice in TCMPs and in rat specimens.

**Results:** The concentrations of opium alkaloids and characteristic compounds of licorice in 13 kinds TCMPs were detected by the UPLC-MS/MS method. Five opium alkaloids (morphine, codeine, papaverine, narcotine, and thebaine) and two characteristic compounds of licorice (glycyrrhizic acid and liquiritin) were detected in all samples. We obtained the PK profiles of heroin, opium alkaloids and characteristic compounds of licorice. The results indicated that the constituent species detected and concentration ratio of each others could provide reference for distinguishing heroin abuse from the TCMPs administration.

**Discussion:** This method provides more substantial foundation for establishment of an opiates abuse testing false positive identification system.

## STRESS AND PERIODONTAL DISEASES: A CORRELATIONAL STUDY

### *STRESS ET MALADIES PERIODONTALES: UNE ÉTUDE CORRELATIVE*

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**Introduction:** It is well known fact that psychological well-being is as important as physical well-being. The peer reviewed literature suggests a relationship between psychological status and dental attrition. This study was designed with objectives as to study the professional life stress among aircrew, the coping strategies being used, the psychological well-being of the IAF aircrew and to find the relationship between stress, coping, well-being with dental attrition.

**Material and Methods:** Study sample constituted (n=112) aircrew from two strategic forward airbases of IAF. Average age (in yrs) was  $30.27 \pm 5.89$ . The subjects were administered professional life stress scale (David Fontana, 1989); stress coping inventory (Carver et al's COPE, 1989), and psychological general well-being schedule (Harold J. Dupuy's 1984). Subjects were subjected to a dental examination simultaneously. Bruxism grading was done according to Smith and Knight Tooth Wear Index (1984). Periodontal Disease Index was also measured according to Periodontal Disease Index scale given by Ramjford (1959). Data were analyzed through SPSS-ver.11.

**Results:** Professional life stress score range was  $10.40 \pm 4.88$  (scale 0-59) suggestive of mild to moderate stress. The main coping strategy being used was problem focused coping  $58.46 \pm 8.26$  (scale 20-80). The data shows that aircrew have sound psychological well-being  $87.35 \pm 11.20$  (scale 0-110). The data suggests that aircrew has dental attrition problems, as mild degree of gingivitis  $0.87 \pm 0.87$  (scale 0-3) was present. Periodontal disease index  $1.06 \pm 0.81$  (scale 0-6) was mild to moderate, showing inflammatory gingival changes not extending around the tooth. Bruxism  $2.15 \pm 1.48$  (scale 0-4) shows loss of enamel exposing dentine for less than one third of surface.

**Conclusion:** The study shows a positive correlation amongst the variables of dental attrition, but there is no significant correlation between the stress coping strategies being used & the dental attrition.

## PROACTIVE MEDICAL DATA ANALYSIS FOR EVIDENCE BASED MEDICAL POLICIES: NAFLD IN AIRCREW

*ANALYSE DES DONNÉES MÉDICALES PROACTIVES POUR POLITIQUES MÉDICALES BASÉES SUR LES PREUVES: NAFLD IN AIRCREW*

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**Introduction:** Despite the best of preventive health care, age, lifestyle related and other disabilities do occur in aircrew and are a cause of morbidity. Once an aircrew has been detected to have a disability, the individual is provided curative treatment as deemed necessary. The aim is to return the aircrew to the cockpit as soon as possible without jeopardizing flight safety. There has been no detailed study on the spectrum of Non Alcoholic Fatty Liver Disease (NAFLD), and its impact on flying career of the aircrew. Information such as above would provide important inputs on the epidemiology of the disease and impact on aeromedical disposal policies. The study was therefore carried out to analyse the spectrum of NAFLD among aircrew in the IAF.

**Methods:** The medical records of all officers in the Indian Air Force are kept in the Dte Gen Med Services at Air HQ. Once the details of aircrew in low medical category for NAFLD were obtained electronically, information was recorded from the medical documents. The key search words in the diagnosis section of the database used were NAFLD, Fatty Liver and Abnormal LFT. An analysis of forty six aircrew with NAFLD (Non Alcoholic Fatty Liver Disease) was carried out. The following variables were analysed: Hepatomegaly on USG, SGOT, SGPT, Fatty liver on USG and Grade of fatty liver, BSL (F), Cholesterol & TGL, Overweight status & BMI, and Associated disabilities, First medical category for NAFLD and duration.

**Results and Discussion:** Results of this study will be discussed along with their implications for aeromedical decision making as well as policy making. This study, albeit with a relatively small population size, provided us with insights into a common problem being encountered in our aircrew population, its impact on flying fitness and the clinical course on follow-up.

**Conclusion:** Application of the findings along with clinical knowledge has enabled developing of evidence based data driven policies that hope to conserve trained human resources.

**009**

## **A COMPLETELY PRESERVED AVIATION MEDICINE LABORATORY FROM WW1**

*UN LABORATOIRE DE MÉDECINE AÉRONAUTIQUE DE LA PREMIÈRE GUERRE MONDIALE  
ENTIÈREMENT PRÉSERVÉ*

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Introduction: In 1994, we luckily found in a cellar all the instruments of the laboratory for the psycho-physiologic selection of pilots that was founded in 1917 by Professor Amedeo Herlitzka in the Physiology Institute of University of Torino (Italy). This lab was under the control of the Army, and in the last two years of the war more than 8700 men underwent the tests: about 6000 of them were accepted and went to the flying schools. This lab was particularly devoted to the physiologic aspects, while in the same time another similar lab was established in Padova by professor Agostino Gemelli, with a peculiar orientation for the psycho-attitudinal studies.

Background: In order to become a pilot cadet, the candidate had to pass a series of tests: the rotating chair was used to evaluate the resistance of candidate airmen to movements and accelerations similar to those experienced during the flight. The volunteer had also to demonstrate his tolerance to significant air pressure changes in a metal chamber in which a pump could recreate the conditions existing at 6.000 meters of altitude, while physiological parameters such as breathing and heartbeat were recorded. There also are two "simulators", or spatial disorientators, the oldest was built in 1917 with components of a Blériot XI aircraft and was not intended for pilots training, but for collecting measurements on the spatial sensory perception. The second simulator was made up of a pilot seat mounted on a wooden tilting frame; it was capable of more complex movements. The reaction time of aspiring aviators was evaluated, up to one thousandth of a second, with a Hipp's chronograph connected to a complex electrical circuit. An ergoesthesiometer checked the control of muscle contraction in continuously varying conditions.

Summary: The whole lab was restored and is shown in our Scientific & Technologic Archives.

**010**

## **AN INVESTIGATION ON THE EPIDEMIOLOGY AND RISK FACTORS OF SNORING IN CIVIL AVIATION PILOTS**

*UNE ENQUÊTE SUR L'EPIDEMIOLOGIE ET LES FACTEURS DE RISQUE DU RONFLEMENT DANS LES PILOTES DE L'AVIATION CIVILE*

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**Introduction:** To investigate and analyse the snoring disease incidence, moderate and severe snoring disease incidence rate, the risk factors and their relationship to daytime sleepiness among civil aviation pilots.

**Method:** Using cluster sampling method, a questionnaire survey was conducted on 1400 civil aviation pilots, and 1227 valid questionnaires were statistically analyzed. The prevalence rate of snoring and moderate and severe degree snoring and the related risk factors were calculated and analyzed. The scores obtained from Epworth sleepiness score (ESS score) between different snoring groups were compared.

**Results:** A total of 1206 male pilots and 21 female pilots were investigated. The snoring prevalence rate of male pilots was 58.9% (723/1206) and the moderate and severe degree snoring prevalence rate of male pilots was 14.6% (179/1206). None of the women pilots snores. Of male pilots over 30 years old, the snoring prevalence rate was 64.5% (402/623), and the prevalence rate of moderate and severe snoring was 19.4% (121/623). The prevalence of snoring and moderate and severe snoring increased with age and body mass index. Prevalence of snoring and moderate and severe snoring increased with the increase of smoking and alcohol consumption. Age, body mass index (BMI), neck circumference, waist circumference, smoking, drinking and family history were risk factors of snoring. Flight factors (flight route, jet lag) are the risk factors of snoring. Statistically significant differences of daytime sleepiness scores between non-snoring group and different snoring groups were found ( $F=6.126$ ,  $P<0.001$ ).

**Conclusion:** The snoring prevalence and moderate and severe snoring prevalence rate of civil aviation pilots are lower than the general population. Incidence of snoring is related to age, body mass index, neck circumference, waist circumference, smoking, drinking and family history.

## THE COMPARISON BETWEEN RESULTS OF RENAL PALPATION AND ULTRASOUND IN DETECTING NEPHROPTOSIS DURING MEDICAL SELECTION OF FLYING CADETS

*LA COMPARAISON ENTRE LES RÉSULTATS DE LA PALPATION RENALE ET DES ÉCHOGRAPHIE DANS LA DÉTECTION DE LA NEPHROPTOSE PENDANT LA SÉLECTION MÉDICALE DES CADETS*

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**Introduction:** Nephroptosis is one of the leading disqualification causes in medical selection of flying cadets for it may threaten the pilot's health, military training, and flight safety. In PLA Air Force we screen the applicants for nephroptosis by evaluating kidney size below costal arch in a standing position with renal palpation empirically. While in clinical practice, nephroptosis is confirmed by ultrasound and intravenous urography. Here we compared results of renal palpation and ultrasound in detecting nephroptosis.

**Methods:** 38 military pilot applicants whose kidney was palpable below costal arch were recruited sequentially and five subsets were defined according to the kidney size. The length kidney descended during a position change from supine to upright was recorded by ultrasound. Another age-matched 72 applicants without nephroptosis by palpation were randomly recruited, and their blood pressure, heart rate, body mass index (BMI), chest circumference and grip strength were compared with applicants with nephroptosis. The association between the degree of nephroptosis detected by palpation and ultrasound was analyzed.

**Results:** BMI ( $p < 0.01$ ) and circumference ( $p < 0.01$ ) of applicants with nephroptosis were significantly lower than those without nephroptosis, and there was no significant difference of blood pressure, heart rate and grip strength (all  $P > 0.05$ ). One-way ANOVA revealed that the length kidney descended during the position change detected by ultrasound in the five subsets were significantly different ( $p < 0.01$ ), and there was a positive correlation between the results of palpation and ultrasound ( $r = 0.698$ ,  $p < 0.01$ ). While the degree of nephroptosis detected by ultrasound had no relation with blood pressure, heart rate, BMI, chest circumference or grip strength.

**Conclusion:** The results of renal palpation upright were consistent with ultrasound in detecting nephroptosis, indicating the method of palpation is applicable. But it required experience, and should be combined with ultrasound to get more precise results.

## ANALYSIS OF INFLUENCING FACTORS OF BONE MINERAL DENSITY IN CHINESE CIVIL AVIATION PILOTS

*ANALYSE DES FACTEURS AFFECTANT LA DENSITÉ MINÉRALE OSSEUSE DANS LES PILOTES DE L'AVIATION CIVILE CHINOISE*

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**Introduction:** The influencing factors of bone mineral density (BMD) have been rarely investigated in civil aviation pilots. The study is aiming at characterizing the relationship of age, BMI, body composition and flight duration with BMD in Chinese Han civil aviation pilots.

**Methods:** A total of 200 healthy male Chinese Han pilots was randomly selected (aged 23~60 years, mean age  $37.7 \pm 10.2$  years). Dual-energy X-ray absorptiometry (DEXA) was used to assess lean mass (LM), fat mass (FM), lumbar spine (L1-L4) BMD, femoral neck (FN) BMD, total hip (TH) BMD and total body BMD. The correlation between the age, BMI, LM, FM, cumulative flight hours and BMD was analyzed by using Pearson correlation and stepwise linear regression.

**Results:** Significant correlations were identified between L1-L4 BMD and BMI ( $r=0.156$ ,  $P=0.028$ ), L1-L4 BMD and LM ( $r=0.195$ ,  $P=0.006$ ), FN BMD and age ( $r=-0.305$ ,  $P=0.001$ ), FN BMD and BMI ( $r=-0.256$ ,  $P=0.001$ ), Total body BMD and LM ( $r=0.349$ ,  $P=0.001$ ). Regression analyses demonstrated age as the influencing factor for FN BMD, FM for FN BMD and TH BMD, BMI and LM for BMD at all sites except for L1-L4 BMD. However, the cumulative flight hours did not significantly affect BMD at all sites.

**Conclusions:** The present study demonstrated that FM had negative association with FN and TH BMD, BMI and LM had positive associations in the FN, TH and total body BMD, whereas flight duration did not affect the BMD in Chinese Han civil aviation pilots.

## TUBERCULOSIS AMONG CREW MEMBER, CASE REPORT AND REVIEW FROM LITERATURE

*TUBERCULOSE ENTRE MEMBRE DE L'ÉQUIPAGE A BORD RAPPORT DE CAS ET EXAMEN DE LA LITTÉRATURE*

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Background: Literature data concerning risk assessment of tuberculosis transmission on aircraft are highly variable; no strong evidence have been produced so far in favour of an higher risk of infection. Only few cases have been positively correlated to inflight transmission; in this regard risk assessment guidelines for infectious diseases transmitted on aircraft establishes that contact tracing should only be limited to particular cases that fulfill specific condition and exclusively to passengers sitting nearby in accordance with WHO guidelines.

Case: In this paper we report the case of an infectious crew member who came to the emergency room for long standing history of cough and weight loss, not responsive to antibiotics without reference of emottisis. She underwent chest Xray and CTscan which showed solitary cavitation in the lower right lung, associated to miliary and centrilobular nodules. Meanwhile sputum smear microscopy and mycobacterial culture confirmed the presence of typical Mycobacterium Tuberculosis. The patient was offered anti-tuberculosis therapy and was immediately hospitalized with respiratory isolation. CT scan 2 months later showed good reduction of the lung lesions and negative mycobacterial culture was obtained on sputum smear microscopy.

Because of the decrease in medical fitness, the patient underwent an additional medical examinations at the military aerospace medical institution which assessed a temporary denial of flying licence lasting 60 days, in agreement with the common knowledge that patients with confirmed infectious pulmonary TB should avoid air travel unless strictly unavoidable, in which case each condition should be assessed using national guidelines. The following medical evaluation assessed the patient as fit for her cabin crew duties. According to the data literature, contact tracing in this circumstance should only be limited to crew members if there is positive history of long standing flight (>8 hours) and if there is evidence of infection to household or other close contacts; however, for statistical use, transmission on ground could not be excluded.

## **OBSERVATIONAL STUDY: PREVALENCE OF ODONTOSTOMATOLOGICAL DISEASES DIAGNOSED BY PANORAMIC RADIOGRAPH IN PILOTS AND FLIGHT CREW MEMBERS OF ITALIAN ARMED FORCES**

*ÉTUDE OBSERVATIONNELLE: PRÉVALENCE DE MALADIES ODONTOSTOMATOLOGIQUES DIAGNOSTIQUÉES PAR RADIOGRAPHIE PANORAMIQUE DANS LES PILOTES ET MEMBRES D'ÉQUIPAGE DE VOL DES FORCES ARMÉES ITALIENNES*

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**Introduction:** According to national laws (COM D. Lgs. 15 marzo 2010, n. 66-art.150; TUOM DPR 15 marzo, n. 90- art. 583 e seguenti; SMA-ORD-015), pilots and flight crew members should undergo panoramic radiograph (OPTX) in order to assess fitness to fly. In literature there are no observational studies regarding odontostomatological diseases among healthy adults. The aim of this study is to evaluate the prevalence of odontotomatological diseases detectable on panoramic radiographs in a large group of healthy adult subjects.

**Materials and Methods:** We retrospectively evaluated 3900 panoramic radiographs and corresponding reports, performed from August 2014 to August 2016 in a group among Active Duty military personnel ranging in age from 18 to 64 years (average 40.7). As statistical analysis we assessed the prevalence of most common anomalies (dysodontiasis, lytic lesions, sclerotic lesions, periodontitis).

**Results:** Dysodontiasis was founded in 180/3900 subjects (prevalence 4,6%), perodontitis was found in 107/3900 subjects (prevalence 2,7 %); 11/3900 subjects showed both conditions (prevalence 0.2%). Focal opacity and transparency were found respectively in 148/3900 subjects (prevalence 3.8%) and in 471/3900 (prevalence 9.5%).

**Conclusion:** According to OPTX analysis, this observational study demonstrates that odontostomatological diseases occur in 20.6% of pilots and flight crew members among Italian Armed Forces. In light of the relatively high prevalence of detected anomalies, OPTX execution in military personnel has proved to be not only a medicolegal necessity, but also a clinical and therapeutic opportunity, whose consequences may be further investigated in terms of clinical outcome in long term studies.

## SLEEP APNEA SYNDROME IN AVIATION: EVALUATION, TREATMENT AND IMPLICATION FOR FLIGHT SAFETY

*SYNDROME DE L'APNEA DE SOMME EN AVIATION: ÉVALUATION, TRAITEMENT ET IMPLICATIONS POUR LA SÉCURITÉ DU VOL*

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Background: Obstructive sleep apnea syndrome (OSA) is a sleep disorder characterized by pauses in breathing periods or periods of shallow breathing during sleep. Each pause can last for a few seconds to several minutes for many times a night. This could imply sleepiness and reduced vigilance during day time. There has been in the latter years a remarkable increased prevalence of the syndrome up to the 6% of general population and some risk factor such as male gender, obesity, age above forty, large neck size, deviated septum, gastric esophageal reflux, family history have been clearly recognized.

Cases: We have recently observed 2 cases: a 1st and a 2nd class pilot. Both cases underwent a polysomnography study.

The first patient was affected by positional sleep apnea (AHI= 18.3, AHI in supine position= 46.9). The patient started with a treatment of positional therapy by the Night Shift device. Worn on the back of the neck, Night Shift begins to vibrate when the patients start to back-sleep. The vibration slowly increases in intensity until the patient changes positions. In the observational 2-month period in our patient, the mean AHI with the device was 3.9 (mean percentage of time in supine position < 1% of the total sleep time).

The second patient was affected by moderate OSA (AHI= 30.7). The patient started with CPAP treatment and for monitoring CPAP adherence a web-based telemedicine system was used. In a 6-month period, the mean daily use of CPAP was 5.8 hours, and the mean residual AHI was 5.6.

Conclusions: It's reasonable to investigate OSA in commercial aviation. In patients treated with CPAP, telemonitoring may improve the compliance of the therapy. This aspect is not trivial in pilots affected by OSA, since there is evidence that sleep-related intermittent hypoxia is significantly associated with decreased psychomotor vigilance.

**016**

**A QUALITATIVE ANALYSIS OF THE NYSTAGMUS EVOKED BY CROSS-COUPLED HEAD ACCELERATION (CORIOLIS PHENOMENON)**

*UNE ANALYSE QUALITATIVE DU NYSTAGMUS PRODUIT PAR LA CROSS-COUPLED ACCELERATION DE LA TETE (PHENOMENE DE CORIOLIS)*

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**Introduction:** Motion Sickness and Spatial Disorientation represent two outstanding challenges in aviation medicine. In both cases, the vestibular system plays a fundamental role in their genesis. One of the most common ground-based simulations utilized in aerophysiological training is the sense of vertigo and tilt generated by the cross-coupled stimulation of the semicircular canals, while exposed to rotation in the yaw axis. However, the complex stimulus induced on the two labyrinths by this maneuver still deserves some investigation.

**Methods:** 8 male subjects sitting on a rotatory chair were asked to tilt their head back and forth during a yaw-axis clock- (CW) or counter-clock-wise (CCW) rotation at a constant speed of 70°/sec. Their eye movements were recorded via Video-OculoScopy (VOS) and qualitatively analyzed. A second camera simultaneously recorded the subject's and chair's movements. The observed Nystagmus (Ny) was then analyzed and related to the actual head/chair position and motion.

**Results:** A clear relationship was detected between Ny, head movements, and direction of chair rotation. During CW rotation, backward head tilts systematically induced a CW-Ny. On the contrary, a CCW-Ny was observed while returning to the upright position, or during forward head tilt. Opposite patterns were detected during CCW chair rotation. Minor lateral eye movements were also observed, due to the activation of horizontal semicircular canals.

**Conclusions:** Due to the neural connections between extra-ocular muscles and each labyrinth sensor, the semicircular canals involved in the genesis of the Ny during this form of stimulation could be identified. In agreement with the third Ewald's law, our results indicated a dominant left labyrinth during backward tilt and CW motion, or forward tilt and CCW rotation. On the contrary, during forward tilt and CW rotation, or backward tilt and CCW rotation, the right vertical canals showed a stronger contribution to ocular response.

## PREVALENCE OF SPINAL ABNORMALITIES ON MAGNETIC RESONANCE IMAGING IN ASYMPTOMATIC YOUNG ADULTS (18-21 YRS) MILITARY PILOT CANDIDATES

*PRÉVALENCE DES ANOMALIES DE LA COLONNE VERTÉBRALE SUR L'IMAGERIE PAR RÉSONANCE MAGNÉTIQUE CHEZ LES JEUNES ADULTES ASYMPTOMATIQUES (18-21 ANS) CANDIDATS COMME PILOTES MILITAIRES*

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Introduction: It is important to assess the prevalence of spinal MR imaging findings in asymptomatic young military pilot candidates.

Materials and Methods: 275 asymptomatic Air Force Flight candidates (266 M, 9 F, age range 18-21 years) underwent MRI of the spine (cervical, thoracic and lumbosacral tracts) between July 2013 and July 2016. All the examinations were performed with a 3 T MR scanner using a phased array surface coil. Sagittal T1 (TR/TE= 500/15), sagittal T2 (TR/TE=3000/80), axial T2 (TR/TE=3000/80) and sagittal turbo short tau inversion recovery (STIR, TR/TE=2500/40) pulse sequences were obtained for spinal examination.

Results: 34 candidates (12%) had no spinal MR abnormalities. 19 cadets (7%) showed disc extrusion while 53 (19%) had disc protrusion, with the lumbar column being the most involved tract (57% of disc protrusions and 75% of disc extrusions). There was no disc sequestration. Disc bulging was found in 141 cadets (51%). 41 candidates presented low grade intervertebral spondylosis and of these 13 also had facet joints spondylosis. There were 4 cases of grade 1 spondylolisthesis (2% of cadets). A vertebral fracture was observed in 2 cadets.

Conclusions: the high rate of MR spinal abnormalities detected in asymptomatic subjects demands reconsideration of a pathomorphology-based explanation of back pain and has to be carefully evaluated in healthy subject candidates to be military pilots, in order to prevent the onset of neck and/or back pain related to the exposition at high acceleration forces.

## **BREASTFEEDING, CABIN CREW WOMEN AND EU AERONAUTICAL SAFETY: AN AIRLINE COMPANY MANAGEMENT PROBLEM**

*ALLAITEMENT, FEMMES ÉQUIPAGE DE CABINE ET SÉCURITÉ AÉRIENNE DE L' UNION EUROPÉENNE : UN PROBLÈME ORGANISATIONNEL DES COMPAGNIES AÉRIENNES*

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Background: Breastfeeding is a human right strongly guaranteed by the EU and WHO. EU women are protected by two EU Directives (92/85/CEE and 89/391/CEE). The EU Commission wrote a guideline (COM/2000/0466) that explains measures to protect female worker from professional risks during breastfeeding. EU guidelines and Bristol employment tribunal underline a cabin crew member has to freely and safely choice to breastfeed or not.

Case: An E.A.S.A. Cabin Crew member on breastfeeding has requested AME renewal of her medical report. Her child was in exclusive breastfeeding and she had a plan to follow her child's weaning up to 2yrs old. She was advised that there are some risks to develop mastitis, and if she doesn't empty regularly her breasts she could occur in mastitis.

A special medical report with 2 limitations has been issued:

TML (Time limit limitation of medical report): up to 24 month old of her baby

SSL (Special restrictions as indicate): Duty shorter 8 hour shifts.

She has been informed if she will cease to breastfeed before her child is 2 years old, she has to do a new medical report without these 2 limitations.

Discussion: An airline company not only has to recognize risks of a mother on breastfeeding but companies have to promote breastfeeding, finding effective solutions to help mothers. We suggest to apply 2 limitations to E.A.S.A. Cabin Crew Medical Report: a time limitation linked to baby's age and a SSL limitation that specify how many hours a woman have to rest to breastfeed or to store her milk in a safe way.

Conclusion: Solutions are needed that defend interests of all subjects: airline companies and cabin crew mothers.

## ACQUISITION AND ANALYSIS OF NECK EMG SIGNALS FOR SUBVOCAL SPEECH RECOGNITION

*ACQUISITION ET ANALYSE DES EMG SIGNAUX DU COU POUR LE RECONNAISSANCE DE L'ÉLOCUTION SUBVOCAL*

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**Introduction:** Subvocal speech recognition (SSR) might give hope to people with certain speech disabilities. Modern technologies allow the building of virtual prostheses for human beings without vocal folds. The SSR is also valuable where secure communication needed during war, hazardous materials management operations, space extravehicular activity, crowded and high privacy environment. The SSR also play great role during medical speech impairment. Therefore, SSR has been assessed using electromyography (EMG) signals from neck surface area.

**Methods:** Two pairs of self-adhesive Ag/AgCl electrodes were placed on the neck surface area of throat. Dimension of electrode is 4.5 X 3 cm including the foam and adhesive gel with conducting area of a circle with diameter of 0.75 cm. The electrodes were connected to NeXus-4 (4 channel 24 bit ADC physiological data acquisition) which has inbuilt bluetooth module. Bio Trace+ software was loaded into HP laptop based Intel processor i-5 which has also built-in Bluetooth module. The NeXus-4 and laptop are switched on and paired each other. The EMG signals were recorded on 21 subjects (13 males and 8 females) with age variation from 19 years to 35 years. The 8 set of control words were spoken by each subject and thereafter EMG signals recorded for each word for 30 seconds. The recorded data were analyzed using MATLAB. A parametric approach of spectral estimation employed to estimate autoregressive parameters (AR) by employing Burg's algorithm. Time and frequency based features extracted from recorded EMG signals.

**Results:** The AR parameters were extracted from EMG signals using Burg's algorithm. Average accuracy rate of subvocal speech recognition is 82.6% for pronounced control words.

**Conclusion:** The AR model proved as best suited for speech recognition with information interpreting subvocal EMG signal into speech or text. Application may include command inputs for automatic wheel chair. Further, the SSR may also be useful for astronauts exploring various applications in the space.

## HYPERTENSION IN AIRCREW: IMPLICATIONS FOR PREVENTIVE STRATEGIES

*HYPERTENSION ARTERIELLE DANS LE PERSONNELLE DU VOL :IMPLICATIONS POUR LES STRATÉGIES DE PRÉVENTION*

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**Introduction:** Hypertension is a leading cause of morbidity among Air Warriors, including aircrew. An understanding of the epidemiology and risk factor profile is essential for designing evidence-based prevention programmes. Additionally, knowledge about presence of other cardiovascular risk factors in cases of hypertension can provide insight into prevention of coronary events. At present, this information is not available for aircrew of the IAF.

**Methods:** This study was carried out at the Dte Gen Medical Services to understand the epidemiological and risk factor profile of aircrew with hypertension in the IAF. Medical records were retrieved from our electronic medical database to collect relevant information on pre-designed formats.

**Results:** The search resulted in 79 aircrew with hypertension. The number of aircrew with hypertension was similar from the Fighter/ Transport/Helicopter stream. The mean age of onset/ detection of Hypertension was 40.5, 42.3 & 39.9 years for Fighter, Transport and helicopter aircrew, respectively. The differences were not statistically significant. The BMI at the time of detection of hypertension ranged from 24.9 for Fighter and 25.12 for Helicopter aircrew. There was no difference between mean years of service put in at the time of detection of hypertension. Majority of the aircrew were asymptomatic at the time of detection and were detected during routine medical examination. Family history of hypertension was present in eighteen aircrew. Other variables analysed include family history of coronary artery disease, smoking, alcohol intake, symptoms, bio-chemical parameters as well as presence of co-morbid diseases. An analysis of presence of coronary artery disease risk factors was also carried out.

**Conclusion:** The study provides insights into the epidemiological profile of hypertension among aircrew in the IAF. It also provides leads for primary prevention of the disease as well as prevention of coronary events.

## **AIRWAY MULTIDIRECTIONAL SYSTEM - OPEN VIEW: AN INNOVATIVE CONCEPT OF VIDEOLARYNGOSCOPE FOR ORO-TRACHEAL INTUBATION IN MEDEVAC AND BIO-MEDEVAC ENVIRONMENT**

*AIRWAY MULTIDIRECTIONAL SYSTEM - OPEN VIEW UN ORIGINAL CONCEPT DE VIDEOLARYNGOSCOPE POUR L'INTUBATION ORO-TRACHÉALE DANS LE CONTEXT DE MEDEVAC ET DE BIO-MEDEVAC*

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**Introduction:** Nowadays we have seen an important implementation of the devices that enable to perform the oro-tracheal intubation when the traditional technique cannot be applied, due to the patient's anatomy, or to difficult situational factors (such as those that may be observed within a bio-medevac context). The microcamera embedded at the tip of the laryngoscope blade enables the operator to perform an oro-tracheal intubation also in a non-conventional environment. According to the specific features of the video-laryngoscope blade, we can distinguish the "tunneled video-laryngoscope" from the "non-tunneled one."

**Method:** A new type of video-laryngoscope (Airway Multidirectional System - Open View: AMS-OV) was developed, in which two types of blade, tunneled e non-tunneled, were simultaneously available. We also tested a "tunneled video-laryngoscope (Airtraq)," and a "non-tunneled" one (APA Video Laryngoscope)" with a Laerdal manikin simulating a high difficult airway condition, in order to compare our prototype with the two other kinds of video-laryngoscope.

**Results:** The non-tunneled video-laryngoscopes allow operators to shape the endotracheal tube according to the ideal curve for each specific patient. This flexibility of use requires remarkably skilled operators, who are well trained in shaping the tube by means of a potentially traumatic stylet. On the other hand, tunneled video-laryngoscopes are more straightforward to use. In this case, a channel parallel to the blade guides the endotracheal tube, thereby releasing the operator from the need of the stylet. However, this increased user-friendliness inevitably compromises flexibility in that the channel prevents the device from adapting to the patient's anatomy. In our investigation, AMS-OV performed an easy oro-tracheal intubation, combining simultaneously and dynamically the two different features of the other systems.

**Conclusion:** AMS-OV seems to offer the advantages of non-tunneled video-laryngoscopes without losing the flexibility of the tunneled ones.

## PREVALENCE OF MEDICAL CONDITIONS IN APPLICANTS FOR EASA MEDICAL CERTIFICATE

### *PREVALENCE DES CONDITIONS MÉDICALES DANS LES DEMANDEURS DE CERTIFICATS MÉDICAL D'EASA*

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**Introduction:** The major aim of medical investigation in applicants for EASA medical certificate is to rule out any condition potentially at risk of acute incapacitation. This leads to a special concern in candidates at the initial visit, whose medical history is unknown. In 2015 the Italian CAA issued a change in the protocol that now includes a psychiatric and psychological evaluation at the initial visits of Class 1 and 3. It was made to improve the predictivity of the visit with special attention to self-harm behavior, since it could possibly have catastrophic consequences in flight.

**Methods:** The local database of initial visits made in our AeMC from 2014 to 2016 was analyzed.

**Results:** A total of 1231 individual record were reviewed: 1075 (87.0%) were certified and 156 (12.7%) were declared unfit. The highest prevalence was observed for eye & visual conditions (mean 30.0%), while psychiatric and psychological conditions increased from 0.3% in 2014 to 7.8% in 2016. In 2016, the psychiatric disorders overtook the visual defects as major cause of certification denial (59.1% vs. 36.4%,  $p < 0.01$ ).

**Conclusion:** The major finding of this study was the higher proportion of eye and visual conditions among applicants for aeromedical certification at the initial visit. This was expected, as visual defects of mild entity are often unknown. Moreover, the proportion of psychiatric and psychological conditions increased in 2016 compared with 2014, corresponding to a significant increase of certification denial, due to the implementation of a dedicated psychiatric evaluation in the protocol.

## AN ANALYSIS OF MEDICAL CONDITIONS IMPACTING FITNESS IN FEMALE AIRCREW OF THE INDIAN AIR FORCE

*UNE ANALYSE DES CONDITIONS MÉDICALES IMPACTANT L'APTITUDE À L'AÉRONEF FEMME DE LA FORCE AÉRIENNE INDIENNE*

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**Introduction:** Currently, women are employed only in the officer cadre of the Indian Armed Forces. Studies on health issues impacting female military aircrew in developing countries are practically nonexistent. The aim of this study was to analyse various medical conditions occurring in serving female aircrew of the Indian Air Force (IAF) in comparison with those in female ground duty (GD) and male aircrew officers.

**Methods:** This cross sectional study involved analysis of computerised medical data and medical records of serving women aircrew, women ground duty officers and male aircrew of the IAF, from Oct 2015 to Jan 2016 . Records of a total of 108 women aircrew were analyzed. Amongst these, 93 were from the Transport and Helicopter stream and 15 were from the Navigator stream. These were then compared with trends in female ground duty and male aircrew officers. The data was statistically analysed.

**Results:** Higher percentage of female aircrew were in low medical category (classification) as compared to male aircrew officers of the same age group i.e. 20 to 40 years. The difference was statistically significant ( $p=0.0015$ ). However, the difference between low medical category female aircrew and female ground duty officers was statistically not significant ( $p=0.121$ ). The leading cause of medical unfitness in women officers was pregnancy followed by diseases due to endocrine causes.

**Conclusion:** This study highlights a significant difference in medical fitness of female aircrew viz a viz male aircrew in the age group of 20 to 40 years. Continuing trend analysis is essential to understand health issues amongst female aircrew so as to enable their optimum utilisation.

## RISK FACTORS FOR CULPRIT CORONARY PLAQUE IN CIVIL AVIATION PILOTS WITH CORONARY ARTERY DISEASE

*FACTEURS DE RISQUE POUR LA PLAQUE CORONAIRE CULPABILITÉ DANS LES PILOTES D'AVIATION CIVILE AVEC UNE MALADIE CARDIAQUE CORONAIRE*

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**Introduction:** Culprit coronary plaques are responsible for the majority of major adverse cardiac events in patients with coronary artery disease (CAD). The study was aimed to identify the risk factors for culprit plaque in civil aviation pilots with CAD.

**Methods:** This study consisted of 105 civil aviation pilots admitted to Civil Aviation General Hospital from January 2013 to April 2017 and underwent intravascular ultrasound (IVUS). Based on the culprit plaque determined by virtual histology-IVUS, patients were divided into: non-culprit plaque group (n = 58) and culprit plaque group (n = 47). Baseline characteristics and biomarkers were compared between the two groups.

**Results:** (1) Monocyte to lymphocyte ratio (MLR), fasting blood glucose (FBG), low density lipoproteins (LDL) and high-sensitivity C-reactive protein (hs-CRP) were significantly higher in the culprit plaque group (P = 3.105, P = 0.025), FBG (OR = 2.967, P = 0.032), LDL (OR = 1.724, P = 0.047) and hs-CRP (OR = 3.243, P = 0.029) were independent risk factors of culprit plaque. (2) MLR (r = 0.426, P = 0.015), FBG (r = 0.351, P = 0.024), LDL (r = 0.310, P < 0.001), and hs-CRP (r = 0.475, P = 0.032) were positively correlated with the percentage of the plaque component necrotic core, respectively. (3) By ROC curves analysis, a MLR of 0.26 (70.1% sensitivity, 75.3% specificity), a FBG of 6.33 mmol/L (65.7% sensitivity, 68.2% specificity), a LDL of 2.47 mmol/L (63.9% sensitivity, 67.3% specificity), and a hs-CRP of 4.58 mg/L (71.7% sensitivity, 67.3% specificity) were found as threshold values in detecting the culprit plaque.

**Conclusions:** MLR, FBG, LDL and hs-CRP were independent risk factors for the culprit plaque in civil aviation pilots with CAD, which would be helpful in diagnosis and treatment of culprit coronary plaques.

## PREVALENCE OF MUSCULOSKELETAL DISORDERS AMONG F-15 AIRCREWS

*LA PREVALENCE DES AFFECTIONS MUSCOLOSQUELETTIQUES CHEZ LE PERSONNELLE NAVIGANT DU F-15*

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**Introduction:** Lower back pain (LBP) is one of the most common musculoskeletal symptoms among fast jet aircrew aircrews. This study aimed to determine the prevalence and the effects of LBP among F-15 aircrew. Fighter pilots frequently report neck pain and injury, and although risk factors have been suggested, the relationships between risk factors and neck pain have not been quantified. The aim of this study was to identify personal and work behaviors that are significantly associated with neck pain in fighter pilots.

**Methods:** This cross-sectional study was conducted in a fighter squadron. The study included only active F-15 aircrews. A survey was sent to F-15 aircrews selected participants to be filled and completed. Both descriptive and inferential tests were reported. IBM SPSS version 21 will be used for analysis of the collected data. A  $P < 0.05$  was identified as statistically significant for all the tests. Fighter pilots were surveyed about their flying experience, neck pain prevalence, and prevention.

**Results:** In-flight low back pain was very common, yet positively associated with flight hours and high demand missions. The duration pilots were considered temporarily medically unfit for flying was positively associated with pilot age and their weekly flying hours.

**Discussion:** Flying-related complaints are a major issue facing aircrews and air forces worldwide. It varies according to the type of aircraft and mission. LBP is a common problem that many aircrews suffer from. It is recommended to conduct further research to study the burden of this problem in different aspects, such as psychological and social. The risk factors identified by the current study should guide low back and neck pain prevention for fighter pilots.

## FEATURES OF MEDICAL EXAMINATION OF PILOTS' MENTAL HEALTH BY CENTRAL FLIGHT EXPERT MEDICAL COMMISSION (CFEMC)

*CARACTÉRISTIQUES DE L'EXAMEN MÉDICAL DE LA SANTÉ MENTALE DES PILOTES PAR COMMISSION CENTRAL D'EXPERTS MÉDICAUX DE VOL*

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**Introduction:** Nowadays civil aviation pilots are expected to have not only piloting capabilities but also a range of expertise and skills, which allow operating an aircraft and interacting with crewmembers with an optimum level of safety. Since avionics become automatic and computerized pilots responsibilities indispensably change. The requirements concerning their personal and professional features rise together.

**Methods:** Since 2013 CFEMC at CCHCA has performed survey of 1115 aviation personnel where 634 persons were 40-65 years old (including 410 persons aged 50-60). The analysis of "Manual of psychological recommendations on selection, training and professional development of aircrew members and air traffic controllers within The Russian Federation" identifies standard approved mental fitness tests as to be applied for medical certification. They can be divided into: (1) Assessing personal psychological features, and (2) Assessing higher mental functions and cognitive skills. Personal features are tested with such methods as: standard method of personality assessment, method of color choices, method of portrait choices. Standard mental status examination include the following tests: Landolt's test, working memory test, "Compass" test of comprehensive capability, reaction on moving subject, and "Labyrinth."

**Results:** Summarizing the results of cognitive processes and functions of the examined persons, there were 70% of those (even aged ones) who pass all the tests not less than average key level. The decrease is usually observed when being tested of visual-motor coordination and reaction speed. Those capabilities are more vulnerable and less trained.

**Conclusion:** Civil aviation pilots face high flight intensity in specific environment (altitude, weather conditions, time zone logging, tough rosters and psycho emotional pressure). And where meeting all those requirements could be a challenging task for a pilot, the medical practitioners need to exercise highly professional skills to provide reliable assessment. However, the results of mental examination of the pilots in CFEMC cannot be applied to any other medical commissions. CFEMC is the very last decisive stage of proficiency tests and it puts a lot of pressure to the aviation personnel.

## PRELIMINARY INVESTIGATION OF AGE AND DAMAGE/INJURY IN COMMERCIAL AVIATION, 1982-2014

*RECHERCHES PRÉLIMINAIRES SUR LE RAPPORT ENTRE L'ÂGE DES PILOTES ET LES DOMMAGES MATÉRIELS/CORPORELS DANS L'AVIATION COMMERCIALE, 1982-2014*

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**Introduction:** The AGE60 rule requires mandatory retirement at age 60 of commercial airline pilots. Pilots have for many years challenged the rule as arbitrary and discriminatory. The question is at what age is aviation safety adversely affected. The answer is not clear and is different from pilot to pilot, so setting a standard age is an arbitrary exercise.

**Methods:** This study utilized the NTSB database from 1982 to 2014 for commercial operations to see if there is any decrease in aviation safety due to age. There were 7,203 valid records in the database. Male pilots, at 97.4%, had a mean age of 41.75 years (SD=10.88). Female pilots, at 2.6%, had a mean age of 43.51 (SD=9.71). Ages were significantly different,  $t(7009)=8.76, p<.001$ . The average number of flying hours for all pilots was 8078.46 (SD=6208.39,  $sk=5.197$ ). For male pilots, average flight hours were 8167.13 and for female pilots, 9692.33. This was a significant difference (Mann-Whitney U  $<.001$ ).

Damage levels of none, minor, substantial, and destroyed produced a significant difference by age,  $F(3, 7197)=40.558, p<.001$ . All levels were significantly different with the exception of none and minor. Age decreased across the levels of damage from an average of 43.38 for none to an average of 39.76 for destroyed. The highest level for damage was substantial, making up 47.26% of reports and with an average age of 40.75.

Injury levels of none, minor, serious, and fatal, produced a significant difference by age,  $F(3,7193)=10.332, p<.001$ . Serious and fatal injuries were significantly different from each other. Fatal injuries were not significantly different from none though serious injuries were. Average age increased from a mean age across none and minor of 41.62 to 43.07 for serious injuries, then dropped to 40.65 for fatal injuries.

## HEART RHYTHM MODIFICATIONS IN FIGHTER JET PILOTS: AN EARLY SIGN OF CARDIAC DISEASE? ROLE OF MRI SCAN AS A SECOND LEVEL DIAGNOSTIC TOOL IN CARDIOLOGY

*MODIFICATIONS DE LE RYTHME CARDIAQUE AU COMBAT JET PILOTES: UN SIGNE PRECOCE DE MALADIE CARDIAQUES? RÔLE DE IRM COMME DEUXIÈME OUTIL DIAGNOSTIQUE EN CARDIOLOGIE*

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**Methods:** From 1 January 2016 through 31 May 2017 we performed 154 cardiologic evaluations exclusively in 112 asymptomatic male Air Force Military jet pilots of high performance aircraft based on surface electrocardiogram and stress test ECG. The global (n=112) average age was  $40\pm 9$  years. Height was  $177.98\pm 5.02$  cm, BMI  $24.95\pm 2.41$  Kg/m<sup>2</sup>, PAs  $121.21\pm 11.01$ , PAd  $78,35\pm 5.75$ . All underwent maximal Bruce protocol stress test which was negative for cardiac ischemia. In 14/112 (12,5%) some asymptomatic alteration of cardiac rhythm were observed either during the test or during resting ECG; in 1/14 alteration of cardiac rhythm were observed in high G-force training in human centrifuge. We observed in 13/14 ventricular ectopy (VE) (92,8%), in 1/14 marked sinus bradycardia VE was considered sparse if unifocal VE suppressed if unifocal VE were lower during exercise (n=6/14 42,8%). With sparse VE or VE suppressed by exercise echocardiogram and speckle tracking echo were negative and we decided for no further examination. The remaining patients underwent a MRI scan.

**Discussion:** Average MR left ventricular ejection fraction was  $54,4\pm 5,2$ , left ventricular end diastolic vol index was  $90,2\pm 16,6$ . In 3/6 MRI showed a normal heart with no pathologic sign and no late enhancement. In 1/6 MRI showed late enhancement related to a possible post- myocarditis pattern, in 2/3 of the patients MRI showed abnormalities of the coronary arteries, in one patient an intramyocardial tract of the left coronary artery, and in the second patient a long stenosis of 50% in the left coronary artery confirmed by angiography.

**Conclusion:** These abnormalities even if could be acceptable in common patients, may represent a possible risk in high-G environment and required some restrictions in fitness to fly.

## DELAYED ENHANCEMENT IN MRI SCAN: ROLE IN AEROMEDICAL DECISIONS

*IRM CARDIAQUE AVEC REHAUSSEMENT TARDIF: RÔLE DANS LES DÉCISIONS  
AEROMEDICAL*

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**Introduction:** The use of Magnetic Resonance (MR) for diagnosis of cardiac diseases is expanding. Delayed Myocardial Enhancement (DME) MR imaging is important to recognize fibrous tissue in a variety of cardiac disorders ranging from myocardial infarction to congenital or genetic pathologic conditions. MR in cardiac aeromedical examinations represent a second level diagnostic tool when electrocardiogram or echocardiogram are not sufficiently reliable as non-invasive tests.

**Methods:** We present an overview of DME findings in 8 male subjects. From July 2014 to July 2016 between 1164 cardiologic evaluation, a MR scan was asked as a second level diagnostic tool in 41 male subjects; 8/41 (19.5%) presented DME.

**Results:** The average age was  $51.03 \pm 12.42$  years, BMI was  $26.42 \pm 2.53$ , PAs  $131.2 \pm 12.1$  mmHg, PAd  $81.9 \pm 4.5$  mmHg. Average MR left ventricular ejection fraction was  $52.6 \pm 10.3$ , left ventricular end diastolic vol index was  $90.6 \pm 18.6$ . Prevalent clinical findings included ventricular arrhythmias in 4/8 patients (50%), ECG ischemic patterns in 3/8 cases (37.5%), Left Bundle Branch Block in 1/8 cases (12.5%). In one patient the arrhythmic episodes occurred during centrifuge training and required discontinuing the training activity.

**Conclusion:** We would like to emphasize that DME in asymptomatic subjects led to diagnosis of peculiar relevance for flight safety.

**030**

**PREDICTORS OF FATIGUE AND PERFORMANCE IN HIGH-PERFORMANCE AIRCRAFT SORTIES**

*PREDICTEURS DE FATIGUE ET PERFORMANCE EN SORTIES D'AVIONS D'HAUTE PERFORMANCE*

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**Introduction:** In 2014, the 711th Human Performance Wing conducted the High-Performance Aircraft Respiratory Study (HPARS) to assess respiratory symptoms among fighter pilots. Initial results have previously been reported; no definitive conclusions were drawn from the initial analysis. In an effort to further understand the data, this effort examined predictors of fatigue and sortie performance using modern machine learning techniques.

**Methods:** Data were collected from 235 pilots over a 1 month period for five flying squadrons: one F-15E, one F-16, one T-38, and two F-22 squadrons. Data collected consisted of demographic information, environmental and breath sampling, and a prospective questionnaire after each sortie. Learning algorithms were used to assess the statistical relationships between the collected features and the target variables fatigue and sortie performance, which were self-reported on a 0-9 rating scale; cross-validation was used to assess model performance. As an occupational assessment, this study did not require Institutional Review Board approval.

**Results:** The distribution of fatigue and performance scores was asymmetrical. The median of the self-reported fatigue values was 4, and the median sortie performance was 5. Roughly 44% of the variability in fatigue could be explained by various fitness and g-force related features. Only 21% of the variability in sortie performance could be accounted for; the biggest contributors were rank (higher ranks were associated with higher sortie performance) and fitness level.

**Discussion:** Preliminary findings from the study were briefed to the U.S. Air Force Air Combat Command in early 2015. The results of the current analysis contribute to a deeper understanding of risk factors for fatigue and poor sortie performance. These findings inform further study with additional fighter squadrons; this work has been proposed. A future study with additional fighter squadrons and features (e.g., sleep habits) has been proposed to address the remaining knowledge gaps.

## HEART RATE VARIABILITY DURING SIMULATED FLIGHT

### *LA VARIABILITÉ DE FRÉQUENCE CARDIAQUE PENDANT LE VOL SIMULÉE*

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**Introduction:** The effects of stress on human behavior and performance have been well recognized. The pilots are under high task demands also during real and simulated flight. Thus, aircraft piloting requires a high level of the cognitive functioning associated with various stress factors. Such conditions affect the activity of the autonomic nervous system (ANS). The purpose of the present study was to analyze the status of sympathovagal balance during simulated flight tasks.

**Material and Methods:** 24 candidates to Polish Air Force Academy were performed simulated flight tasks (SFT) on Hyperion Simulator. All of them had ECG monitoring in order to evaluate heart rate (HR) and the autonomic activity with frequency domain analysis (heart rate variability - HRV).

**Results:** There were significant differences ( $p < 0.05$ ) between resting HR and during SFT - 77.8 vs. 81.9. Furthermore, throughout SFT we noticed significant reduction of parasympathetic activity (high frequency component of HRV - HF) - 334.5 vs 393.0 and also sympathetic activity (low frequency component of HRV - LF) - 959.7 vs. 1313.8. Moreover, SFT did not affect the low frequency to high frequency ratio (LF/HF).

**Conclusion:** The autonomic nervous system strives to maintain the dynamic balance between parasympathetic and sympathetic activity for optimal performance of tasks involving cognitive and executive functions.

## SPATIAL ORIENTATION AND DIRECTIONAL JUDGMENTS IN PILOTS VS. NON-PILOTS

*COMPETENCES DE NAVIGATION ET JUGEMENTS DIRECTIONNELS CHEZ LE PILOTS ET LE NON-PILOTS*

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**Introduction:** Reading a map requires judgments about position in a large-scale space from information presented in a small scale representation (Bluestein and Acredolo, 1979). Generally, individuals are more accurate and faster in making judgments when the "up" direction on the map is the same as the "forward" direction in the environment, that is when a map is aligned with the perspective of the spatial layout they had learned (alignment effect). Nori and Giusberti (2003, 2006) have showed that this effect could be explained considering individual differences. The aim of this work is to explore the effect of expertise on this relationship: we hypothesized that military pilots who have high spatial abilities do not show alignment effect compared with non-pilots.

**Methods:** 20 pilots and 20 non-pilots were recruited. The mean flight hours was 418.75. Non-pilots were without flight experience, matched for age and education with pilots. All participants were asked to learn a map and to perform (10 aligned and 10 contra-aligned) directional judgments to verify whether the alignment effect was presented considering absolute angular errors.

**Results:** An ANOVA for mixed designs on absolute angular errors revealed a main effect of "group" ( $F_{1,38}=57.90$ ,  $p<.001$ ): pilots performed better than non-pilots. A main effect of "directional judgments" ( $F_{1,38}=55.334$ ,  $p<.001$ ): the aligned judgments were easier than contra-aligned ones. ANOVA showed a significant "group x directional judgments" interaction ( $F_{1,38}=30.420$ ,  $p<.001$ ): post-hoc comparison (Bonferroni correction) showed that contra-aligned are more difficult than aligned judgments for non-pilots ( $p<.001$ ), whereas in the pilots did not show the alignment effect.

**Conclusion:** The high visuo-spatial abilities as well as the expertise due to the flight experience preserved pilots in having the alignment effect bias. They perform equally well directional judgments apart the changing perspective, suffering less from the increased cognitive load following the changing perspective.

## **AWAY FROM THE HOME BASE; THE ROLE OF THE AIRLINE COMPANY PHYSICIAN IN FOREIGN DESTINATIONS, DETAILS OF A 30 YEARS EXPERIENCE**

*LA MISSION DU MÉDICAL CORRESPONDANCE AU ESTRANGER*

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**Introduction:** The role of the company physician in foreign destinations keeps expanding and remains effective and cost effective. This presentation addresses some new aspects of the physician intervention, summarizes existing protocols, and describes particular observations made in the special situations.

**Background:** A review of existing protocols in the delivery of services pertaining to many areas of airline operations, in which the advisement or intervention of the designated company physician takes place and facilitates the resolution of the problems that have to be confronted. This report is based on 30 years of experience with several air carriers.

**Discussion:** The company medical physician gives general medical advice to management, contributes to the care of sick crew members, is a participant of the crisis intervention team. The company physician also provides support in flight operations such as; management of sick passengers that apply for transportation, supporting legal matters, participant in programs of telemedicine when it is conducted by the airline instead of having been outsourced. Additionally the company physician can support problems with local ground staff, escort sick crew members back to home base when warranted, and intervene and advise in any matter where a physician contribution may be relevant always applying the "industrial mentality" that can be lacking in other physicians who are not familiar with the airline environment. Special situations are described in the presentation.

**Summary:** Designated company physicians away from the home base assume many roles in the daily airline operations, either through direct intervention or monitoring of the situation. The services rendered are effective and cost effective with opportunities to decrease costs without compromising the welfare of the crew member and adding the "industrial mentality" to the general medical knowledge.

## THE ROLE OF AEROMEDICAL INVESTIGATION IN AN AIR FRAME DEVELOPMENT

### LE ROLE DE L'ENQUETE AEROMEDICAL EN LE DEVELOPPEMENT D'UN AVION

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**Introduction:** In 2011 and 2013, two prototype aircraft of an advanced jet trainer were involved in severe mishaps (class A). Due to the unusual injuries suffered by the aircrew (pilot and test engineer in the first one, and pilot in the second one) the ITAF Flight Safety Center requested the same flight surgeon to be involved in the investigation.

**Cases:** In the first mishap the pilot suffered from a sternum fracture and neck soft tissue damage, while the flight engineer, in the rear seat, suffered from lumbar vertebrae fractures and left femur fracture. In the second mishap, the pilot suffered from D3 and D4 comminuted flexion/distraction fractures (Magerl Type B), D9 compression fracture along the superior endplate; sternum fracture-dislocation between manubrium and body and other minor fractures.

**Discussion:** During the investigations, the biomechanical and biodynamics issues were studied, analyzed and discussed within the Investigation Board and among the aircraft company, the Air Force and the ejection seat company. In accordance with the findings and recommendations provided by the investigation boards, an interim solution was developed (new rosters design for canopy fragmentation), and after the second mishap a structural design evolution (canopy fracturing system) was designed and installed.

**Summary:** The investigations were conducted with an effective multidisciplinary approach to the unusual injuries observed, highlighting the aeromedical issues. A strong aeromedical and flight safety education should be requested to the flight surgeons in any case of mishap investigation, mainly in the military environment, to fulfill the advanced and complex requests in the aviation domain.

## SEA URCHIN EMBRYO AS A MODEL TO EVALUATE THE STRESS RESPONSE ELICITED BY IONIZING RADIATION

*L'OURSIN COMME UN MODÈLE POUR ÉVALUER LA RÉPONSE AU STRESS INDUIT PAR LES RAYONNEMENTS IONISANTS*

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**Introduction:** The sea urchin embryo is a well-established model system used for classical embryology and for molecular eco-toxicological studies, to evaluate the effects of many harmful environmental chemicals (metals and physical stimuli (X-rays and UV radiation) as well as their combined action. Indeed, many studies have focused on the mechanisms adopted by sea urchin embryos to deal with UVR. Here, we used *Paracentrotus lividus* embryos to evaluate the stress response induced by X-rays at molecular level.

**Methods:** Embryos were exposed to X-rays at doses ranging from 0.1 to 5Gray (Gy). Development was monitored at 24 and 48 hours post irradiation (hpi), when unexposed embryos were at gastrula and pluteus stages respectively. We also collected embryos exposed to the highest dose (5Gy) in order to analyze the accumulation levels of stress/anti-apoptotic proteins, such as HSP60, HSP70, BAG3 and p63, and to evaluate the mRNA levels of PI-SM30 and PI-msp130, two skeleton-specific genes.

**Results:** We observed a dose-dependent increase of developmental delays and morphological defects in exposed embryos. In parallel, we measured a reduction in the mRNA levels of the two skeleton-specific genes, PI-SM30 and PI-msp130 and an increase in the HSP70, BAG3, and p63 protein levels only at 48hpi. No increase was detected in HSP60 protein levels. The levels of the mRNA coding for HSP70 and p63 were also investigated by relative RT-PCR and were found to increase at 24hpi, returning to their initial levels at 48hpi. These results suggest the presence of an adaptive regulatory mechanism operating at transcriptional (24hpi) and at translational (48hpi) levels.

**Conclusion:** In conclusion, we propose the sea urchin embryo as a suitable ethical model for monitoring the effects of ionizing radiations such as X-rays for studying the protective pathways operating after irradiation.

We acknowledge M.Biondo for technical assistance. Dedicated to the memory of V. Matranga

## NAVIGATION ABILITIES AND DIRECTIONAL JUDGMENTS IN PILOTS DURING DAY AND NIGHT VISION GOGGLES (NVGS) CONDITIONS

*ABILITÈ DE NAVIGATION ET JUGEMENTS DIRECTIONNELLES DANS LES PILOTES PENDANT LE CONDITIONS DU JOUR ET AVEC LE NVG*

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**Introduction:** Navigation awareness, according to Aretz (1991) is the pilot ability to answer the question: "Am I- egocentric reference where I should be- allocentric reference?". Individuals are better in making judgments when the "up direction on the map is the same as the "forward" direction in the environment, that is when a map is aligned with the perspective of the map they had learned (aligned effect). The aim of this work is to explore whether or not the ability of military pilots, could be influenced by the use of NVGs in making map directional judgments.

**Methods:** 40 pilots were recruited and divided in two groups of 20 pilots. One group in day vision and the other in NVGs conditions were asked to perform directional judgments on five maps, after learning the map itself. For each map the pilot had to give both aligned and counter-aligned judgment. The angular error and time were recorded for each judgment.

**Results:** Statistical MANOVA test, considered as independent variables two groups (NVGs and day vision) and judgments (aligned and contra-aligned), revealed no main effect on absolute angular errors for "group;" (pilots performed equally in aligned and contra-aligned). A main effect of "directional judgments" concerned the time needed to execute the task: the aligned judgments were faster than contra-aligned ( $F=5.183$ ) ( $p=0.02$ ). The test showed that there are no statistically significant differences in performing the task with NVGs vs day vision.

**Conclusion:** Pilots perform equally well directional judgments both aligned and contra-aligned. The reason of this result can be due to the type of two-dimensional maps that are not altered by the use of NVGs.

## WORK-RELATED STRESS IN COMMERCIAL AIRLINE PILOTS: EPIGENETICS IMPACT

### *STRESS LIÉ AU TRAVAIL DES PILOTES DE LIGNE: IMPACT ÉPIGÉNÉTIQUE*

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Introduction: Stress is a biological response to adverse stimulus, internal or external. Commercial pilots working conditions' impact on health is relatively studied and work-related stress is still a major problem. The nature of job of aircraft pilots involves several sources of stress.

Background: Physical stress is due to conditions in cockpit, such as confined space, noise, vibration, decreased barometric pressure, gravitational forces, cosmic radiation, absence/presence of air recirculation, degree of air filtration, prolonged exposure to low relative air humidity or lack of oxygen. Physiological stress is related to operational fatigue, change in dietary habits, lack of sleep and altered sleep-wake cycles, conflicting shift schedules, altered perception, jet lag. Psychological stress relates to workload managing, irregular working hours, strict deadlines, difficult decision making, responsibility, aeronautic emergencies, work interference with home/personal life (Runeson R et al, 2011). Environment (environment and occupational exposure) and lifestyle (stress, physical exercise, dietary habits, drug-abuse) are directly related to epigenetics mechanisms, such as DNA methylation and hydroxymethylation (primarily C in CpG sequences), posttranslational histone acetylation/methylation (most often H3 and H4) and production of noncoding RNAs, thus determining, with genetic background, the health status. Most susceptible genes to epigenetic influence are involved in the control of stress-response, oxidative stress, DNA damage, inflammatory response, energetic and proteic metabolism. Epigenetic modulation of target genes are strictly related to early ageing, onset of cancer, type II diabetes mellitus and age related disease, such as arteriosclerosis. In a recent study, aviation pilots displayed a mild but constant oxidative stress, more pronounced in intercontinental routes pilots, with lymphocyte chromosomal alterations, DNA oxidation and cardiovascular malfunction (De Luca C. et al, 2009).

Summary: Assessing levels of DNA methylation on peripheral blood sample could be an important early diagnostic marker for the onset of some diseases and have significant prognostic value among health monitoring strategies for airline pilots.

## EFFICIENCY OF CADET PILOTS IN TERMS OF THE AQUATIC AND TERRESTRIAL ENVIRONMENT.

### *EFFICACITÉ DES ÉLÈVES PILOTES EN TERMES DANS L'ENVIRONNEMENT TERRESTRE ET AQUATIQUE*

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**Introduction:** In the aquatic environment, the Cureton test gives you the ability to assess body buoyancy. Flight-Synthetic Fitness Test (LSTS) has training measures that affect the main muscle groups involved in the L-1 overloading maneuver. The purpose of the study is to examine the relationship between Cureton's results and the results achieved in LSTS.

**Methods:** The study was attended by 51 first year Cadets of the Polish Air Force Academy in Dublin. The pilots were divided into four groups: helicopter pilots, group I (N = 16), pilots of a transport aircraft, group II (N = 12), jet aircraft pilots, group III (N = 13). All cadets passed anthropometric tests, body buoyancy tests using the Cureton test, and motor skills tests using LSTS. Based on statistical analysis and one-way analysis of variance (ANOVA), it was attempted to differentiate between LSTS and Cureton test groups as well as BMI, Rohrer's, and correlated between these tests.

**Results:** It was found that the BMI and Rohrer index showed a statistically significant difference between the study groups at BMI  $p = 0.05$  and Rohrer  $p = 0.02$ , as not found in the LSTS and Cureton tests. LSTS negatively correlates with the Cureton test, in group II  $r = -0.69$ , and group III  $r = -0.57$  with  $p$  all tested had negative correlation  $r = -0.24$  with  $p = 0.085$ .

**Conclusions:** Based on the results of the LSTS, the Cureton test found a statistically significant negative correlation between these tests in groups II and III, which indicates supersession of the body on motor performance. On the other hand, demonstration of the statistically significant difference between the studied groups the BMI and Rohrer indicators show a high diagnostic value in LSTS.

## AEROMEDICAL MANAGEMENT OF FLIGHT SAFETY

### *LA GESTION AÉRO-MÉDICALE DE LA SÉCURITÉ AÉRIENNE*

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**Introduction:** Medical condition of pilots and other certified aviation personnel is considered to present a low risk for flight safety, although the state of their health plays one of the major roles in safety of aviation. The threat to flight safety is presented not only by in-flight incapacitation, but also by reduced performance due to the deterioration of physical or mental state of a person. Assessment of medical fitness for duties in aviation is the prevention of risks for flight safety. Management of medical risks presents a certain challenge for aeromedical specialists.

**Methods:** We have analyzed the principles of preventive medicine that are used in aeromedical examination of aviation personnel in Moldova and their advantages in the medical risks evaluation. Supplementary investigations are done on clinical, epidemiological indications or according to the required by state protocols related to a corresponding disease. Most attention is given to the conditions that could lead to in-flight incapacitation and/or long-term unfitness. It is important to note that the favorable financial policy permits additional investigations not to increase the final costs of the aeromedical examination.

**Results:** Most of the cases that needed supplementary to the minimum periodic requirements evaluation were the assessment of risks to cardio-vascular diseases, diabetes mellitus, malignant tumors of some localizations, hepatitis, cholelithiasis, urolithiasis, ulcer disease, etc. Some typical clinical cases where preventive measures led to the reduction or full elimination of medical risks are given in presentation.

**Conclusion:** Preventive care of aviation personnel is a good tool for the management of medical risks to flight safety. Lifestyle intervention and other preventive measures introduced as systematic policy help to slow down the onset of the disease or reduce the risks to its development. Mutual trust between doctors and examined personnel, cost effective policy of the medical examination are two important components for the preventive approach system work effectively.

## THE IMPACT OF MOTOR PREDISPOSITIONS OF PILOT-CADETS ON RESULTS IN AVIATION SYNTHETIC EFFICIENCY TEST

*L'IMPACT DES PREDISPOSITIONS MOTEURS DES ÉLÈVES PILOTES SUR LES RÉSULTATS DANS LE TEST D'EFFICACITÉ SYNTHETIQUE D'AVIATION*

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**Introduction:** The aim of the study is to determine the types of motor skills and their impact on achieving results while undergoing Aviation Synthetic Efficiency Test (ASET).

**Method and Materials:** The study involved 59 cadets, 21-years-old on average, who are studying on first year for a pilot. The average weight of the respondents is 73.8 kg. The subjects were divided into two groups by weight: up to 73.8 kg -group A (n-30) and above 73,8kg -group B (n-29). All subjects underwent the following tests: running at 40m, 100m, 1000m, 2000m, pull-ups, ASET. In both groups, the cadets were divided into two motor skills types taking into advance 40m running, pull-ups, 2000 meters running and then subjected to do ASET.

**Results:** There has been shown statistically significant increase in group B in body height, weight and BMI with  $p < 0.0003$ ,  $p < 0.0001$ ,  $p < 0.0001$  compared to group A. The results indicate that the dominant motor type in all subjects is the endurance-strength model, which reached the speed  $V = 1,42\text{m/s}$  in overcoming ASET. This is confirmed by the correlation between 2000m and pull-ups  $r = 0.37$  ( $p < 0.05$ ). In group A, the results indicate that the dominant type of motor is a high-speed-endurance model (26.6%), which reached speed  $V = 1,42\text{m/s}$  in overcoming ASET. In Group B, there was type of motor speed-strength (20.6%), which reached speed of  $V = 1.45\text{m/s}$  in overcoming ASET. This confirms the correlation between ASET and pull-ups  $r = 0.56$  ( $p < 0.005$ ). Examined cadets who were having one dominant characteristic achieved worse results in ASET.

**Conclusions:** The best results from all examined cadets in overcoming ASET had the type of motor endurance-strength, in group A endurance-speed model and in group B type of speed-strength.

## IMPACT OF TEMPERAMENT FEATURES ON STRATEGIES OF COPING WITH STRESS DURING PHYSICAL EDUCATION SELECTION EXAMS FOR AN AVIATION SCHOOL

*IMPACT DES CARACTÉRISTIQUES DU TEMPERAMENT SUR LES STRATÉGIES DE COPIE AVEC STRESS DURANT DES EXAMENS DE SÉLECTION DE L'ÉDUCATION PHYSIQUE POUR UNE ÉCOLE AVIATION*

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**Introduction:** The goal of the conducted research was evaluation of temperament features on used coping with stress strategies in situation of physical education selection exams that are decisive factor for the aviation school acceptance.

**Materials and Methods:** The subjects were 30 candidates for the aviation school for the jet airplane pilot field. To assess the features of the temperament the "The Formal Characteristics of Behaviour-Temperament Inventory" (FCB-TI) by B. Zawadzki and J. Strelau was used. To define the styles of stress coping "The Coping Inventory for Stressful Situations" (CISS) by N. S. Endler and J. D. A. Parker was used. The temperament and styles of coping with stress assessment was executed right before the physical education selection exam. The obtained results were analyzed using "Statistica 9" software.

**Results:** The research showed that: 1) there is a negative correlation between "perseverance" temperament feature and a preferred "style of coping with stress focused on a task" ( $r=-0,590$ ;  $p<0,004$ ); 2) there is a positive correlation between "emotional reactivity" temperament feature and preferred "style focused on emotions" during the stressful situation ( $r=0,520$ ;  $p<0,011$ ); and 3) there is a negative correlation between "stamina" temperament feature and "style focused on emotions" ( $r=-0,580$ ;  $p<0,004$ ).

**Conclusions:** Research shows that temperament features determine the perception of stress and preferred styles of coping with it during the physical education selection exams.

## EFFECTS OF A POSTURAL EXERCISE PROGRAM ON NECK PAIN AMONG EUROFIGHTER PILOTS

*LES EFFETS D'UN PROGRAMME DE GYMNASTIQUE POSTURAL SUR LA DOLEUR CERVICAL DANS LES PILOTES DE EUROFIGHTER*

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**Introduction:** Neck pain is frequent among pilots of high performance aircraft and it may affect individual health and work performance. The aim of this study is to examine whether a postural exercise intervention could reduce neck pain and improve neck functionality among Eurofighter pilots.

**Methods:** A group of 20 EFA pilots (mean age 36.25) at an Air Force base received weekly encouragement to perform a specific postural exercise program every other day (at least three times per week) for two months (training group TG). A reference group (RG) of 21 EFA pilots (mean age 32.95) from another Air Force base kept doing their routine physical activity. Both groups completed the Aircrew Neck Pain Survey, Neck Disability Index (NDI), Baecke Questionnaire and Numeric Pain Rating Scale (NPRS) at the beginning and at the end of the intervention period. The two groups were also submitted to the muscular endurance test (MET) and the active cervical range of motion (ACROM) valuations.

**Results:** The training group showed no statistically significant improvement in ACROM nor difference in MET after training. No differences related to neck pain were found between groups. However, the pilots who performed the postural training reported subjective relief in executing it.

**Conclusion:** The postural exercise training proposed was not effective in improving neck functionality (ACROM, MET), nor to reduce neck pain and improve clinical conditions. Due to the duration of the intervention and the constant duty required to the pilots, several subjects failed in accomplish the task and this significantly reduced the sample. Further studies with higher number of pilots and a better compliance would be desirable.

## ASSESSING PROFESSIONAL AIR TRAFFIC CONTROLLERS EXPERTISE: A BRAIN CONNECTIVITY STUDY

*ÉVALUATION DE L'EXPERTISE OF CONTRÔLEUR AÉRIEN PROFESSIONNELLE: ÉTUDE DE CERVEAU CONNECTIVITÉ*

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**Introduction:** The ability to objectively define the expertise of a subject could allow better assessment of learning processes both during training period and while practicing with new technology, saving time and economic resources. This aspect is crucial in operational contexts such as the Air-Traffic-Management (ATM). Rearrangement of brain activities has been proposed as practice-related investigation instrument. The aim of this work was to use Electroencephalographic (EEG) signals to evaluate the expertise of Experts and Novice Air Traffic Controllers (ATCOs).

**Methods:** Thirty-seven ATCOs from the École Nationale de l'Aviation Civile (ENAC) of Toulouse (France) have been asked to perform a high-realistic ATM scenario, run within a simulator hosted at the research Lab of ENAC, consisting in three phases with different levels of complexity (variable number of aircrafts, traffic geometry, and number of conflicts). During the execution of the ATM scenario, behavioural, subjective and EEG data have been collected. Brain connectivity has been then estimated by means of Partial Directed Coherence providing the information flows exchanged between scalp brain areas. The different involvement of fronto-parietal network has been analysed by means of graph theory indexes.

**Results:** Density of connections in Novices group network was significantly higher ( $p < 0.05$ ) than Experts network density, in particular in term of parietal and parieto-frontal connections. Moreover the Modularity was significantly higher in the Novices than Experts ( $p < 0.05$ ).

**Conclusion:** The results demonstrated that in the Novices the fronto-parietal network was more involved than in the Experts, and it could reflect the different involvement of attentional and control brain areas, not only in terms of global brain activations, but also considering the redistribution of such activity due to expertise level. Such findings open the way to methodologies able to objectively assess the level of expertise of users both during training and for skills maintenance check.

**HUMAN PERFORMANCE AND LIMITATIONS IN PILOT TRAINING – NO LINK BETWEEN CLASSROOM AND COCKPIT?**

*PERFORMANCE HUMAINE ET LIMITATIONS DANS LA FORMATION PILOTE - PAS DE LIEN ENTRE LA SALLE DE CLASSE ET COCKPIT?*

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Introduction: The Germanwings crash in 2015, LAM crash (2013), SilkAir (1997), EgyptAir (1999), and the disappearance of MH370 (2014) showed that airline pilots are not only very well trained, extremely controlled high performers--Deep inside they are also human. A recent study by the Harvard School of Public Health revealed that 12.6% of airline pilots are depressed (PHQ-9), and 4.1% are having suicidal thoughts, while they are on flight duty. The mandatory self-reporting of the severely mentally sick first officer did not work. The mental fitness assessment for the medical certification did not raise any suspicion, although the Medical Class 1 of the Germanwings pilot had a clear waiver due to a severe depression at the beginning of his basic flight training.

Background: About 20 years ago EASA made Human Performance and Limitations (HPL) a mandatory theory topic for all pilots at all levels (PPL to ATPL) for airplanes and helicopters. Ab initio pilots get HPL-theory-training by meteorologists, nurses or physicians at their ATO. The theory topic HPL is taught in classroom or self-study. It is very sophisticated, usually written by scientists. It is far from personal experience and skill training, contains lots of content, that is not very relevant in emergency situations like aircraft upset. It is usually written in a foreign language, and evaluated in a highly questionable multiple choice test. These may be contributing factors, why pilots hardly apply this topic in their life and flight operations. Many pilots also have good reasons to hide potential decrease in medical fitness they are aware of.

Summary: The present pool of HPL learning objectives, and multiple choice questions still used for the evaluation of HPL-knowledge are shown and analyzed. They are compared with the present hot topics in Human Performance and Limitations, like fatigue (despite the application of the new rules of flight time limitations), effects of fatigue on mental health, upset recovery training, startle and surprise.

**045**

**HYPOBARIC HYPOXIA DOES NOT ACUTELY AFFECT ENDOTHELIAL FUNCTION BUT INCREASES LEVELS OF THE PROTECTIVE ADIPOCYTOKINE ADIPONECTIN IN MALE AVIATORS**

*HYPOXIE HYPOBARIQUE N'OBSTACLE PAS NETTEMENT LA FONCTION ENDOTHE LIALE, MAIS AUGMENTE LES NIVEAUX DE ADIPOCYTOKINE ADIPONECTINE PROTECTIVE DANS LES AVIATEURS MASCULINES*

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**Introduction:** Several reports have indicated that hypobaric hypoxia (HH) might increase the risk of high altitude related illnesses including pulmonary edema and cerebral edema. These HH derived complications seems to be due to altered endothelial function (EF). Adiponectin (ADP) is an adipocyte-derived substance able to modulate endothelial response. Aim of the study was to investigate the effects of acute HH on EF as well as on ADP levels in individuals usually exposed to HH such as male aviators.

**Methods:** Fifteen male aviators were exposed to HH, by a simulated altitude of 25,000ft above sea level for 3 minutes in a hypobaric chamber. Hypoxia was induced by removing the oxygen masks until the onset of hypoxia symptoms. EF was "acutely" measured by the EndoPAT test immediately before and after HH. ADP levels were measured by ELISA-test in serum and saliva (before and at 24hrs after HH).

**Results:** HH did not cause any "acute" significant variation in EF. On the contrary, ADP levels measured in serum as well as in saliva significantly increased 24hrs after HH exposure (64 vs 29 ng/ml in serum and 57 vs 15 ng/ml in saliva;  $p < .005$ ). Interestingly, improved EF was observed in those aviators with significant increase of ADP levels.

**Conclusions:** Data from the present study describes that HH does not "acutely" change EF; however, being an endothelial injury, it stimulates the release of adiponectin, an endothelial "protective" adipocytokine. A close relationship exists between serum and salivary levels of ADP, indicating the potential utility of this noninvasive measurement test.

## EVALUATION OF SOUND TRANSMISSION UNDER HYPOBARISM AND ITS IMPACT ON AUDIOMETRIC THRESHOLD

### *ETUDE DE LA TRANSMISSION DU SON EN HYPOBARISME ET SON IMPACT SUR LA SEUIL AUDIOMÉTRIQUE*

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**Introduction:** At high altitudes aircrew members are exposed to a reduced barometric pressure, along with hypobaric hypoxia. The lower environmental pressure can significantly influence sound transmission via a standard headphone. The aim of this study was to evaluate how hypobarism and hypoxia can separately affect sound perception at different frequencies.

**Methods:** The study was conducted in a hypobaric chamber using a standard audiometer. Seven male volunteers performed a Pure Tone Audiometry (PTA) at ground level, at 15,000 ft in normoxia (oxygen mask), and at the same altitude after 15 minutes of ambient hypoxia. PTA at 1, 2, and 4 kHz was recorded at the right ear. A TDH-39 headphone, calibrated under hypobarism in a previous research, was utilized. Oxygen saturation monitoring was also performed throughout the three subsequent experimental steps (i.e. normoxia at ground level, normoxia and hypoxia at 15,000 ft).

**Results:** As expected, due to the headphone behavior, at 15,000 ft the 2 kHz PTA threshold resulted 5 dB better than at ground level, while at 4 kHz it increased 7 dB. These data became similar to the ground level results after correction for transducer behavior. After 15 min of hypoxia, both thresholds showed an increase of 4 and 9 dB respectively, even after correction. At 1,000 Hz, no significant changes were observed between the three experimental steps.

**Conclusions:** This study evaluates the critical role of loudspeaker behavior for audiometric measurements in hypobaric conditions, suggesting the absolute need of the acoustic signal calibration. In agreement with previous literature data, a significant increase of PTA threshold can be observed after 15 minutes of hypoxia, even after correction for transducer behavior, especially for high frequencies.

**047**

## **EVALUATION OF A HEARING AID BEHAVIOR UNDER HYPOBARIC CONDITIONS**

*EVALUATION DU COMPORTEMENT DE UNE PROTHÈSE AUDITIVE EN HYPOBARISME*

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**Introduction:** The purpose of this study was to characterize the response and behavior of a particular class of loudspeakers and microphones (i.e. those mounted on miniaturized hearing aids) by varying the ambient air pressure, simulating high altitude environments.

**Materials and Methods:** A hypobaric chamber simulating the pressure conditions inside a cockpit or in high mountain environments was utilized. The sensitivity of a microphone and of a miniaturized loudspeaker derived from a commercial acoustics prosthesis was tested. Input/output curves were evaluated at ground level and at simulated altitudes of 9,000 and 15,000 ft.

**Results:** Our data showed a global decrease of the loudspeaker sensitivity of about 3dB at 15,000 ft and of 1dB at 9,000 ft. The result is well matched with a theoretical model that considers the variation of air density which proportionally follows the static pressure variation from 1 atm (0 ft) through 0.9 atm (9,000 ft), up to 0.6 atm (15,000 ft). The microphone also showed a slight decrease of sensitivity at 15,000 ft (about 2 dB) only at frequencies lower than 4kHz and higher than 8 kHz.

**Conclusions:** The acoustic pressure of the sound wave radiated by the loudspeaker decreases with the height as the square density root, corresponding exactly to 1 dB at 9,000 and 3 dB at 15,000 feet. Such a finding is in agreement with the results from other studies carried out on professional sized microphones and on headphones of telephone type, as those used in commercial audiometers. The microphone behavior might be rather due to the small thermal variations (<2 deg C) occurring inside the hypobaric chamber during ascension. Sensitivity to such thermal variations could be attributed to the electronic circuit equipping the microphone itself and should not differ from those observed at ground level during its standard use within a hearing aid.

## RAPID DECOMPRESSION CHALLENGES: A CASE OF AIRCRAFT CANOPY LOSS

### *CHALLENGE A LA DÉCOMPRESSION RAPIDE: UN CAS DE PERTE DE TOIT DU PLAIN*

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Background: Rapid decompression in a fighter aircraft results in physical and physiological effects on the aircrew. A case of a fighter pilot who developed difficulty with equalizing his left ear after an in-flight incident when the aircraft lost its canopy at 35000ft is discussed.

Case: An aviator suffered the loss of his aircraft canopy while flying his aircraft at an altitude of 35000 ft. then he made a rapid descent and landed safely. Following the incident he was observed for 3 days before returning to his home. Later on, he presented to aviation medicine clinic complaining of slight pain in his left ear with difficulty equalizing pressure, prescribed medication and arranged for review after one month. However, he continued to complain of delay in equalizing and prescribed medication for a further week by his flight physician. He referred to AFMC for decompression chamber assessment. Unfortunately, he has a recurrent otic barotrauma due to Eustachian tube dysfunction, which is has not resolved and it is likely to be an ongoing problem if he returns to flying duties.

Discussion: Proper function of the ears is indispensable to aviator, pressure differences between the middle ear and the external auditory canal are normally equalized by the Eustachian tube. Therefore, the presence of Eustachian tube dysfunction represents a serious risk for pilots of incurring in sudden onset of ear pain, fullness, or barotitis media during the flight mission. This case highlights the important of equalization in military aviation and the physiological effects of rapid decompression. A decompression chamber exposure may be required to assess aircrew flying fitness following the development and treatment of an ENT problem affecting the individual's ability to equalize pressures between the atmosphere and the middle ear cavity through the Eustachian canal. The aim of the assessment is to demonstrate adequate Eustachian canal function.

## TERRA X CUBE: THE NEXT HI-TECH RESEARCH PLATFORM FOR EXTREME HABITAT SIMULATION

*TERRA X CUBE: LA PLATE-FORME DE RECHERCHE HI-TECH SUIVANTE POUR UNE SIMULATION EXTREME D'HABITAT*

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Introduction: Field-based scientific investigations in extreme environments represent a major research challenge. Complex combinations of multiple environmental parameters can prove highly difficult to mitigate against, making it difficult to standardise the logistics necessary to enable assessment of individual physiological or biological response. In an effort to resolve these research concerns, plus remain reactive to technological, and aerospace medicine advancements, institutions have developed specific simulation chambers and accessible facilities in extreme earth habitats. In conjunction with the ongoing development of next generation, simulation-tech research platforms, environmental simulation and interest in extreme terrestrial conditions as potential space analogs is becoming an international hot topic. Important to the EU industrial sector, this field has grown rapidly, as further diverse applications relating to health-based research for the future are identified.

Background: The realisation of the TerraXcube, powered by Eurac Research, is a unique example of the latest in technological advancement. A newly emergent EU research infrastructure, the TerraXcube is complete with two hypobaric, environmental facilities (cubes), medical support services and research expertise. The large cube (137 m<sup>2</sup>), will enable the synchronous control of multiple climatic parameters: barometric pressure (= 300mbar), temperature (-40°C - +60°C), humidity (10% - 95%), wind (= 30m/sec), precipitation (rain and snowfall) and light (day and night cycles). In total 15 individuals can be accommodated. Test protocols may be inclusive of the adjacent hypobaric ambulatory room, airlock and toilet facilities; thus enabling investigation of long-term exposure at low barometric pressures, specific aerospace ascent/ decent use cases, O<sub>2</sub> and CO<sub>2</sub> enrichment considerations and controlled investigation of potential invasive measures.

Summary: TerraXcube will be operational by autumn 2018. The aim, to facilitate a collaborative International research platform with specific interest in medical and ecological challenges facing human exploration and residence in extreme terrestrial/ extraterrestrial habitats, plus long duration flight considerations.

## OXIDATIVE STRESS RESPONSE TO ACUTE HYPOBARIC HYPOXIC EXPOSURE: IS IT ASSOCIATED TO OPTIC NERVE SHEATH DIAMETER?

*RÉPONSE DU STRESS OXYDANT À L'EXPOSITION HYPOXIQUE HYPOBARIQUE AIGUË:  
EST-IL ASSOCIÉE AU DIAMÈTRE DE LA SHEAT DE NERVE OPTIQUE?*

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**Introduction:** Failure to adequately adapt to hypobaric hypoxia during rapid ascent to high altitude can result in hypoxemia, tissue oxidative stress (OxS) and altitude illnesses. Altitude illnesses can also be associated with substantial cerebral structural alterations and edema. Previously, optic nerve sheath diameter (ONSD) changes have been correlated with intracranial pressure (ICP) in critical care patients, however the mechanistic processes necessary to define causal relationships between OxS biomarkers and increased ICP remain unclear. The aim of this study was to investigate the association between OxS biomarkers and changes in ONSD.

**Methods:** Clinical signs and symptoms of altitude illnesses, plus biological samples and ultrasonography of ONSD, were assessed at baseline and post passive ascent via helicopter to 3830m (9, 24 and 72h) in 16 healthy lowlanders. Reactive oxygen species (ROS) production rate was determined via Electron Paramagnetic Resonance. OxS biomarkers were assessed via immune and/or enzymatic methods. ROS and OxS biomarkers were correlated with ONSD by means of a model including subject as a random effect; first without time and then adding time as fixed effect. A multivariate analysis of factors associated with ONSD was performed by means of generalised estimating equations for all measurements up to 24h.

**Results:** ROS, OxS biomarkers and ONSD increased with exposure to altitude ( $p < 0.001$ ). ROS production and OxS biomarkers were correlated with ONSD ( $p < 0.001$  for all tests) only if time was not added to the model. The regression analysis did not show a significant influence of ROS production and OxS biomarkers on ONSD.

**Conclusion:** A multivariate analysis did not infer a causal relationship between ROS production, OxS biomarkers and changes in ONSD. Further studies with neuroimaging techniques and different altitude of exposure to acute hypobaric hypoxia are necessary to better elucidate the clinical significance of changes between OxS biomarkers and ONSD.

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## **FAST RESCUE IN MINE HUNTER COAST UNIT**

*RAPIDE SAUVETAGE DANS L'UNITE DE CHASSEUR DE MINE DELL'ARMEE DEL MER ITALIENNE*

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Introduction: Rescue work in sea is a part of the Navy's tasks: the heterogeneity of the Naval Units, their equipment and their use by crews do not necessarily imply the same methodologies and intervention procedures that aim at human aids in the aquatic environment.

Background: The Health Service and the Sub Department of the Command of the Counter Measures Mine, by perfecting what has been already elaborated and operated in the "Caccia mine Units" (Mine Hunt), have developed and refined a method of intervention for a rapid recovery of underwater conditions in post-immersion critical condition in order to minimize the time between the immersion and the entry into the hyperbaric chamber, and to reach a stable interval of less than 7 minutes. This goal was achieved with the introduction of the Jason's Cradle stretcher in use, with the optimization of the usage of the one-size inflatable boat for the MHC (Mine Hunter Coast).

Summary: Units, with the introduction of a readily reproducible but rigorous procedure and the introduction of some auxiliary equipment designed to carry it out and, most importantly, with adequate training while guaranteeing the safeguarding and safety of the rescuer as well. Ultimately knowledge, training, security were engaged for the achievement of this goal.

## THE ROLE OF INDIVIDUAL FACTORS IN AFFECTING THE TOLERANCE TO HYPOXIA IN PILOTS DURING HYPOBARIC CHAMBER TRAINING

*LE ROLE DES FACTEURS INDIVIDUELS DANS LA TOLERANCE À L'HYPOXIE EN AVIATEURS PENDANT L'ENTRAÎNEMENT DANS LA CHAMBRE HYPOBARIQUE*

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**Introduction:** The causes of the differences in hypobaric hypoxia tolerance in military air crew are not well defined. The aim of this study is to investigate whether individual factors can, singularly or in combination, affect the subject tolerance to hypoxia during hypobaric chamber training.

**Methods:** We retrospectively reviewed records collected during the aerophysiological training at a simulated altitude of 25000 feet in a sample of 562 pilots. During the training pilots doff the mask and put it on again when they feel at least two hypoxia-related symptoms. The time elapsed (Time of Hypoxia TH), SpO<sub>2</sub> and HR at the moment of "mask on" have been recorded. Subjects were divided in 8 groups by 4 factors: age, < 33 years (N = 281) and = 33 years (N = 281); BMI, BMI = 24 (N = 343) and BMI = 25 (N = 219); smoking habits, smokers (N = 123) and nonsmokers (N = 439); physical activity, = twice a week (N=452) and < twice a week (N = 110). Data related to hypoxia (TH, SpO<sub>2</sub> and HR) have been compared between the different groups, using a multiple ANOVA, to carry out hypothetical differences in the tolerance to hypoxia.

**Results:** Physical fitness resulted to be the only factor to affect the performance in hypobaric chamber, prolonging the TH ( $p < 0.009$ ) and reducing the level of SpO<sub>2</sub> at the moment that pilots wear the mask ( $p < 0.006$ ). In hypobaric chamber, trained subjects' age resulted to be the only factor affecting TH ( $p < 0.023$ ) and SpO<sub>2</sub> ( $p < 0.039$ ) in the younger group vs the older one. No significant HR differences were found between groups.

**Conclusions:** Trained subjects resulted in putting the mask on later than the others, and among trained subjects the younger ones put the mask on even later, showing a delayed symptom onset and reaching lower SpO<sub>2</sub> blood levels at 25000 feet.

## EFFECTS OF AEROBIC CAPACITY ON COGNITIVE TESTS DURING HYPOXIA TRAINING

*EFFETS DE LA CAPACITÉ AÉRÉBIQUE SUR LES ESSAIS COGNITIFS PENDANT LA FORMATION HYPOXIA*

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**Introduction:** Acute hypobaric hypoxia, which possesses an accident risk in aviation, has negative effects on cognitive and psychomotor functions. Therefore, it is important to develop hypoxia tolerance to preserve pilot's mental functions during possible hypoxic conditions. We intended to investigate the role of aerobic exercise capacity on cognitive functions during hypoxic conditions.

**Methods:** 25 pilot candidates, applied for training in flight physiology were included in this study. After routine health examinations, physical fitness test of aerobic capacity measurements was applied to the participants. Hypoxia was applied at equivalent pressure of 5486 meters (18.000 ft) in height. Go/NoGo and Digit Span neuropsychological tests were applied during pre-training and hypoxia phases. Depending on means of aerobic capacities, the participants were grouped as high and low two groups.

**Results:** When compared to the pre-training phase, the means of response times and negligence errors of GNG tests increased significantly during hypoxia. For Digit Span test, the means of memory span and the number of correct answers decreased significantly in hypoxia when compared to pre- and post-training phases. When these findings were examined in terms of aerobic capacity, negative effects in both neuropsychological tests were more prominent in the low aerobic group than the high aerobic group.

**Conclusion:** We found that both cognitive and psychomotor functions could be adversely influenced during hypoxia and post-training phases. We showed that if aerobic capacity is high, it might be a positive factor against deterioration of both cognitive and psychomotor functions during hypoxia and post-training phases. We suggest regular aerobic exercise habits for aircrew as a factor that may increase their acute hypoxia tolerance.

## CHANGES IN LIPID PARAMETERS IN THE BLOOD SERUM IN FEMALE CADET PILOTS DURING HIGH-G CENTRIFUGE TRAINING

*MODIFICATION DES PARAMÈTRES DE LIPIDES DANS LE SANG DES ÉLÈVES PILOTES FEMININE PENDANT L'ENTRAÎNEMENT DANS LA CENTRIFUGUE A HAUTE-G*

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**Introduction:** The study is aimed at examining the impact of 45-day targeted physical training of female cadet pilots on: Changes of lipid index WS caused by duration of exposure to G-loads in centrifuge test, applying lipid profile which represents a variation of acceleration characteristics of interval type physical fitness assessment based on Aviation Synthetic Efficiency Test (ASET).

**Materials and methods:** The study was conducted on the group of 7 first year female cadet pilots of the Polish Air Force Academy, aged 20 on average. The centrifuge tests were conducted twice i.e. prior to and after 45 days which constituted the final period of the 6-month physical training targeted at flight preparation. The concentration of HDL cholesterol, triglycerides, apolipoprotein A1 i B in the blood serum were determined before and after the first and second test. The concentration of LDL cholesterol was calculated based on the Friedewald formula. WS was used to determine performance capacity. Targeted physical fitness was determined based on ASET at the beginning and end of the training period. The results were calculated using analytics package STATISTICA 9.0.

**Results:** WS in the first centrifuge test decreased statistically significantly at  $p < 0.02$  in comparison to its value before the test. In the second test after centrifugation WS was statistically significantly higher at the  $p < 0.005$  as compared to its value before centrifugation. Moreover, a statistically significantly shorter time of performing ASET at  $p < 0.05$  and longer total centrifugation time at the end of the training was observed, in comparison to the time at the beginning of the training.

**Conclusions:** 1) It was found that WS possesses a diagnostic value in differentiating performance capacity in female cadet pilots during the test in the human centrifuge. 2) The training period of the female cadet pilots significantly enhanced the targeted performance capacity.

## INFLAMMATION MARKERS IN FIBROBLASTS EXPOSED TO MODELED MICROGRAVITY

*MARQUEURS D'INFLAMMATION DANS LES FIBROBLASTS EXPOSÉS À LA MICROGRAVITÉ SIMULÉE*

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**Introduction:** Inflammation plays a crucial role in the wound healing process, affecting significantly its progression and outcomes. During the inflammatory phase important steps occur, such as clearance of damaged cells and extracellular matrix (ECM) at the wound site, removal of pathogens and secretion of mediators that regulate later steps, such as proliferation, re-epithelization and remodeling of the wound. In particular, macrophages and neutrophils produce pro-inflammatory cytokines that promote the activation of growth factors such as transforming growth factor (TGF) and several fibroblasts growth factors, resulting in the proliferation and infiltration of activated fibroblasts to the wound site. Trauma, diseases and aging can be responsible of deregulation of these mechanisms and induce an impaired inflammatory response and, consequently, defective wound healing. The study here reported was aimed at evaluating the impact of modeled microgravity on the production of inflammatory markers by fibroblasts.

**Methods:** NIH-3T3 fibroblasts were exposed for 72h to  $\mu$ g conditions, modeled by a Rotating Cell Culture System (RCCS). Then, production and release of inflammation markers were analyzed by western blotting of cell lysate and by enzyme immunoassay (EIA) in conditioned media.

**Results:** Preliminary results showed that modeled  $\mu$ g induced a decrease in the proangiogenic factor VEGF while increased the levels of cyclooxygenase-2 (COX-2), a key enzyme in the pro-inflammatory prostanoïd synthesis. We also observed an upregulation of iNOS, inducible isoform of nitric oxide synthases and decrease of CD-40, a family member of TNF receptor and mononuclear cell adhesion receptor. Moreover, a low release of prostaglandin E2 in the conditioned media was found.

**Conclusions:** In summary, studies carried out so far demonstrated that the production of inflammatory markers by fibroblasts exposed to  $\mu$ g is significantly altered. This effect can cause an impaired inflammatory response and adversely affect wound healing process.

This study was funded by the Italian Space Agency (Tissue Repair in Microgravity ASI N. 2013-090-R.O)

## ENDOTHELIAL-STROMAL INTERACTION IN WEIGHTLESSNESS

### *INTERACTION ENDOTHÉLIALE-STROMALE EN IMPESANTEUR*

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**Introduction:** Dynamic remodeling of the stroma, due to the extracellular matrix (ECM) turnover, plays a fundamental role in tissue morphogenesis during development and injury response. ECM stiffness and mechanical stress transmitted by the ECM-integrins-cytoskeleton system to the cells regulate their adhesion, migration, proliferation, differentiation, survival, ECM production and remodeling. Mechanical signals play a pivotal role in tissue repair and unloading conditions offer a unique opportunity to understand their impact on the dysregulation of stromal reaction to injury and healing impairment. The aim of this study is to evaluate the impact of microgravity, modeled by a RCCS, on endothelial-fibroblast cross-talking related to stromal activation in wound healing.

**Methods:** nHDF fibroblasts were exposed for 72h to  $\mu$ g conditions, modeled by a Rotating Cell Culture System (RCCS). Then, cells and conditioned media were collected. Endothelial cells (HUVECs) were cultured with conditioned media or co-cultured with fibroblasts previously exposed to  $\mu$ g. HUVECs ability to migrate (scratch assay) and form tube-like structures in Matrigel were studied.

**Results:** HUVECs showed a lower ability to migrate when cultured in medium conditioned by fibroblasts exposed to modeled  $\mu$ g for 72h. Also the ability to form tube-like structures in Matrigel was negatively affected by culturing in conditioned media. Tubulo-genesis and 3D organization of HUVECs resulted strongly impaired also in co-cultures with nHDF fibroblasts previously exposed to modeled  $\mu$ g for 72h.

**Conclusions:**  $\mu$ g compromised fibroblast ability to condition endothelial cell migration, tubulogenesis, and 3D organization. The decreased ability of fibroblasts to stimulate endothelial cell function can alter neoangiogenesis, leading to consequences on the evolution of the healing process.

This study was funded by the Italian Space Agency (Tissue Repair in Microgravity ASI N. 2013-090-R.O)

**057**

## **ASSESSMENT OF CEREBROVASCULAR REACTIVITY WITH ARTERIAL SPIN LABELING AND TRANSCRANIAL DOPPLER WITH CO<sub>2</sub> CHALLENGE IN A GROUP OF ITALIAN AIR FORCE FIGHTER PILOTS AND NAVIGATORS**

*ÉVALUATION DE LA RÉACTIVITÉ CEREBROVASCULAIRE AVEC L'ÉTIQUETAGE DE SPIN ARTERIAL ET DU DOPPLER TRANSCRANIEN AVEC LE CO<sub>2</sub> DANS UN GROUPE DE PILOTES ET NAVIGATEURS DE L'ARMÉE DE L'AIRE ITALIENNE*

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**Introduction:** Aim of the study is to investigate long-term effects of micro- and hypergravity on the cerebrovascular reactivity (CVR) in a group of Italian Air Force fighter pilots and navigators. Transcranial Doppler (TCD) with a vasoactive challenge is, nowadays, one of the most clinically non-invasive accepted method for the evaluation of CVR. Arterial spin labeling (ASL) is a relatively new RM technique that enables to measure cerebral perfusion at the tissue level without contrast medium injection. The study has been developed within an act of intent signed between The Italian Air Force Aerospace Medicine Institute of Milan and the Neurologic Institute "C. Besta" of Milan.

**Methods:** Two groups of fighter pilots and navigators (group 1 and 2) belonging to the same squadron and employed on the same aircrafts will be studied. The inclusion criteria will be: a) group 1, up to 30 years of age and number of flight hours up to 750; b) group 2, over 30 years of age and flight hours over 750. All subjects will be matched for sex and age with healthy control subjects without routine flight experience. Participants will undergo an MRI scan with an ASL-based CO<sub>2</sub> challenge test consisting in a morphologic 3D T1-weighted sequence followed by two ASL sequences (pseudo continuous ASL) performed before and after administration of a mixture of air and CO<sub>2</sub> 5%. End Tidal CO<sub>2</sub> (EtCO<sub>2</sub>) and hemodynamic parameters will be monitored during the MRI examination.

**Results:** Data collection has started at the Neurologic Institute "C. Besta" in Milan. Data are currently under evaluation and preliminary results will be available for the designed congress session.

**Conclusions:** the study investigates the long-term effects on CVR in subjects exposed to high-stress hemodynamic conditions such as military pilots and navigators. Modification in CVR values between the pilot/navigators group and controls could be useful to develop strategies to prevent cerebral hypoperfusion under hemodynamic stress conditions.

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## **UNPOWERED FLIGHT ABOVE THE ARMSTRONG LINE – THE PERLAN II PROJECT**

*VOL PLANANTES AU DELA DE LA LIGNE DE ARMSTRONG: LE PROJECT PERLAN II*

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Introduction: The current world's altitude record at 50,772" (15,475m) was achieved by the Perlan Project in a modified DG505 sailplane, by Steve Fossett and Einar Enevoldson. Aircrew physiological protection was effected by conventional pressure suits. The Perlan 2 Project will attempt to set a new record, and soar as high as 90,000' (27,432m) environment in a uniquely designed sailplane, with a closed, pressurized cabin.

Background: The cabin has been designed to maintain an equivalent altitude of 15,000' (4,572m) with compressed air supplied from bottles. The 2-person crew will breathe 100% oxygen via continuously worn masks supplied by an adapted, closed loop, Self-Contained Breathing Apparatus, using gaseous oxygen bottles. Exhaled CO<sub>2</sub> will be adsorbed in a calcium carbonate bed. Excess cabin moisture from ambient air and exuded sweat will be adsorbed on a zeolite bed. No heating or cooling equipment is installed.

Flights will be flown in the polar vortex wave in southern Argentina, will be of 4-8h duration, and will operate above the "Armstrong Line" of approximately 63,000' (19,202m). Atmospheric conditions at anticipated altitudes will be very low pressure, and temperatures as low as -70C. Decompression Sickness risk is minimized by the closed, 100% oxygen system and relatively low rate of climb allowing long pre-breathe time. However, ebullism would occur if a cabin pressure failure occurred above the Armstrong Line. Rapid descent is available with an installed drogue chute, and a separate, ballistically deployed, whole-aircraft parachute.

Summary: The engineering solutions that were selected present unique aeromedical problems. Protection against DCS and ebullism will be emphasized. Recorded physiological and cabin environmental data will be presented. Organization of DCS treatment from this very remote location will be outlined. Special treatment methods for ebullism will be described. Scientific experiments and planned atmospheric sampling will be shown.