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Oral Presentation Abstracts

001

A VISION FOR THE FUTURE SPACE EXPLORATION MISSIONS.

UNE VISION POUR LES FUTURES MISSIONS D'EXPLORATION SPATIALE.

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Planet Earth is the cradle of humankind but, at the same time, it is its cage and nobody likes to live in captivity. It is not only a question of curiosity, it is a question of survivability and expansion over time. Achieving the possibility of orbiting around our planet was only the first step to overcome such obligation. Soon there would be a second step, made up by the stability into the Earth-Moon system, creating a suitable environment for colonization and use of local resources. We are very close to have a look at the Martian environment, therefore proceeding to Mars will be the third step, when our capabilities will allow an interplanetary mission. In a distant future, all these achievements would allow humankind an interstellar mission even if it will entail for a review of the human concept of "short term". But, as Lao Tzu says: "Even the longest journey start with a step". Space exploration is the perfect combination of science and technology; the same that allowed Columbus, centuries after the Vikings' lonely enterprise, to land in America again with a permanent settlement, taking advantages of years of evolution in technical knowledge and equipment development. Also, to settle into a new environment will need an enormous leap not only technological but social too. That's why space exploration and conquest wouldn't be a lonely hero's challenge; all together as a team we should prepare ourselves to the future. Therefore, the new vision of the human space exploration envisages the possibility that even private enterprises would support the modern space race for the benefit of the general public and the governmental organizations. Furthermore, the incoming era of the human space flights, from the sub-orbital missions to the interplanetary journey, will introduce new challenges for the aerospace medicine community, in terms of defining good medical practice to select and certify commercial professional space crew and allow space flight participants/passengers the opportunity to explore space.

002

SCREENING AND IMAGING FOR CORONARY DISEASE IN AIRCREW

DÉPISTAGE POUR LA MALADIE CORONARIENNE EN ÉQUIPAGE AÉRIEN

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Introduction: Coronary artery disease (CAD) remains the leading cause of loss of aeromedical certification in both civilian and military aircrew. Coronary events often occur without prior symptoms, and in many cases, with sudden death. The role of the AME and specialist is to try and identify aircrew at increased risk prior to an acute coronary event, and to initiate appropriate risk factor modification. This includes the use of various screening tools and increasingly non-invasive coronary imaging.

Methods: The NATO aviation cardiology working group (HFM 251) has developed consensus recommendations for screening aircrew for underlying CAD. The recommendations are based on the observation that most acute coronary events occur as a result of the rupture of non-obstructive coronary plaque. Hence, functional screening for obstructive, flow-limiting disease (eg stress testing), which has been traditionally used, has limited utility. Anatomic imaging for plaque with CT provides better identification of individuals with significant plaque burden who are at increased risk for a coronary event.

Discussion: This paper will present the NATO consensus approach to screening and investigation of potential CAD and highlight areas of discussion around the use of various imaging techniques using illustrative cases.

Conclusion: CAD remains a major cause of loss of license; a standardised, evidence based approach to screening and investigation of potential CAD, including CT imaging, may allow early detection of aeromedically important CAD.

003

CORONARY ARTERY DISEASE IN AIRCREW – WHAT TO DO NEXT?

LA MALADIE CORONARIENNE EN ÉQUIPAGE AÉRIEN - QUE FAIRE ENSUITE?

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Introduction: Coronary Artery Disease (CAD) is the leading cause of death in both men and women in most industrialized nations. Its modes of presentation (sudden cardiac death, myocardial infarction (MI), unstable and stable angina, and ischemic arrhythmias) are of paramount concern in aircrew because of possible sudden incapacitation or performance decrement. A careful examination of known CAD in United States Air Force (USAF) aviators was done to determine prevalence, risk factors, and presenting symptoms as well as long term outcomes. Using this data, as well as published data, the 8 nation member NATO aviation cardiology working group recently developed a consensus document that will be reviewed.

Methods: All aviators with CAD are followed by the USAF Aerospace Consultation Service, home to the Clinical Sciences Database which contains over 1.2 million cardiac studies on over 283,000 aviators. In this database, 172 unique aviators had CAD to include 33 with myocardial infarctions and 76 revascularizations. Current policy regarding disposition of USAF aircrew with coronary artery disease including revascularization and the recently written NATO working group consensus document was analyzed.

Results: Annual cardiac event rates in apparently healthy military aviators are approximately 0.15% per year for males aged 35-54 years. In those requiring revascularization, the most common presenting symptoms were myocardial infarction (34%), chest pain (30%) and abnormal screening tests (13%). Long term follow up in those with revascularization demonstrated a 14% rate of repeat revascularization with no MI or cardiac death at 10 years.

Discussion: All aircrew and especially military aviators are likely at low risk of CAD. Aircrew with revascularization have very low risk of recurrent MI and death and a relatively low repeat revascularization rate with close follow-up. Using this new data as well as published data a consensus document on coronary artery disease has been developed and when published should be the world's guide for aeromedical coronary artery disease disposition.

004

VALVULAR HEART DISEASE IN AIRCREW: ASSESSMENT AND IMPACT

VALVULOPATHIE CARDIAQUE PARMIS LES PERSONNELS NAVIGANT: EVALUATION ET IMPACT

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Introduction: Valvular heart disease (VHD) has a variable progression, and is asymptomatic until late in the disease process. Clinically significant degrees of VHD may result in decreased G tolerance, and a risk of arrhythmia, which may result in distraction or incapacitation. The frequency of periodic medical examinations amongst aircrew may result in the detection of milder forms of VHD when a cardiac murmur is heard. More severe may cause symptoms, which trigger further investigation. When VHD is found, appropriate assessment and aeromedical disposal must be carefully considered.

Background: Aircrew who are found to have VHD require appropriate assessment to carefully establish the severity of their disease, which guides aeromedical disposal. Interval follow up must also be planned. Methods of assessment will depend on the relevant valve lesion, severity of the disease, any interval change in the haemodynamic effect of the lesion, and onset of symptoms. In many cases, transthoracic echocardiography will be the main way of assessing VHD. However, trans-oesophageal echocardiography, cardiac magnetic resonance, exercise stress testing and echocardiography, as well as cardiac rhythm monitoring, may all play a part. Work up for valve surgery when appropriate may also prompt investigation for possible coronary artery disease.

Summary: This paper will discuss the different methods of assessing VHD, in order to inform aeromedical decision making. The risks associated with VHD will be discussed, and the potential impact of significant VHD on aircrew will be explored. VHD is a challenging area, due to the variability in the natural history of the disease, and the potential for presentation late in the disease process. An awareness of the potential haemodynamic effects of VHD on aircrew, methods which may be used to assess its severity, and the possible impact on aeromedical fitness, are all of relevance to aeromedical examiners.

005

ASSESSING CARDIOVASCULAR AEROMEDICAL RISK: BEYOND THE 1% RULE

L'ÉVALUATION DU RISQUE CARDIOVASCULAIRE AÉROMÉDICALE AU-DELA DE LA REGLE DE 1%

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Introduction: The notion of formal risk assessment in aviation cardiology was introduced at the First United Kingdom Workshop in Aviation Cardiology in 1984, at which the concept of linking aeromedical risk to accepted targets for aircraft accident rates resulted in the 1% rule. This was based on a series of assumptions relating to commercial aircraft operations with a target of less than one accident per 1000 million (10^{-9}) flying hours due to an incapacitating cardiovascular event. Over the subsequent 30+ years, risk management has evolved into a formal discipline practiced in multiple diverse sectors, with risk assessment forming an integral tool. Risk assessment now involves assessing not only the probability of an event, but also the likely consequences. Additionally, the operational role of the particular aircrew influences the likely impact of a cardiovascular event on aviation safety and mission.

Methods: The widely utilized process of risk assessment using risk matrices has been extended to the assessment of aeromedical cardiovascular risk. A risk matrix is a table with probabilities of events in rows, and consequences of events in columns. To include aircrew roles, a series of risk matrices are stacked to reflect the probable impact of a cardiovascular event in differing aircrew.

Discussion: This paper will present the concept of utilizing risk matrices to assess aeromedical cardiovascular risk, and present two illustrative cases.

Conclusion: The 1% rule established a target for an acceptable probability of an incapacitating cardiovascular event in aviation. Aeromedical risk assessment has evolved beyond utilizing simple event probability to include defining likely consequences of an event and the impact of the operational role of aircrew on aviation safety.

006

ELECTRICAL HEART DISEASE IN AIRCREW: EVALUATION AND RISK ASSESSMENT

TROUBLES DU RYTHME ET DE LA CONDUCTION CHEZ LE PERSONNEL NAVIGANT: EVALUATION DU RISQUE

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Introduction: Electrical disorders of the heart are variable and consist of bradyarrhythmias, conduction disturbances, supraventricular and ventricular tachyarrhythmias, atrial and ventricular ectopy etc. Some of them are caused by structural heart disease or genetic disorders, others occur without any underlying disease. Risk for aircrew can be diverse. It can be minimal in asymptomatic ectopy. Other arrhythmias can lead to impairment by distraction or hemodynamic symptoms. Most severe risks are sudden incapacitation or even sudden cardiac death. For some arrhythmias there are therapeutic options, which are able to restore aeromedical fitness at least with certain restrictions and after a certain observation period.

Background: Aircrew with electrical disorders of the heart have to undergo thorough evaluation with an emphasis on risk assessment. Different levels of investigation may for example consist of medical history including family history, physical examination, ECG, stress ECG, Holter monitoring, event recording, invasive electrophysiological studies, genetic and pharmacological testing. Underlying diseases have to be excluded or evaluated by examinations like laboratory tests, echocardiography, CT, MRI, or invasive coronary angiography. Therapeutic options like drugs, catheter ablation or pacemaker implantation are available for some arrhythmias and can sometimes restore aeromedical fitness under certain circumstances.

This paper will describe different levels of electrophysiological evaluation for electrical heart disease with an emphasis on risk assessment. Some electrical disorders will be taken as examples. Examination strategies for underlying diseases will briefly be explained. Therapeutic options for certain arrhythmias and their impact on aeromedical fitness will be mentioned.

Summary: The term electrical heart disease covers a large variety of arrhythmias, conduction disturbances, and genetic disorders, and is a very challenging field for every aeromedical examiner. Some knowledge about different diseases, about evaluation and risk assessment strategies, and about therapeutic options and their impact on aeromedical fitness is mandatory.

007

CARDIOMYOPATHY: IMPACT ON AIRCREW

CARDIOMYOPATHIE: IMPACT SUR L'AEQUIPAGE DE L'AIR

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Introduction: Cardiomyopathy is a disease of the heart muscle that, depending of the cause, may result in deterioration of the heart muscle and a decrease in left ventricular ejection fraction (dilating cardiomyopathy), stiffening of the heart muscle and reduction of the myocardial function (restrictive cardiomyopathy), or proliferation of myocytes with or without obstruction of the left ventricular outflow tract (hypertrophic (obstructive) cardiomyopathy, H(O)CM). Cardiomyopathy may lead to heart failure, decreased exercise capacity, and arrhythmias like atrial and ventricular fibrillation. When cardiomyopathy is symptomatic, it is incompatible with flying duties. However, there is a subset of patients with cardiomyopathy (usually hypertrophic cardiomyopathy) that is asymptomatic and has a good prognosis, and thus may be eligible for (restricted) flying. It is sometimes a diagnostic challenge to establish the diagnosis of cardiomyopathy and to differentiate it from other myocardial abnormalities, like athlete's heart, or myocarditis.

Methods: Asymptomatic aircrew with cardiomyopathy are usually found by (a combination of) an abnormal ECG and a positive family history of cardiomyopathy or Sudden Cardiac Death (SCD). The key diagnostic tool for the diagnosis of cardiomyopathy is the cardiac MRI. In aircrew, the most important risk is an incapacitating (fatal) arrhythmia. To estimate the risk of SCD in HCM, a calculator (HCM Risk-SCD Calculator) has been developed using age, echocardiographic criteria, family history, the presence of (non)sustained ventricular tachycardia and unexplained syncope as its elements. Also, genetic counseling may be used to establish the diagnosis of cardiomyopathy and to estimate the risk of SCD.

Discussion: This paper will discuss how to evaluate the risk of sudden incapacitation in asymptomatic aircrew with cardiomyopathy and how to advise them with respect to (un)restricted flying.

Conclusion: Cardiomyopathy in aircrew is a challenging disease, both for the Aeromedical Examiner and for the patient. A thorough evaluation may identify patients who can continue flying despite the diagnosis of cardiomyopathy.

008

CORONARY ARTERY DISEASE SCREENING IN AIRCREW MEMBERS: A FRENCH RETROSPECTIVE STUDY

DÉPISTAGE DE LA MALADIE CORONAIRE DANS LA POPULATION NAVIGANTE: UNE ÉTUDE RÉTROSPECTIVE FRANÇAISE

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Introduction: Coronary artery disease (CAD) is a major preoccupation for flight surgeons because of the risk of in-flight incapacity. That's why the prevention and the screening of CAD among aircrew members (AM) are systematic. The constant progress of cardiological tests, especially imaging, can help the flight surgeon to diagnose a CAD in AM before the clinical stage.

Methods: The aims of this study are to describe the population of AM with a diagnosis of CAD, and to analyze the investigations that led to the diagnosis. All the medical files of AM suffering from CAD were extracted from the 86,691 files of AM who were examined in our aeromedical center from 01/01/2010 to 12/31/2015.

Results: Our population was composed of 120 AM with CAD (mean age: 53.2 +/-8.9yo, 98.3% males, 79.2% civilians, 76.7% pilots). CAD was discovered based on acute cardiovascular events (myocardial infarction/sudden death) for 55% of the population, and on moderated symptoms (chest pain, dyspnea, palpitations) for 22.5%. For the remaining 22.5%, the diagnosis was posed thanks to the systematic resting electrocardiogram or thanks to investigations (exercise test, coronary tomography, cardiac MRI, myocardial scintigraphy) as a result of an increased cardiovascular risk.

Discussion: Coronary tomography and stress tests are interesting tools as they allowed in our study an early diagnosis of CAD before the onset of symptoms or acute events for some aircrew. Nonetheless, more than the half of our population was diagnosed after myocardial infarction or sudden death. The systematic evaluation of cardiovascular risk among aircrew members seems mandatory, and the use of cardiological tests needs to be discussed.

009

PHYSICAL AND SPORT PREPARATION FOR THE PATROUILLE DE FRANCE PILOTS

PRÉPARATION PHYSIQUE ET SPORTIVE DES PILOTES DE LA PATROUILLE DE FRANCE

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Introduction: The authors evaluate the physical and sport preparation of the 9 pilots of The Patrouille de France ("PAF"), the French Air Force flight demonstration squadron.

Method: On the occasion of their annual evaluation at the military aeromedical center of Toulon, the PAF pilots are interviewed by an anonymous questionnaire. Several aspects are searched successively: socio-demographic characteristics and lifestyle, aeronautical experience and possible remarkable aerial events, precise and detailed modalities of their sport and physical activity, and results of the military assessment tests of the physical condition.

Results: The 9 PAF pilots are fighter pilots and French Air Force officers. They are 35 years old on average and have no particular medical history. They all have a regular sport practice, mainly 3 to 6 hours per week. Despite their busy schedule, the planned sport slots are respected by all. Their practice combines endurance exercises (running and mountain biking) and split exercises (including Tabata and strength training of the back and the abdominal strap).

Conclusion: This physical background training in winter allows them to physically ensure the summer season of flight demonstrations. Despite all these results and the available bibliographic data, it is necessary to provide the PAF pilots with the best advice for their physical and sport training. The aim is of course to ensure the best, safest and best adapted sport practice to the constraints of demonstration flights.

010

IS THE EEG A RELEVANT TOOL OF SELECTION IN MILITARY AERONAUTICAL EXPERTISE?

L'EEG EST-IL UN OUTIL DE SÉLECTION PERTINENT EN EXPERTISE AÉRONAUTIQUE MILITAIRE?

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Introduction: The absence of clinical orientation coupled with the predictive value of the EEG represent the main arguments used against it in aeromedical expertise. This exam disappeared from professional civil standards but French military regulations dedicated it a determining place. The authors suggest supporting its relevance by recent data.

Method: The authors report three retrospective surveys realized in the French military AeMC. Two descriptive and monocentric prevalence studies allowed to analyze EEG considered incompatible with fitness within applicants for aircrew and military air-traffic controllers. A third multicentric and impact survey was interested in the predictive value of recorded anomalies.

Results: Global prevalence of abnormal records varies according to the studies from 3.7 to 8% and the graphical paroxysmal proportion from 1.3 to 1.9%. Drafts diffuse or focal slow activities are the most represented. The occurrence of a generalized seizure was documented among 44 subjects followed during an average period of 4.8 years.

Discussion: Global prevalence of abnormal records varies according to these studies whereas the proportions of paroxystic activities seem comparable to previous publications. The results of the impact study seem in favour of a comitality risk which must be confirmed. These elements suggest a selection strategy based on many arguments. The lack of reliable surveys does not allow the prediction of future epilepsy but highlighted paroxystic activities are at risk of transient cognitive impairment. It raises questions about flight safety whereas a military operational context is convenient to an epileptic threshold reduction.

Conclusion: In context of expertise, the EEG demonstrates functional traits related to a cortical hyperexcitability which is not synonym of epilepsy, but at risk of subtle or major clinical expression, favored in military environment by operational factors.

011

EVALUATION DE DIFFÉRENTS TESTS DE LA VISION DES COULEURS POUR L'APTITUDE EN MILIEU AÉRONAUTIQUE

A PERFORMANCE COMPARISON OF COLOR VISION TESTS FOR PILOTS' REQUIREMENT

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Introduction: Déterminer la sensibilité et la spécificité de 7 tests d'évaluation de la vision des couleurs incluant le nouveau « Colour Assessment and Diagnosis » (CAD) test, pour le dépistage, la qualification et la quantification des dyschromatopsies congénitales d'axe rouge-vert.

Méthodes: Vingt sujets trichromates normaux et 23 sujets présentant une déficience de la vision colorée, identifiés et diagnostiqués par l'avis d'un expert ont été inclus. Les résultats du CAD test ont été comparés aux tests habituels : planches d'Ishihara, tests de classement (Farnsworth D-15, 15 Hue désaturé de Lanthony, 100 Hue de Farnsworth Munsell), tests de dénomination (lanterne de Fletcher-Evans CAM et Tritest L3 de Beyne), anomaloscope de Tomey (formule de Rayleigh).

Résultats: La sensibilité est de 100% pour les planches d'Ishihara, le CAD test et la lanterne de Fletcher, 95,6% pour l'anomaloscope, 86% pour le 15 Hue désaturé de Lanthony, 82% pour le 100 Hue Farnsworth Munsell, 78% pour la lanterne Tritest de Beyne, 60% pour le Farnsworth D-15. La spécificité est de 100% pour le CAD test, les planches d'Ishihara, le Farnsworth D-15 et le 15 Hue désaturé de Lanthony, 95% pour le 100 Hue Farnsworth Munsell, l'anomaloscope et la lanterne Tritest de Beyne, 92% pour la lanterne de Fletcher. Deux sujets trichromates anormaux ont de faibles scores au CAD test, les rendant éligibles à une aptitude EASA classe 1 sans restriction. Six sujets trichromates anormaux et un sujet protanope n'ont fait aucune erreur à la reconnaissance des feux colorés à la lanterne de Beyne, autorisant une licence classe 1 sans restriction.

Conclusion. En sélection chromatique, le CAD test présente l'avantage d'être reproductible, non-opérateur dépendant, qualitatif et quantitatif, aux dépens d'une réalisation plus longue par rapport aux lanternes chromoptométriques.

012

UNE NORME MÉDICALE D'APTITUDE AU PILOTAGE EST-ELLE NÉCESSAIREMENT MESURABLE ? A PROPOS DU STADE PRÉCOCE DE LA CATARACTE ET DE SON INCIDENCE SUR LA SÉCURITÉ

IS A MEDICAL STANDARD FOR FITNESS TO FLY NECESSARILY MEASURABLE? ABOUT EARLY ONSET OF CATARACT AND ITS IMPACT ON SAFETY

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En février 2015, le BEA a publié le rapport d'enquête sur l'accident de l'avion immatriculé F-GHPN (f-pn130306.pdf) qui pose la question de la dégradation, lors d'un vol de nuit, des performances visuelles du pilote liée à l'opacification du cristallin.

Ce rapport contient deux recommandations adressées à l'AESA.

L'Agence a donné suite à la première recommandation (FRAN-2015-002) en invitant les médecins représentants des autorités nationales à diffuser l'information sur la cataracte auprès des centres et des praticiens qui relèvent de leur juridiction.

Pour la deuxième recommandation (FRAN-2015-003), l'Agence rappelle la place prépondérante du caractère mesurable du critère diagnostique et invoque le rapport de proportionnalité entre l'importance de la cataracte et celle d'autres pathologies.

La surveillance d'une cataracte par la mesure de l'acuité visuelle a pour but, thérapeutique, de déterminer le meilleur moment pour opérer un patient. Au stade précoce, c'est à dire avant que la cataracte ne diminue notablement l'acuité visuelle, la phase "infra-clinique" constitue une période de danger. Durant cette phase, le pilote répond aux critères de classe 2 mesurés en conditions standard au cabinet médical. En situation réelle, c'est aux luminances extrêmes que le pilote risque de découvrir un accroissement brutal de la gêne visuelle auquel il n'est pas préparé (pour le vol face au soleil, voir également f-zb040201.pdf).

La question de la cataracte ouvre la discussion sur les limites du "tout mesurable" et convoque, face au principe de proportionnalité, la prévention des risques spécifiques liés aux modifications progressives de l'état de santé du pilote susceptibles de le piéger.

013

REDUCED INTERFERENCE EFFECT ON TOPOGRAPHICAL WORKING MEMORY IN MILITARY PILOTS

RÉDUCTION DE L'EFFET DE L'INTERFÉRENCE SUR LA MÉMOIRE TOPOGRAPHIQUE À COURT TERME DANS LES PILOTES

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Introduction: Spatial navigation enables humans to move through a new or familiar environment to reach a target. It requires a contribution from several processes such as memory, cognitive flexibility, mental imagery and planning. It is a very complex ability that encompasses all four stages of human information processing (sensory input, perception/cognition, selection, and execution of an action), involving both cognitive and physical requirements. During flight, the pilot uses all of these stages and one of the most critical aspect is interference. In fact, spatial tasks competing for the same cognitive resource cause greater distraction from a concurrent task than another task that uses different resource modalities.

Methods: We compared the performance of pilots and nonpilots of both genders performing increasingly complex navigational memory tasks while exposed to various forms of interference. We investigated the effects of four sources of interference: motor, spatial motor, verbal, and spatial environment.

Results: We found that flight experts perform better than controls (Pilots: 6.50 ± 1.29 ; Nonpilots: 5.45 ± 1.41). In the general population, topographical working memory is compromised only by spatial environmental interference (Nonpilots: 4.52 ± 1.50) and women were less able than men. The flight expert group showed the same interference, even if reduced (Pilots: 5.24 ± 0.92); but women and men pilots did not differ in performance.

Conclusions: Spatial environmental interference is the only interference producing a decrease in performance. Nevertheless, pilots are less affected than the general population, probably as a consequence of the need to commit substantial cognitive resources to process spatial information during flight.

014

THE EFFECT OF EXPERIENCE ON DECISION MAKING AND COGNITIVE ABILITIES IN A GROUP OF ITALIAN AIR FORCE FIGHTER PILOTS AND NAVIGATORS.

L'EFFET DE L'EXPÉRIENCE SUR LA PRISE DE DÉCISIONS ET LES CAPACITÉS COGNITIVES DANS UN GROUPE DE PILOTES ET NAVIGATEURS DE LUTTE CONTRE L'AIR FORCE ITALIEN

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Introduction: To investigate the processes and mechanism(s) underlying decision making in a group of Italian Air Force fighter pilots and navigators analyzing morphologic and functional MRI data to identify brain areas involved in performing a series of cognitive tasks. The rationale for the study is to compare two groups of pilots and navigators differing in experience and number of flight hours to assess whether and how these elements influence cognitive performance. A control group will be also tested.

Methods: Two groups of fighter pilots (group 1 and 2) and two groups of navigators (group 3 and 4) belonging to the same squadron and employed on the same aircrafts will be studied. The inclusion criteria will be: age up to 30 years and number of flight hours up to 750 for group 1 and 3, and age over 30 years and flight hours over 750 for groups 2 and 4. All subjects will be matched for sex and BMI. Participants will undergo a functional Magnetic Resonance Imaging (fMRI) experiment. During the fMRI session, participants will perform a perceptual decision making task that can be solved either by following the instructed strategy or by applying an easier strategy based on the stimulus color (and not disclosed to the participant) (Schuck NW et al. 2015).

Results: After careful definition of the experimental protocol, recruiting all volunteers and collecting their informed consents, data collection has started at the "Besta" Neurologic Institute in Milan. Data are currently under evaluation and preliminary results will be available for the designed congress session.

Conclusions: Decision making processes are currently being widely investigated by using neurophysiological and neuroimaging techniques. Fighter pilots represent a very interesting model, since they undergo a highly standardized training, thus representing a homogenous population of subjects characterized by outstanding capabilities, representing a reliable model to evaluate the influence of experience and progressive training on the decision making performance.

015

HIGH-PERFORMANCE AIRCRAFT RESPIRATORY STUDY

ÉTUDE RESPIRATOIRE DANS L' AVIONS DE HAUTE PERFORMANCE

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Introduction: In 2014, the 711th Human Performance Wing conducted the High-Performance Aircraft Respiratory Study to assess respiratory symptoms among fighter pilots. Initial results have previously been reported; this effort examined multifactorial symptom etiologies using multiple analysis techniques.

Methods: Data were collected over 1 mo for four different airframes across five flying squadrons. Data collected consisted of (a) a retrospective questionnaire, (b) a prospective questionnaire after each sortie, and (c) environmental and breath sampling; this analysis focuses primarily on the prospective questionnaire. Additionally, flight recorder data was used for some squadrons if available to provide more robust analysis. Multiple analytic methods were used. As an occupational assessment, this study did not require Institutional Review Board approval.

Results: Analysis identified two different types of reported cough, generally split by airframe, duration, and presence or absence of tightness of chest. In certain airframes, the data demonstrate a correlation between cough and altitude and also between cough and heavy G-time in certain airframes. Many variables superficially associated with cough appear to be explained primarily by the variation in exposures between airframes, and the strong variation in rates of cough between airframes, but an in-depth analysis of the squadron with the highest rates of cough revealed that high altitude and low heavy G-time are useful predictors of cough in that airframe. Finally, within-airframe, within-base analysis showed preliminary indications that cough may be negatively correlated with use of the max setting on the oxygen regulator.

Discussion: Preliminary findings from the study were briefed to the U.S. Air Force Air Combat Command in early 2015 and to AsMA in 2016. The results of the current analysis contribute to a more nuanced understanding of respiratory symptoms among high- performance aircraft pilots. These findings inform further study with additional fighter squadrons; this work has been proposed.

016

NECK AND SHOULDER MUSCLE FATIGUE IN PILOTS FLYING ON EUROFIGHTER AIRCRAFT

LA FATIGUE DES MUSCLES DU COU ET DES ÉPAULES EN PILOTES VOLANT SUR UN EUROFIGHTER

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Introduction: Jet pilots undergo very high neck stress due to high level accelerations. Several papers show the association between high +Gz forces and neck injuries in fighter pilots, as reported in a review from Cockwell. According to Snijders, these forces are particularly harmful when neck flexion gets over 15°. Furthermore weight and shape of the helmet and seat-back angle are to be taken into account. Albano found an increased risk (6,9% every 100 hours of total flying time) due to F-16 aircrafts' backward reclined seat. Our study aims to evaluate neck and shoulder muscle fatigue in jet pilots.

Methods: Two experienced jet pilots were enrolled in the study. sEMG activity of neck and shoulder muscles was recorded before and soon after a flight on European Fighter Aircraft (EFA). Muscle activity was recorded bilaterally from Sternocleidomastoid, Upper and Middle Trapezius muscles. The sEMG Joint Analysis of the Spectrum and Amplitude (JASA) fatigue plots (Luttman), which analyzes temporal changes of amplitude and frequency of the sEMG signals, were calculated on root mean square values (rms) and mean frequency of the power spectrum (MNF).

Results: The main finding of this study is that, by means of JASA fatigue plot, we observed more fatigue events in both the right and left neck and shoulder muscles in the examined pilots soon after the flight.

Conclusions: It is possible to conclude that by studying sEMG fatigue parameters, it is possible to obtain more detailed information about neck stress and to provide insight towards helmet and seat design improvements. The reduction in some of the causative factors for neck pain may help to increase the career longevity of jet pilots, reducing the work compensation cost and the costs associated with training new aircrew.

017

ADVANCED BODY SENSORS AND NETWORKS FOR INFLIGHT BIOMEDICAL MONITORING

DÉTECTEURS DE CORPS AVANCÉS ET RÉSEAUX POUR LA SURVEILLANCE BIOMÉDICALE INFLIGHT

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Introduction: Wearable sensors include clothing and accessories that incorporate computer and advanced electronic technologies. A body area network (BAN), also referred to as a wireless body area network (WBAN) or a body sensor network (BSN), is a wireless network of wearable computing devices.

Background: BAN devices may be embedded inside the body, implants, may be surface-mounted on the body in a fixed position or may be accompanied devices which humans can carry in different positions, in clothes pockets, by hand or in various bags. Wearable devices are available in various types including smart glasses, smart contact lenses, smart socks, smart patches and electrodes, smart fabric, electronic shirts and suits, electronic skin patches, flexible electronics, smart earphones, smart watches, smart bracelets, smart necklaces, smart rings, transient electronics, etc. Wearable devices such as physical activity trackers are embedded with electronics, software, sensors and connectivity to enable objects to exchange data with the manufacturer, the user and/or other connected devices, without requiring human intervention. Wearable medical devices are designed for the monitoring of blood pressure, blood glucose, alertness, sleep, physical activity/exercise, vital signs (heart rate, respiratory rate, body temperature), pulse oximetry, body fat percentage, body position and posture, fall detection, electrocardiography, electro-myography, ultraviolet light exposure, bowel movements, medication intake, sweat composition (lactate, electrolytes), skin pressure, etc. Advanced body sensors and networks could be used as the next generation of non- invasive, wireless, small, light-weight, low mass, and self-powered inflight biomedical monitoring devices for aerospace crews, passengers and air ambulance patients.

Summary: The development and practical application of these advanced medical technologies are rapidly changing the scope and complexity of Aerospace Medicine and its impact on human safety and performance during flight.

018

ASSESSING THE IMPACT OF FORWARD CENTER OF GRAVITY HELMETS ON THE REPORT OF CERVICAL PAIN AMONGST F-15C PILOTS

ÉVALUATION DE L'IMPACT DU CENTRE AVANT DES CASQUES DE GRAVITÉ SUR LE RAPPORT DE LA DOULEUR CERVIQUE ENTRE LES PILOTES F-15C

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Introduction: Cervical pain is a common complaint amongst fighter pilots. With the growing use of helmets with added equipment to enhance situational awareness often comes an increase in helmet mass and a forward center of gravity (CG), potentially placing the wearer at risk of cervical pain and injury. We sought to prospectively assess the impact of forward CG helmet use in reported cervical pain amongst a cohort of F-15C pilots.

Methods: An Institutional Review Board-approved, Health Insurance Portability and Accountability Act-compliant, prospective study was undertaken with 21 male F-15C pilots. For twelve weeks, pilots logged pre- and post-flight pain using the Numerical Rating Scale (NRS), whether the forward CG joint helmet mounted cueing system (JHMCS) was employed, maximum +Gz experienced, and sortie duration. We also recorded pilot age, total high-G hours, any history of prior neck problems, and measured cervical range of motion. Pain with and without JHMCS was compared using paired t tests and correlations assessed with Pearson or Spearman coefficients.

Results: Mean flight-related pain increased by 0.729 on numeric rating scale with JHMCS and 0.517 without ($P = 0.005$). Flexed neck posture coupled with JHMCS use correlated with increased pain ($r = 0.489$, $P = 0.029$). Higher number of previously reported neck problems correlated with pain when using JHMCS ($r = 0.474$, $P = 0.040$). Age, maximum +Gz per sortie, total high +Gz hours flown, and hours per sortie did not correlate.

Discussion: Mission-related neck pain was significantly worse with JHMCS in the setting of a flexed neck posture or a history of prior neck problems. To our knowledge, this is the first prospective evaluation of cervical pain risk factors amongst fighter pilots using forward CG helmets. This information will help inform cervical pain countermeasure development.

019

CONSIDERATIONS FOR A EUROPEAN HARMONIZED EXEMPTION CONCEPT OF SINGLE COMMERCIAL HELICOPTER PILOTS AGED 60-65 YEARS

CONSIDERATIONS CONCERNANT UN CONCEPT HARMONISE EUROPEEN D'EXCEPTION POUR LES PILOTES D'HELICOPTERE ASSURANT DES TRANSPORTS AERIENS COMMERCIAUX EN SOLO A L'AGE DE 60-65 ANS

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Introduction: Single pilot commercial air transport operations by pilots aged 60-65 years are prohibited by the European Aviation Safety Agency (EASA) in line with ICAO. Several EASA Member States have already been granted exemptions under Article 14.4 of Regulation (EC) No 216/ 2008 for such pilots. These exemptions raised discussions about the different national concepts which build the basis of the exemption. This issue has been discussed in an international, interdisciplinary workshop in March 2017. One conclusion was the demand for a harmonized solution in Europe (in coordination with ICAO) and turning away from different national exemptions.

Methods: We analyzed the medical parts of the different national concepts ("mitigation measures") which led to a derogation of the age limit by EASA and compared them with the Swiss concept.

Results: Seven EASA Member States (including Switzerland) have been granted an exemption by EASA. All concepts include operational and medical mitigation measures. There is a huge variety of the medical concepts, some with numerous medical requirements, partly lacking scientific basis and causing high costs. The Swiss concept is practical and cost efficient concentrating on the cardiovascular field, in which an increased risk in this age group is proven.

Conclusions: 1) A harmonized solution for exemption of the age 60-rule must be based on scientific level and include considerations about its decision criteria, its practicability and its cost efficiency. 2) The Swiss model with its focus on the cardiovascular field would fulfill these criteria.

020

AGING REIMAGINED? COGNITIVE AND PSYCHOMOTOR FACTORS IN AGING PILOTS

LE VIEILLISSEMENT REDÉFINI? FACTEUR COGNITIF ET PSYCHOMOTEUR DANS LE VIEILLISSEMENT DES PILOTES

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Introduction: The detrimental effect of aging leads to a concern about older pilots and safety on flights in the commercial and in the general aviation. There are many stressors inherent to aviation environment that are detrimental to pilot performance. These stressors coupled with an increased age of pilots present a particular challenge; however, individuals working in such demanding environments also benefit from advantageous effect of prior experience and specialized expertise of older adults.

Background: On one side, physiological decline occurs with advancing age, however these changes can be attenuated, e.g. by exercise, lifestyle, diet etc., which makes aging a very individual process. On the other side, pilots are highly selected group with above average cognitive abilities and the question is: how long can these abilities be retained? This creates a paradox that is highly apparent in Aerospace Medicine, creating diagnostic dilemmas and challenging the fixed age limit imposed by the regulator. The degenerative effects of aging are a fact, but there are no data to justify a specific cut off point.

Summary: The non-linear relationship between age and safety, raises questions whether the cognitive abilities of experienced pilots are sufficient to counteract the chronological age-related decline, or is there a necessity of operation-specific risk assessments for medical examinations? What is acceptable aeromedical risk and operational risk? Does an older pilot pose a risk on flight and if at what age? These questions will be posed and answered during the presentation based on meta-analysis of several studies conducted in the recent years on the subject of pilot age and performance.

021

AGE LIMITATIONS FOR PILOTS INVOLVED IN COMMERCIAL AIR TRANSPORT

LIMITES D'AGE POUR LES PILOTES DE TRANSPORT AÉRIEN COMMERCIAL

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Introduction: Since 2013 several EASA States reported a shortage of qualified helicopter pilots to perform HEMS Operations. In order to be able to provide medical assistance to all patients the States in question need to use all available proper qualified pilots, including the ones with ages between 60 and 65.

Background: More and more Member States notified the European Commission that they issued an exemption from the requirements regarding age restrictions (FCL.065) for HEMS operations, allowing pilots to fly in single pilot HEMS operations until the age of 65. In order to maintain an increased level of flight safety the operators proposed medical and operational mitigating measures that involve additional medical investigation and increased frequency of the medical examinations as well as reduced working times for these pilots, periodic reports to the licensing authorities and operational restriction to national territory of the Member State. Additionally, the Member States which allowed pilots to fly single pilot HEMS operations up to 65 years old prior to the implementation of Regulation EU 1178/2011, showed that there were no occurrences involving pilots between the ages 60 to 65. However, there are not many research studies related to the risk of incapacitation for pilots above the age of 60 to demonstrate the safety of performing single pilot HEMS operations over the age of 60.

Summary: The increasing number of exemptions as well as the increasing retirement age together with an increased life expectancy and a shift towards an older age for a number of medical conditions inspired EASA to initiate a research project in order to obtain the evidence needed for a decision regarding the age restrictions for pilots involved in commercial air transport as there are multiple question still unanswered. EASA is looking to find a sustainable solution based on scientific evidence that would ensure the safety level is maintained and in the same time the operational need is mitigated.

022

THE METABOLIC SYNDROME: A THREAT FOR BOTH FLIGHT PERSONNEL AND PASSENGERS

LA SYNDROME MÉTABOLIQUE CONSTITUE UNE MENACE POUR LE PERSONNEL NAVIGANT INSI QUE LES PASSAGERS

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Introduction: The Metabolic Syndrome (MS) is represented by the presence of altered glucose / lipid metabolism, hypertension and visceral adiposity in a single individual. It affects one third of the general population and its prevalence steadily increases with age. In an aging society as the one we are living in, a strong association has been found between the MS and the development of cardiovascular disease, stroke, and diabetes mellitus, conditions which negatively influence anybody's quality of life and are also disabling for military aircrew members growing older and older. More broadly, when combined with smoking and aging, the MS is a risk factor for venous and arterial thrombosis, a well-known threat during long-haul flights.

Background: Psychosocial stress – often associated with chronically elevated cortisol levels – and poor nutrition may affect emotional and metabolic components of the MS by various mechanisms eventually leading to steato-hepatitis, male hypo-gonadism, osteopenia, and depression. Sleep deprivation may add to that too and may thus be expected to affect workaholic managers under chronic pressure as well. Moreover, alcohol induced late onset post-meal hypoglycemia may further impair work performance in flight personnel and precipitate cardiovascular events in older travelers.

Discussion: To prevent life-threatening problems during the travel, and reduce the related socioeconomic burden, strong actions should be urgently taken to limit weight gain and identify people at risk for, or affected by the MS. Pilots and flight attendants might be provided with continuous structured nutritional education and regular exercise counseling and monitoring. Extensive and hammering institutional information campaigns might also be addressed to frequent travelers through the media and reinforced at any travel agencies and airport access points. Above all, a proactive attitude should be also promoted among GPs to prevent and efficiently treat the MS as early as possible in all our aging western lifestyle societies.

023

THE ELDERLY PASSENGER

LE PASSAGER ÂGÉ

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Background: Worldwide, airlines transport more than 3 billion passengers each year. The number of aging and elderly travelers is increasing, challenging airports and airlines to respond to the physical and psychological needs of this important group of travelers. Physicians and airline personnel may be increasingly confronted with questions and risks of patients who set off for air travel, despite chronic diseases and/or use of medication. Beyond the age of 60 cardiovascular risks increase and there is accelerated deterioration in capabilities which can restrict mobility, confuse the senses and impair cognitive function. This can make airport terminals and airline flights particularly challenging for many elderly citizens.

Problem: A survey among 230 Dutch General Practitioners showed that 80% of them had no knowledge of the physical characteristics of the in-flight environment and their (patho-) physiological effects on passengers. This allows the conclusion that many physicians will not be aware of the environmental and mental stresses of air travel and elderly passengers may be ill-prepared for travel.

Summary: This presentation is aimed at discussing the challenges of air travel for elderly passengers with chronic diseases, medication, anxiety, and lack of ability to adapt to change whether or not caused by (early) dementia. It is recommended to incorporate key principles of aviation medicine in the curriculum of the basic medical education and stimulate the awareness of physicians, elderly passengers, and airport and airline management concerning the specific problems of elderly passengers. It will be discussed whether some form of pre-travel consultation should be introduced in order to facilitate a smooth journey for the elderly and to reduce problems for airports and airlines.

024

FLIGHT IN AN AGEING SOCIETY - ESAM PANEL DISCUSSION

AVIATION DANS UNE SOCIÉTÉ VIEILLISSANTE - PANEL DE DISCUSSION - ESAM

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Introduction: The 5 papers presented in the panel show different aspects of the older population and flight, from the viewpoint of assessing aeromedical risk in individuals who are part of a group with increasing health risk. The different aspects and perspectives pose some general questions which will be explored in order to involve the audience in alternative views on this complex subject.

Background: An introductory overview of some general questions regarding the ageing pilot and passenger will be given – questions which regulators, pilots and passengers in different flight environments will have to face: Do we have enough evidence to change age limits for professional pilots now, and to what age? Do we have the tools to do away with age limits? If we have these tools, how would we design aeromedical follow-up? Are there any benefits of older pilots? - to flight operators, society and to flight safety? Is there a risk/benefit cutoff point for each pilot – and is this possible to assess? Are there any new technologies which may change our acceptance criteria regarding aeromedical risk? Is it useful to incorporate key principles of aviation medicine in the curriculum of the basic medical education? Should pre-travel consultation for each elderly passenger be introduced?

Summary: The panel will challenge the audience to enter into discussion on these and other aspects, spurred by some questions - The panel members will also prepare at least one question each to each other during the course of the session, teasing viewpoints for an interesting discussion.

025

EVIDENCE-BASED APPROACHES TO SPACEFLIGHT PARTICIPANT TRAINING FOR COMMERCIAL SPACEFLIGHT

APPROCHES FONDÉE SUR L'EVIDENCE DANS L' ENTRAÎNEMENT DU PARTECIPANTS AUX VOYAGES SPATIALS COMMERCIALS

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Introduction: The commercial human spaceflight industry faces the novel challenge of preparing layperson spaceflight participants for the unique experience of suborbital spaceflight. There is currently limited experience in developing standard training techniques that have been demonstrated to be successful in training non-career astronauts for the physiological and psychological challenges of spaceflight.

Background: The recent studies in layperson tolerance to simulated suborbital spaceflight have provided a new perspective and insight into the likely needs and expectations of future spaceflight participants, as well as the potential physiological and psychological risks identified. The next step is to utilize this understanding to help guide and shape the development of specific training approaches within the commercial human spaceflight industry.

Summary: This presentation will discuss the challenges in developing such a training program and will identify potential ways in which such challenges may be addressed for the safe and successful preparation of participants for future suborbital spaceflight.

026

PUBLIC OPINION IMPLICATIONS FOR TRAINING AND COMMERCIAL SPACEFLIGHT INDUSTRY DEVELOPMENT

IMPLICATIONS DE L'OPINION PUBLIQUE POUR L' ENTRAÎNEMENT ET LE DÉVELOPPEMENT DE L'INDUSTRIE DES VOLS SPATIALS COMMERCIALS

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Introduction: The commercial spaceflight industry currently receives little guidance concerning training required of spaceflight participants (SFPs). However, it is likely that SFPs themselves, as well as the public will have innate expectations regarding such training. We sought to determine the opinions of subjects that participated in simulated suborbital flight regarding the commercial industry, to determine whether they thought their training was sufficient, and whether there was a specific training burden on the industry.

Methods: After participation in a larger centrifuge trial, subjects were provided a post-experience questionnaire inquiring about perceptions of training, centrifuge runs, and whether the training was sufficient preparation for spaceflight. They were queried regarding their opinions on the need for training and what such programs should entail, who is responsible for development of programs, and similar industry-related questions.

Results: Of the 148 subjects that participated in the centrifuge trials, 143 (96.6%) responded to the questionnaire. Overall, subjects found the training sufficient, independent of cohort length, and felt that they would be prepared for suborbital flight having completed the program. Most felt that further training or focus should be provided on emergency scenarios, and the majority stated that they would not feel comfortable flying with untrained customers. Finally, most respondents felt that the industry was responsible for providing training, but that programs should be certified by known experts in the aerospace field.

Conclusions: The results of the survey give insight into the public opinion of commercial spaceflight issues. Whether or not expectations are met may have consequences with regard to public opinion and resultant public interest in investment and participation in commercial spaceflight. Efforts towards meeting public expectation, or alternatively the education of the public concerning improved understanding of spaceflight risk and efforts towards risk mitigation may prove to have a beneficial effect on the public acceptance and interest in the commercial spaceflight industry.

027

CHALLENGES ABOUT DECISION MAKING PROCESS AND HUMAN FACTORS IN COMMERCIAL SPACE OPERATIONS – A PILOT’S PERSPECTIVE

LES DÉFIS CONCERNANT LE PROCESSUS DE DÉCISION ET LES FACTEURS HUMAINS DANS LES OPÉRATIONS SPATIALES COMMERCIALES - PERSPECTIVE D'UN PILOTE

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Introduction: Commercial space operations and activities have emerged consistently and successfully in the last decade all over the world. Human access to space with commercial vehicles will be a reality in 2018, thanks to the efforts of companies like Boeing, Space-X, Blue Origin and Virgin Galactic. However, the level of difficulty to master such an incredible feat is at least one or two orders of magnitude higher than launching unmanned payloads into space. Independently from the technology level and readiness available today, humans will remain the weak-link element to successfully foster commercial space initiatives.

Background: Traditionally, the limits of human performance will be tested within two primary areas: 1) Decision making process: 55 years of human space exploration have demonstrated that poor decisions are at the core of avoidable space tragedies, such as the Apollo 1 fire accident in 1967, the loss of the Space Shuttles Challenger in 1986 and Columbia in 2003. Root cause in all these cases was complacency with a poor decision process, substantiated by previous positive outcomes from risk scenarios not well understood. 2) Mission execution: The loss of SpaceShipTwo VSS Enterprise during a flight test in October 2014 highlighted once again the performance limits of the human mind and how “human factors” play an essential role in cockpit design and operations.

A study case will be analyzed for the SpaceShipTwo accident, with particularly emphasis on how human factors and performance have been considered in the redesign and operations of the vehicle.

Summary: Other than facing many technical challenges, human commercial exploration will need to address the multitude of risks humans trigger when directly involved in the operations of spacecraft. A methodical and consistent risk-assessment approach will allow for fully developments in commercial space exploration, allowing humanity to become a truly spacefaring civilization.

028

MEDICAL EVALUATION OF SPACEFLIGHT PARTICIPANTS FOR NASA'S COMMERCIAL CREW ERA

ÉVALUATION MÉDICALE DES PARTICIPANTS AUX VOYAGES SPATIALS À L'ÈRE DU PERSONNELLE NAVIGANT COMMERCIALE DE LA NASA

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Introduction: Eight privately supported spaceflight participant Soyuz flights to the ISS have been completed, and additional private suborbital, orbital, and even lunar fly-by flights are planned soon. The number of individuals that need screening medical examinations and flight certification is already expanding. With NASA's decision to support the Boeing CST-100 Starliner and the SpaceX Dragon 2 to provide their astronaut crew access to the ISS, this paradigm increases opportunity for private paying passengers to share missions with NASA astronauts. In this new era of opportunity, NASA medical operations will now oversee the initial medical certification for commercial crew spaceflight participants instead of the Russian medical team. However, other Soyuz flights may still be conducted.

Methods: In preparation for the commercial crew era, NASA and the International Partners have reevaluated the screening process and approved "Appendix F" that delineates the baseline testing required for medical consideration of spaceflight participants (for missions less than 30 days). Appendix F testing requirements will be presented and evaluated. UTMB currently screens candidates for suborbital, orbital, and lunar missions. This presentation focuses on the new certification requirements and the experience gained already in screening a subject whose exam was based on the Med Volume C standards and the new Appendix F testing requirements.

Conclusion: Based on our experiences, we predict interesting certification dilemmas since individuals from the public with the financial strength to afford these flights tend to be older when the prevalence of medical conditions and physical limitations are exaggerated compared to traditional career astronauts. A process of specialty examinations and consultation beyond that defined in Appendix F will occasionally be required. In addition, a thoughtful waiver process for disqualifying conditions in Med Volume C and subsequently developed medical standards will be needed to assure appropriate safety and access to these missions.

029

THE NOT SO SILENT WORLD OF LIVING AND WORKING IN SPACE: THE CHALLENGES OF ISS NOISE

L'ATMOSPHÈRE N'EST PAS AUSSI SILENCIEUX DE VIVRE ET DE TRAVAILLER DANS L'ESPACE: LES DÉFIS BRUYANT DE L'ISS

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Introduction: The acoustic environment of human space flight is often portrayed in movies as equivalent to terrestrial home or office environments, but it is not. During the historical development and operation of the International Space Station (ISS), noise levels were initially high, but have subsequently decreased over time due to the addition of quieter modules and crew quarters, and through deliberately quiet designs and modifications. However, controlling acoustic levels continues to be challenging, due to additional research and exercise equipment, as well as aging hardware. These challenges could potentially affect astronauts and cosmonauts. This presentation will discuss the noise challenges of space flight, past and present; efforts to monitor and control the noise levels; effects of spacecraft noise on hearing and communication; and how hearing is monitored in space.

Background: Noise levels during launch can be high, but they are experienced for short durations. Once on orbit noise levels are far below those considered by OSHA to be hazardous in typical occupational environments. However, space environments are not typical. Noise is present 24 hours a day, every day. The levels can have both auditory and non-auditory effects, reduce habitability, interfere with communication, and reduce a crew member's ability to detect caution and warning alarms. The ISS Multilateral Medical Operations Panel Acoustics Subgroup established standards and requirements to protect crew members. However, these standards are not always met, prompting needs for engineering solutions, including acoustical blankets, quiet fans, and vibration isolators. Sound levels are monitored throughout ISS. Crew member hearing sensitivity is assessed routinely.

Summary: While some temporary mission-related hearing threshold shifts have been measured, no permanent hearing shifts have been reported to date. This presentation will describe efforts to overcome these challenges, and share reports from two crew members on their perspectives about noise on their ISS missions.

030

GETTING TO MARS: A COMPARISON OF THE PREDICTED PHYSIOLOGIC EFFECTS FROM PROPOSED LAUNCH VEHICLES

ARRIVER À MARS: UNE COMPARAISON DES EFFETS PHYSIOLOGIQUES PRÉDISÉS SUR LA BASE DES VÉHICULES DE LANCEURS PROPOSÉS

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Introduction: Sending a spacecraft to Mars will likely require heavy lift propulsion capabilities. An examination of the anticipated physiologic stress profiles of the proposed launch vehicles is an early consideration for the mitigation of these effects on the flight crew. Indeed, the failure of the initial attempts at a retro design of the Saturn J-2 engines revealed that the acoustic (vibration) profile was outside the tolerance for the human body, and would have likely killed or injured the crew. Anticipation of these effects can help avoid wasted time and resources as we proceed with our efforts to explore beyond our earth.

Methods: A review of the known launch profile parameters of the candidate vehicles was undertaken including the Space X Falcon Heavy and the NASA SLS. Although other groups have proposals they did not yet have flight-tested hardware.

Results: Based upon the profile of the Falcon 9, the space X Falcon Heavy (consisting of three Falcon 9s) is expected to produce a G load profile of 6 to 8.5 Gs along the longitudinal axis with an acoustic vibratory profile of 0.5 to 0.9 Gs spread across a 5 - 100 Hz spectrum with lateral vibrations of 0.5-0.6 Hz. This duration will be around 500 seconds.

Based upon the known RS-25 (formerly Shuttle) engines and solid rocket boosters of the first stage of the NASA SLS, we expect a 3 G axial load similar to Shuttle and applied for 450 seconds, with vibration experienced in the 0.5-0.7 range, again across a 5 - 100 Hz spectrum. However, the second stage JX-2 engine profile has not been completely confirmed, and is not yet released. The first attempt on the JX-2 resulted in vibrations exceeding human tolerances in the 8-15 Hz range.

Conclusion: The currently proposed Mars expeditionary vehicle Space X Falcon Heavy appears compatible with human physiology as projected with the SLS status pending.

031

CONTRAST SENSITIVITY ASSESSMENT OF MILITARY AIRCREW ASPIRANTS ON INDUCTION: REINFORCING THE VISUAL STANDARDS

ÉVALUATION DE SENSIBILITÉ DE CONTRASTE D'ASPIRANTS MILITAIRES MEMBRES D'ÉQUIPAGE SUR L'INDUCTION: RENFORCER LES NORMES VISUELLES

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Background: The requirement of optimum vision for military aircrew operating in difficult terrain and marginal weather condition cannot be overemphasized. Research carried out over the past decades brings out the fact that Contrast Sensitivity (CS) correlates better with air-to-ground or ground-to-air visual tasks compared to conventional visual acuity tests. Despite this, most of the medical evaluation guidelines worldwide are silent about this parameter. While flying over a featureless terrain or low contrast environmental conditions (i.e. haze, fog, dawn, dusk) CS takes the upper hand over visual acuity for optimal performance. Vibration is an unavoidable stressor in aviation and higher levels of this stress experienced by helicopter and transport aircrew may put their visual performance in jeopardy. This study assesses the changes in CS under simulated low frequency whole body vibration, encountered in operational scenario.

Material and Methods: 30 healthy volunteers were assessed for their CS under low frequency whole body vibration using Multi-axial Vibration Simulator. Vibration frequency along the Z-axis varied from 4-20 Hz (fixed at X, Y-axes) for a period of 30 min. CS was measured in no vibration, under vibration and on recovery, using CSV-1000 equipment at spatial frequencies of 3, 6, 12 and 18 cpd in photopic conditions.

Results: Statistically significant changes in CS were observed across some vibration and spatial frequencies. No significant detrimental effect was recorded on CS post 30 min of continuous vibration as compared to baseline.

Conclusion: As optimal contrast perception is an integral part of vision while carrying out aviation tasks, any significant amount of deterioration in this visual parameter, as an effect of vibration or any other aviation stressors, is of aeromedical significance. Testing Contrast Sensitivity as a part of routine vision assessment in candidates will ensure selection of a superior military aircrew.

032

OPERATIONAL BASED VISUAL ASSESSMENT (OBVA) CONE CONTRAST TEST HIGH DEFINITION (CCT-HD) RESEARCH AND DEVELOPMENT

EVALUATION VISUELLE OPÉRATIONNELLE (OBVA) CONE CONTRASTE TEST HAUTE DÉFINITION (CCT-HD) RECHERCHE ET DÉVELOPPEMENT

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Introduction: The United States Air Force (USAF) introduced a computer-based color vision test in 2011-the Rabin cone contrast test (RCCT), to replace pseudoisochromatic plate (PIP). The RCCT measures contrast thresholds with stimuli stimulating a single cone type of a color vision normal (CVN) observer, reliably screens and classifies the type of color deficiency. However, the RCCT has limited contrast levels and imposes a ceiling effect, with most (CVN) individuals scoring a maximum value of 100. To further refine color vision testing, OBVA developed a new CCT-HD color test with improved accuracy, reliability and is a paradigm shift in color vision testing.

Methods: Approximately 1,500 USAF pilot candidates were tested using the CCT-HD and RCCT during medical screening. The test was administered either binocularly or monocularly and some participants repeated the test to examine test-retest reliability. Color deficiency was assessed based on RCCT monocularly criteria (log contrast threshold for L- or M-cone tests > -1.65).

Results: Mean CVN individuals' binocular L- and M-cone log contrast sensitivities were approximately -2.21 and -2.15, respectively. CVN mean monocular L- and M-cone log contrast sensitivities were approximately -2.08 and -2.02, respectively. Among the USAF pilot candidates tested, approximately 3.9% were classified as deutans, and approximately 0.7% as protans. Test-retest reliability of the CCT-HD was good (M-cone $R_2 = 0.87$).

Conclusion: The CCT-HD accurately and reliably tests both congenital and acquired color deficiency, eliminating the annual requirement in the USAF for the former and delaying the latter testing until age indicated. The improved accuracy and reliability of the CCT-HD provides the capability to establish distribution thresholds of CVN individuals, not previously possible with the RCCT. Subtle color changes can now be researched. The improved precision of the CCT-HD tests the full range of color capabilities to examine potential impact on operationally-relevant performance.

033

CLINICAL CASE - REVERSAL OF COLOR PERCEPTION AND ALTERATION OF VISUAL FIELDS AFTER DEFECT ACQUIRED IN A COMMERCIAL PILOT

CAS CLINIQUE - INVERSION DE LA PERCEPTION DES COULEURS ET ALTÉRATION DES CHAMPS VISUELS APRÈS UN DÉFAUT ACQUIS DANS UN PILOTE COMMERCIAL

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Introduction: Color perception, is a complex process involving both retinal and occipital visual cortical activity. Normal individuals have three types of cones with normal amounts of their respective pigments and use all three mechanisms in color perception and color matching. Color vision defects occur when there is deficiency in one or more of the three cone pigments, and there are all grades of severity of the defects. There are variations in the prevalence of color vision defects. Caucasians have the highest prevalence. African Americans, Japanese and Chinese have about half this prevalence, and the lowest rate is found in native Africans.

Case: The case involves a First-Class Pilot, Cape-Verdean, male, 27 years old, who after three years as a Commercial Pilot presents alteration in color perception and tubular vision. The ophthalmologic examination presented bilateral 10/10 visual acuity, marked degradation of color vision - 1/17 in the ISIHARA TEST, inside the ophthalmology office and when tested in daylight (chromatic desaturation). In the computerized Campimetry he had marked constriction of the visual fields, bilateral, more pronounced to the left. Deny family history of color blindness. Denies consumption of illicit substances and medicines. Deny cranial-head trauma.

Discussion: The pilot was assessed as unfit according to national and ICAO international rules. This is the first national registered case of acquired color vision defect and abnormal fields of vision, without identifiable cause, and that motivated the cancellation of the license of the pilot. After two years, the situation was reversed, and the pilot is currently in possession of his license, after demonstrating that he is fit. The causes of those changes are still not clear.

034

GINGER ROOT POWDER FOR THE PREVENTION OF AIR SICKNESS: A RANDOMIZED CONTROL TRIAL

POUDRE DE RACINE DE GINGEMBRE POUR LA PRÉVENTION DE LA MALADIE DE L'AIR: UN ESSAI DE CONTRÔLE RANDOMISÉ

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Introduction: Airsickness is a common problem affecting aircrew. Among trainee pilots, 30-40% become airsick in their first air experience. Drowsiness as an adverse effect of most anti-motion sickness drugs precludes their use in aviation. A new approach to prevention of airsickness symptoms incorporates the use of ginger root (*Zingiber officinale*) powder along with physical exercise therapy and progressive muscle relaxation.

Methods: Subjects (n=21) were randomly allocated into two groups; test (n=11) and control (n=10). The test subjects were administered 1g ginger root powder (*Zingiber officinale*) mixed with pulverised glucose everyday 4h prior to exposure to the provocative stimulus. The controls were given plain pulverized glucose powder. Subsequently, the subjects underwent yogic exercises, physical exercise therapy and progressive muscle relaxation, followed by exposure to gradually increasing provocative motion on the Barany chair. The subjective response to each provocative motion was assessed using the Motion Sickness Assessment Questionnaire (MSAQ). Overall motion sickness scores and specific scores for 4 different dimensions of motion sickness were calculated and compared between the subjects and controls. Mann Whitney U test, a nonparametric test, was utilized to compare the scores.

Results: The subscale scores for all the four dimensions of motion sickness were found to be lower in the test group as compared to the control group. The overall motion sickness scores were also found to be lower in the test group.

Conclusion: Ginger root powder can be safely introduced as a modality of supportive treatment for the prophylaxis of air sickness.

035

SPATIAL DISORIENTATION CAUSING AN ARMY HELICOPTER CRASH: CASE REPORT AND DISCUSSION OF POTENTIAL COUNTERMEASURES

DISORIENTATION SPATIALE CAUSANT UN CRASH D'HÉLICOPTÈRE DE L'ARMÉE: RAPPORT DE CAS ET DISCUSSION DE CONTRÔLES POTENTIELS

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Background: Spatial disorientation is acknowledged to be a frequent cause of helicopter accidents, both in military and civilian flight operations. By analyzing contributing factors in specific accidents, indications for further research and specific countermeasures may be gleaned. This presentation describes such an accident, highlighting some familiar characteristics as well as challenges ahead for aeromedical and safety practitioners.

Case: A US Army UH-60 Black Hawk took off in a flight of two helicopters into foggy night conditions for a training troop insertion mission. The accident aircraft continued after the other aircraft aborted due to poor visibility conditions. The experienced crew became disoriented; attempts to maintain control, including engaging the autopilot, failed and the aircraft subsequently impacted the water with fatal results.

Discussion: As a result of this accident, several countermeasure strategies are being pursued: 1) Education: The hazards of spatial disorientation are stressed to aircrew at every opportunity. 2) Training: A series of disorientation scenarios have been designed for UH-60 simulators to illustrate the circumstances of this accident (and others) and corresponding avoidance techniques; 3) Displays: Research is underway to assess the effects of multisensory cuing (i.e., visual, auditory, tactile) on aircrew workload, situational awareness, and the maintenance of spatial orientation. 4) Technology: While the real-time measurement of aircrew state, to include orientation, is still in the research domain, future aircraft will benefit from adaptive automation systems that sense the aircrew's workload, orientation, and capacity to safely control the aircraft.

Conclusion: The occurrence of accidents like the case reported indicates the continuing need for research into spatial disorientation. Countermeasures may range from simple training techniques to very expensive future enhancements to aircrew cuing and flight control systems. Eliminating this frequent accident cause must remain a top priority.

036

CLINICAL PRELIMINARY STUDY OF NEW VESTIBULAR FUNCTION DETECTION, CORRECTION AND TRAINING EQUIPMENT

ÉTUDE PRELIMINAIRE CLINIQUE DE UN NOUVEAU ÉQUIPEMENT POUR LA DETECTION, CORRECTION ET DE L' ENTRAÎNEMENT DU NERF VESTIBULAIRE

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Introduction: To explore the effectiveness of new vestibular function detection, correction and training equipment for the pilots' vestibular function.

Methods: 35 healthy Chinese pilots were stimulated by rotation with the spindle rotating 1570° while the auxiliary axis rotating 1565° of the 3D rotation stimulus in the equipment. The difference was compared between the residual angle of gravity, the residual angle of the horizontal plane and the time of the third active adjustment after three rotations and to monitor the change of blood pressure before and after rotation.

Results: There was no significant difference the residual angle of gravity ($6.04 \pm 10.70^\circ$, $3.57 \pm 3.97^\circ$, $3.41 \pm 2.93^\circ$, $P=0.199$), active adjustment time ($190.114 \pm 87.328s$, $178.014 \pm 110.811s$, $173.743 \pm 87.332s$, $P=0.760$) and blood pressure before and after the three times rotations. However, the residual angle of the horizontal plane is statistically significant ($94.930 \pm 58.826^\circ$, $66.736 \pm 45.989^\circ$, $65.494 \pm 47.989^\circ$, $P=0.028$).

Conclusions: The three-dimensional rotating equipment that can detect the function of the three pairs of semicircular canal and two pairs of otolith organ can be useful of the vestibular rehabilitation training and also detect blood pressure, EEG, ECG and other physiological signals. The results of this study found that adaptive training of the saccule is effective. Therefore, the research group will further explore the function of this equipment in the next clinical study.

037

NEUROFUNCTIONAL ACTIVATION OF HUMAN VISUAL CORTEX IN AMBLYOPIA INDUCED BY S/NRI TREATMENT AND SENSORY STIMULATION. POTENTIAL APPLICATION FOR AN EYESIGHT IMPROVEMENT

ACTIVATION NEUROFUNCTIONNELLE DU CORTEX VISUELLE HUMAIN EN AMBLYOPIE INDUITE PAR TRAITEMENT S / NRI ET STIMULATION SENSORIELLE. APPLICATION POTENTIELLE POUR UNE AMÉLIORATION DE LA VUE

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Introduction: The effective role of long-term antidepressant administration in promoting the neurogenesis and synaptogenesis as well as in increasing the expression of the Brain Derived Neurotrophic Factor (BDNF) has been clearly demonstrated. A model of neuronal restored plasticity has been also demonstrated in the visual cortex of amblyopic adult rodents treated with the Selective Serotonin Reuptake Inhibitor. Amblyopia, otherwise known as "lazy eye", is a disorder of the visual system characterized by poor or indistinct vision in one eye.

Methods: Our observation has been focused on 3 male adult subjects with different levels of amblyopia. We measured the Best Corrected Visual Acuity (BCVA) at T0, T1 and T2 (respectively 0 - 6 - 12 months. For one subject we also measured the Visual Evoked Potentials (VEPs), with pattern reversal of 15° and 60°. We also prescribed: daily exposure for one/two hour/s to visual stimulation of the amblyopic eye (such as watching TV) for the whole period of observation; and daily intake of a Serotonin/Noradrenalin Reuptake Inhibitor antidepressant.

Results: Measurements at T2 showed stable, functional, increase of BCVA in all cases; for the subject investigated with VEPs, a decrease of P100 Latency Peak Time in msec and an increase of N75- P100 Amplitude in μ V.

Discussion: The clinical and the experimental results of the cases observed seem to confirm other findings and to demonstrate that also the human adult's neuronal cortex never completely developed, as the amblyopic one can be activated or shaped, after proper stimulation, in order to support its natural and specific function. The elicited functional/ structural adaptations observed in our cases, with the improvement of the eyesight BCVA and the VEPs, might be explained through the mechanism of neuroplasticity, likely enhanced simultaneously by the S/NRI related production of BDNF and the active visual-sensory stimulation. If confirmed by further research, a potential clinical application might be proposed for other similar conditions.

038

APPLICATION OF HUMAN CENTRIFUGE TO SIMULATE PARABOLIC FLIGHT: EARLY EXPERIENCE

*APPLICATION DE LA CENTRIFUÏE HUMAINE POUR SIMULER LE VOL PARABOLIQUE:
EXPÉRIENCE ANTÉRIEURE*

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Introduction: We have used the human centrifuge to simulate parabolic flight environment. Psychophysiological and technical aspects of using the centrifuge will be presented.

Method: Tests were carried out on five candidates taking part in a parabolic flight programme. The flight profile was adjusted to replicate characteristic conditions and specificity of a parabolic flight. The study was performed as a practical test in a variable acceleration environment similar to real parabolic flight (with G-limits: max. +2 Gz, min. 0 Gz, and 20 repetitions of a cycle). Evaluation of eye-hand coordination, orientation and Romberg tests were performed. Each candidate was monitored (HR, ECG, SaO₂, ear pulse). The exposure was performed twice on two consecutive days.

Results: All participants positively completed the expositions. They reported that they had the illusion of microgravity. They exhibited similar hand-eye coordination issues as in microgravity. However, with repeated exposures changes in their heart rate were decreasing, pointing to their adaptation to the procedure.

Conclusions: Trained behaviours and organism reactions have been afterwards successfully used and verified during the real parabolic flight organised by the ESA. Despite the preliminary nature of the study, there were obtained promising results, which may be further developed and ultimately used to improve the quality and effectiveness, especially cost effectiveness of ground preparation for astronauts to microgravity.

039

MICROGRAVITY MAINTAINS STEMNESS AND ENHANCES GLYCOLYTIC METABOLISM IN HUMAN HEPATIC AND BILIARY TREE STEM/PROGENITOR CELLS

LA MICROPESANTEUR MAINTIENT LA SOUCHITUDE ET AMÉLIORE LE MÉTABOLISME GLYCOLYTIQUE DES CELLULES HÉPATIQUE ET DES CELLULE SOUCHES/PROGÉNITRICES DE L'ARBRE BILIAIRE HUMAIN

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Introduction: Liver diseases represent a major public health problem affecting 5-15% of the inhabitants worldwide. The final manifestation of chronic liver diseases is cirrhosis. When a successful etiologic approach is unavailable or has failed, progressive, extensive fibrosis, with concurrently impaired hepatocyte regeneration, leads to irreversible cirrhosis and then liver failure. Resident stem cells play a key role in driving the process of liver repair and, indeed, they are currently taken into consideration for the cell therapy of terminal liver diseases and for the liver regenerative medicine. Gravity plays a key role in regulating cell processes such as proliferation, differentiation and cell function. The aim of our research was to evaluate the effects of microgravity on differentiation and exo-metabolomic profile of human hepatic and biliary tree stem/progenitor cells.

Method: Simulated weightless conditions were obtained by using the Rotary Cell Culture System (RCCS, Synthecon). Primary cultures of human biliary tree stem cells (hBTSCs) and immortalized human hepatic cell line (HepG2) were cultured in microgravity or in normogravity conditions. Self-replication and differentiation toward mature cells were determined, respectively, by culturing in Kubota's Medium and hormonally defined medium tailored for hepatocyte differentiation. RT-qPCR was used to evaluate gene expression and NMR to analyze the cell exo-metabolomic profile.

Results: Microgravity determined an increase of stemness genes (OCT4, SOX17, PDX1) in hBTSCs ($p < 0.05$ vs normogravity). hBTSCs cultured in microgravity showed an impaired capacity to differentiate toward mature hepatocytes, since the expression of hepatocyte lineage genes (ALB, ASBT and CYP3A4) was significantly lower with respect to normogravity ($p < 0.05$). In HepG2, the microgravity caused a lower ($p < 0.05$ vs normogravity) expression of CYP3A4, a terminal differentiation gene expressed in lobular zone 3. The NMR PCA of the exo-metabolomic cell profile evidenced that, in microgravity, both cell lines presented higher glucose consumption and lower consumption of pyruvate and glutamate with respect to normogravity ($p < 0.05$), with formation of fermentation.

040

MRI CHANGES IN HUMANS AND SWINE FOLLOWING HYPOBARIC EXPOSURE – POSSIBLE CELLULAR EXPLANATION FOR WHITE MATTER INJURY

IRM DES CHANGEMENTS CHEZ LES HUMAINS ET LES PORCS APRES EXPOSITION HYPOBARE – POSSIBLE LESION CELLULAIRE DE L'EXPLICATION DE MATIERE BLANCHE

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Introduction: Human exposure to hypobaric conditions is associated with both focal and diffuse subcortical brain injury. We hypothesized that MRI parameter changes following single exposure in humans and repetitive exposure in swine would occur, possibly suggesting a cellular mechanism for the injury.

Methods: Magnetic resonance imaging/spectroscopy (MRI/S) was performed on 80 exposed human subjects and 60 controls before and after single exposure. Additionally, MRS/I was performed on 38 exposed swine and 12 controls before and after repetitive exposure. A two-tailed paired t-test was used for comparison.

Results: Exposed human subjects had a significant decrease on MRS#2 in frontal lobe white matter myo-inositol ($p=0.030$) with a trend in other metabolites. Exposed swine had a significant increase in interstitial water content ($p=0.002$).

Discussion: These human metabolite changes are consistent with acute oxidative stress affecting the glial and neuronal components of white matter, possibly reflecting a decrease in mitochondrial function. These swine fluid changes are consistent with acute interstitial white matter injury. These findings would be consistent with changes previously noted in human single exposure cerebral blood flow and human recurrent exposure white matter injury. This data raises the spectrum that every exposure incites an acute traumatic brain injury and that recurrent exposure within a critical window of susceptibility incites permanent damage. Additional study is warranted.

041

INCREASED CEREBRAL BLOOD FLOW RELATED TO HIGH ALTITUDE EXPOSURE – MRI ASSESSMENT OF AIRCREW IN THE HYPOBARIC ENVIRONMENT

A AUGMENTÉ LE DÉBIT SANGUIN CÉRÉBRAL LIÉ À L'EXPOSITION DE HAUTE ALTITUDE – ÉVALUATION DE MRI DE L'ÉQUIPAGE DANS L'ENVIRONNEMENT HYPOBARE

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Introduction: Subcortical white matter (WM) injury and global decreased fractional anisotropy are associated with repetitive exposure to non-hypoxic hypobaric conditions. A single hypobaric hypoxic occupational exposure to 7,620 m (5.45 psi) induces magnetic resonance imaging (MRI) changes that reflect transient brain injury.

Methods: Subjects underwent 3T MRI brain examinations 24 h pre-exposure and 24 and 72 h post-exposure. 90 U.S. Air Force aircrew trainees undergoing occupational altitude chamber training and 65 age-matched control subjects not exposed to hypobaria were evaluated. MRI protocol included fluid-attenuated inversion recovery images, magnetization-prepared rapid gradient-echo sequences, and arterial spin labeling perfusion imaging. Statistical analyses were performed with a linear mixed model for within group comparisons and with a generalized additive model for intergroup comparisons.

Results: WM cerebral blood flow (CBF) at 24 h post-exposure increased by 6% ($p=0.004$) while gray matter (GM) CBF increased by 5% ($p=0.006$). At 72 h post-exposure, CBF remained significantly elevated (WM 6%, $p=0.021$; GM 6%, $p=0.037$). No significant change in CBF was observed in the control subjects (WM $p = 0.154$; GM $p = 0.563$). Exposure vs. control group comparison was statistically significant, WM $p=0.002$; GM $p=0.054$. There were no WM fluid- attenuated inversion recovery or gradient echo changes.

Discussion: Results demonstrate up-regulation of both GM and WM CBF 24 h post exposure to hypobaric training that persists at 72 h. This reflects an increased metabolic demand and suggests a transient cerebral injury has occurred, equated to a concussive-like injury. Repetitive hypobaric exposure prior to an adequate recovery period, a "double-hit" process, may characterize an underlying basis for previously reported subcortical WM injury.

042

ALTITUDE DECOMPRESSION SICKNESS RISK FACTORS REVISITED

FACTEURS DE RISQUE DE MALADIE DE DÉCOMPRESSION D'ALTITUDE RÉVISÉS

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Introduction: Altitude Decompression sickness (DCS) risk prediction is crucial to designing protective equipment and procedures for individuals exposed to high terrestrial altitude or low pressure extra-terrestrial environments. The four critical factors for developing an accurate DCS risk model are prebreathe time (denitrogenation by breathing 100% oxygen), altitude, level of activity while decompressed, and duration of exposure. The level of activity while decompressed has been inadequately quantified in earlier models. Another factor, altitude, has been based on linear measures of altitude, despite the non-linear relationship between altitude and pressure. The current effort demonstrates that revised DCS risk factors provide more accurate inputs to be used in a DCS risk model in development.

Methods: Effect of prebreathe time was based on USAF and NASA research with all other conditions, altitude and level of activity being fixed. Altitude of exposure in feet was converted to exposure pressure in mmHg, and further converted to Tissue Ratio (TR). Effect of level of activity, defined as the highest 1-min of oxygen consumption (ml) per kg per min, was used as reported in previous research publications from Brooks City-Base, TX. The trendline equations for each parameter were used to compare the basis for model in input with results of the previous research.

Results: Equations and graphs of each of the parameters have been shown to better reflect their actual effect on DCS risk. The remaining factor, time at altitude, has a sigmoidal relationship between duration of exposure and risk of DCS and can be adjusted by the other three parameters.

Conclusions: The parameters of prebreathe time, TR, and level of activity should provide more accurate and relevant results than previous models. However, their integration with exposure time has been problematic and, at this writing, is still in development.

043

HUMAN PHYSIOLOGY DURING EXPOSURE TO CAVE ENVIRONMENT: A SYSTEMATIC REVIEW AND POTENTIAL FUTURE IMPLICATIONS FOR AEROSPACE MEDICINE

LA PHYSIOLOGIE HUMAINE LORS DE L'EXPOSITION À L'ENVIRONNEMENT DES GROTTES: UNE ÉTUDE SYSTÉMATIQUE ET DES IMPLICATIONS FUTURES POSSIBLES POUR LA MÉDECINE AÉROSPATIALE

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Introduction: Cave environment has become one of the last frontiers of exploration on earth. Caves, in fact, are characterised by absence of light and day/night cycles, specific environmental conditions, confinement and three-dimensional human movement. Since 1938, studies in caves have been conducted on human behaviour, physiology and neuroscience. In the 70's, Siffre's and Montalbini's isolation studies attracted space agencies' interest. The European Space Agency (ESA) established a course in 2011 for Cooperative Adventure for Valuing and Exercising human behaviour and performance Skills (CAVES) in caves. However, little is known about human physiological responses during a stay/exploration in a cave. The aim of our review was to conduct a systematic bibliographic research review of human studies associated with permanence in caves, with a view to extend the results to implications for human planetary exploration missions.

Methods: A systematic search was conducted following the structured guideline PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) of electronic databases (Google Scholar, MEDLINE, NASA Technical Reports Server, OPAC, WorldCat) and manually searching reference lists of the articles investigating human body responses during a stay/exploration in a cave.

Results: The systematic search retrieved 2097 articles. There were 156 articles selected for further revision. Articles were classified into seven categories: atmospheric science (24), emergency medicine (61), human factors (0), human physiology (23), neuroscience (29), psychological aspects (4) and radiation (15). An analysis of the methods of each study revealed wide discrepancies with respect to the selection and number of participants, the nature of the experimental protocols, and degree of scientific rigor.

Discussion: Our study provides the first comprehensive overview of physiological human studies related to the underground environment. The review will facilitate comparison with knowledge in related disciplines, stimulate research and offer an opportunity for implementation of human space analogue research in underground environments.

044

SOME CONSIDERATIONS ON AIRCREW EXPOSURE TO COSMIC RAYS

QUELQUES CONSIDÉRATIONS SUR L'EXPOSITION DES L'AÉRIENNE EQUIPAGE AUX RAYONS COSMIQUES

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Introduction: Cosmic rays still represent a concrete problem in terms of Aircrew radiation exposure. From our review on the state of art, this matter appears well investigated and regulated, various actions have been also taken to contain the related health risks but It is anyway our opinion that further efforts in this field are needed. Our first experimental step was to assess a first level radiation exposure estimation in real time and retrospective way.

Methods: Radiation exposure was assessed on five routes, five military flights, of different contexts in terms of Altitude (range 25kft-37,8kft) and Latitude (range 41-59) by using the CARI-7 (FAA's Civil Aerospace Medical Institute; ICRP pub. 103) computer program in retrospective way. We also used on board a simple and very light geiger detector (Gammascout, GmbH), well aware of its technical limitations we considered anyway useful the possibility to detect in real time and have a recorded track of in-cockpit ionizing events during the flights.

Results: Average Effective-Doses, estimated on higher and longer routes with greater latitude displacements (to the North), was 10.8 μSv for an average time of flight of 2.62 hours. In low altitude and short latitude displacements routes it was estimated an Effective-Doses value of 3.25 μSv for 2.7 hours. The simple Geiger device, as expected, provided a dose estimation of about 30% lower but was able to detect coherently, in the recorded time course, the effects of altitude and latitude in terms of dose-rate.

Conclusions: Due to the scenario complexity of cosmic rays, many related issues remain still open, in particular in high altitude flights, Air Force and space mission contexts. Our objective is to create a multidisciplinary research team (Astrophysicists, Health Physicists, Engineers, Military Crews, Aerospace Medicine Experts...) focusing on the improvement of real-time dosimetry and development of innovative shielding strategies.

045

DEVELOPMENT OF “IN VITRO” MODELS TO STUDY WOUND HEALING IN SPACE – THE SUTURE EXPERIMENT

DÉVELOPPEMENT DES MODÈLES “EN VITRO” POUR ÉTUDIER LA CICATRISATION DANS L'ESPACE - L'EXPÉRIENCE SUTURE

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Introduction: In interplanetary missions medical evacuation times to Earth might become too long. Therefore, the future planning procedure for medical care in space should incorporate space surgery and trauma care concepts. A critical aspect in surviving a trauma or surgery is wound healing. The little literature on wound healing in weightlessness is controversial. The prevailing evidence and our previous studies indicate an impairment of the healing process. The experiment “Wound Healing and Sutures in Unloading Conditions”, selected by ESA to be performed on the ISS, is conceived to study in weightlessness the behavior and healing of “in vitro” sutured wound models. In addition to biological parameters, the tensile strength will be monitored, because tissue mechanical properties strongly affect wound healing and regeneration processes. The goals of on ground activity for experiment preparation were to model physiological tensile strength and ensure tissue survival throughout the experiment (3 weeks).

Methods: Skin and blood vessels biopsies derived from surgical procedures for abdominoplasty or breast reduction in healthy subjects (under informed consent). Specimens were stitched to a frame, specifically developed to apply a tension similar to the physiological one, and cultured in different media. To model sutured wounds, little cuts (10 mm length, 2 mm depth) were performed on skin and sutured with interrupted stitch 3.0 non absorbable suture (Nylon), while vessels were completely divided to perform an end-to-end vascular anastomosis with continuous 6.0-8.0 non absorbable suture (Polypropylene).

Results: Applying a proper tension and adding hormones, pro-angiogenic and antioxidant factors to culture media, we strongly improved tissue survival as shown by histology and electron microscopy

Conclusions: We developed a tissue culture technique able to model tensional strength in tissues and ensure tissue survival for over 3 weeks. This technique and resulting models can be applied also on ground to: tissue culture and engineering for transplantation and regeneration, studies for improvement of surgical techniques and materials.

046

THE CROSS-SECTIONAL STUDY OF HIGH-RISK DISEASES IN CIVIL AVIATION PILOTS

LA RECHERCHE À SECTION TRANSVERSALE DES MALADIES À HAUT RISQUE PARMIS LES PILOTES DE LIGNE

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Introduction: Focusing on civil aviation pilot health is one of the most important works in airline safety. This study aimed at understanding the prevalence and characteristics of high-risk diseases, which may cause pilots grounded or disabled.

Methods: According to our HSMS (health safety management system), which provides the items of high-risk diseases, we collected the medical record of physical examination, including age, area, flight hours, physical conclusion and diseases of each pilot in our company in 2016. The statistical analysis we chose were descriptive statistics, Chi-square test and nonparametric test and the software was SPSS20.0.

Results: There were 5889 Chinese pilots in service. The prevalence of cardiovascular disease was 9.7% (hypertension accounted for 5.36%), ranking the first among all the high risk diseases, followed by cholelith disease (0.9%), brain disease (0.6%), type 2 diabetes (0.5%) and urinary calculi (0.3%). The prevalence of cardiovascular disease increased with age and reached the highest in the 50-plus age group, 40.1%. The prevalence of cardiovascular disease in Dalian was 22.0%, which was higher than other regions, and the province of Heilongjiang and Henan were followed with 14.1% and 13.6%, respectively. The prevalence of cholelithiasis in Guangzhou, Hubei and Xi'an were 2.82%, 2.55% and 3.33%, respectively, and higher than the other areas. Flight hours of pilots with cardiovascular diseases, brain disease and urinary calculi were less than pilots with no disease, respectively. The difference above was statistically significant ($p < 0.05$).

Conclusion: The prevalence of cardiovascular and cholelith disease were the top two among high-risk diseases, and the distribution of regions was different. In the future, it is necessary to find out targeted measures to reduce the prevalence of high-risk disease to keep airline safety.

047

AEROMEDICAL EXAMINATION OF ROTARY WING PILOTS-A FORGOTTEN CLASS 1: RETROSPECTIVE ANALYSIS OF AN ACCUMULATING ANNUAL RECORDS OF 2013-2015 IN KOREA

EXAMEN AÉROMÉDICAL DES PILOTES D'AILE ROTAIRES - UNE CLASSE OUBLIÉ: ANALYSE RETROSPECTIVE D'UN DOSSIER ANNUEL ACCUMULANT DE 2013-2015 EN CORÉE

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Introduction: The medical certification for pilots is required by the aviation safety authority in most countries based with the ICAO recommendation.

Methods: Medical data of the years of 2013-2015 for the Korean rotary-wing pilot population, including examination findings and reasons of unfitness, were reviewed by retrospective analysis.

Results: Among the total 1791 cases, 190 (10.6%) were determined to be conditioned fit as a consequence of abnormal findings. Nine (0.5%) were denied certification as unfit. Hearing loss (32.8%) is the most common cause of disqualification, differing from that of fixed-wing pilots. It is not surprising data in that helicopter is notorious for its noise and vibration compared with fixed-wing aircraft during flights. Hypertension (23.9%) and diabetes (9%) are following causes. There is an increasing tendency of medical unfitness as pilots' age or total flight time is increased respectively. Rate of the conditioned fit tends to be significantly increasing as age of 55 or more or the flight time of 5,000 hours or more.

Conclusion: These results suggest that aeromedical decision should be made under understanding of the influence of age, total flight time and aircraft type to ensure flight safety.

048

RELATIONSHIP OF ASSIGNMENT LIMITATION CODES TO ACCESSION WAIVERS IN THE USAF

RELATION DES CODES DE LIMITATION D'AFFECTION AUX ÉLÉMENTS D'ADHÉSION EN L'USAF

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Introduction: US military accession medical standards are defined in Department of Defense Instruction 6130.03. Specific goals of the standards are to ensure individuals entering military service are 1) free of contagious diseases, 2) free of conditions that may require excessive lost duty time or early separation, 3) able to complete training, 4) adaptable to all military environments, and 5) able to do military duties without worsening the medical condition. Air Education and Training Command (AETC) Surgeon's Office is the authority for all accession waiver determinations. AETC studied the relationship between conditions waived for accession and the frequency of these conditions causing Assignment Limitation Codes (ALCs), violating 4) above.

Methods: Air Force Personnel Center (AFPC) provided a list of all ALCs. AFPC data was compared to AETC's Physical Exam Tracker (PET) program data for accession waiver matches. Diagnosis data was compared and relative risks calculated.

Results: AFPC reported 11,419 ALCs in August 2016. Risk of having an ALC in the USAF was 4.76%. The risk of accession waiver ranges from 8.6% up to 10%. 1,800 of 11,419 individuals had PET entries (15.8% of all ALCs). The risk of accession waiver in the ALC group was 7.5-8.3% (a 57-74% increase). Only 35 individuals in the ALC group matched diagnoses to the accession waiver condition. Thus, the risk of having an ALC for a condition previously granted an accession waiver that "worsened" is 0.31% overall or 1.9% if granted an accession waiver.

Conclusion: The vast majority of ALCs in USAF represent medical developments not attributable to previously waived conditions. AETC accurately assessed the waiver risk of specific conditions at least with regards to adaptability to all USAF environments; however, waived individuals appear to have a significantly increased relative risk of acquiring an ALC during their time in service.

049

CARDIOVASCULAR RISK FACTORS IN FLIGHT PERSONNEL: AN ITALIAN SURVEY

FACTEURS DE RISQUE CARDIOVASCULAIRE CHEZ LE PERSONNEL DE VOL: UNE ENQUETE ITALIENNE

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Introduction: The control of cardiovascular risk is part of the aeromedical decision making process supporting flight safety. Therefore, the cardiovascular risk estimated over the next 10 years (Risk Score, RS), via the algorithm developed by the Istituto Superiore di Sanità, was introduced in the medical check of flight personnel in 2014.

Methods: The study was conducted in three parts on 3975 airmen for which the RS was computed between October 2014 and December 2015. #1: RS and each components of the algorithm, that includes also age, blood lipids, blood glucose, and blood pressure were investigated in all subjects. #2: 399 subjects who underwent at least two visits were reviewed to assess whether any change occurred in RS. #3: 2930 civilian airmen were compared with 1044 military.

Results: The mean RS was 2.9 (CI95% 2.4 to 3.4), and it was 11.1 (CI95% 2.7 to 19.5) in the highest class of age, not different from previously published data. The proportion of subjects with 10-year risk greater than 10% was, respectively, 7.5% in the age 55-59 (CI95% 4.6 to 10.4%), 13.3% in the age 60-64 (CI95% 6.3 to 20.3%), and 48.0% in subjects over 65 years (CI95% 34.2 to 61.8%). Smoking habit, blood lipids and glucose were not different from the general population of the same age. Subjects visited twice showed a significant reduction in total cholesterol and blood glucose at the second visit. Finally, the mean RS and the proportion of subjects with RS greater than 10% was significantly lower in military personnel than in civilians.

Conclusion: The cardiovascular risk score can be a helpful tool to estimate the future risk of acute incapacitation in flight personnel. People of older age have greater cardiovascular risk, thus they could receive more benefit from special advice leading to appropriate changes in their lifestyle.

050

ACQUIRED LEFT BUNDLE BRANCH BLOCK (ALBBB) IN AIRCREW- A DILEMMA UPDATED

UN BLOC DE BRANCHE GAUCHE ACQUIS CHEZ LE PERSONNEL NAVIGANT – UN DILEMME MIS A JOUR

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Introduction: Aerospace Medicine is dedicated to fitness of aircrew for a full flying career. Any acquired electrocardiographic abnormality requires the aviator to undergo comprehensive cardiovascular evaluation for underlying cardiac disease. Presentation of an ALBBB is of concern in aircrew as it usually a manifestation of significant underlying cardiovascular disease. This updated review was conducted to evaluate the incidence, presentation, and prognosis of ALBBB during the 2010-2017.

Methods: US Army Aeromedical Epidemiological Data Register (AEDR) contains a total aircrew of 214,740 with 62,553 rated aviators with over 600,000 Flying Duty Medical Examinations (FDME). AEDR was searched for aircrew with an ICD 9 code of 144.7 and ICD 10 codes of 426.2, 426.3 for LBBB. Unique ECG codes of G124 for LBBB and G123 Incomplete LBBB were also searched. Initial entry ECG codes were compared to the ECG code first documenting ALBBB.

Results: For the period 2010-2017, a total of 17 rated aviators with an ALBBB. The initial entry ECGs were reviewed for the presence of Left Axis Deviation and Incomplete LBBB (ILBBB G133). LAD was present in 8.2 % and ILBBB was present in 6.3% A previous review prior to 2010, found 59 aircrew with ICD-9/ICD 10 codes indicating complete, and incomplete LBBB. Review of ECG reports prior to diagnosis of ALBBB in that cohort found 14.1%% Left Axis Deviation (LAD) and 10.5% Incomplete LBBB (ILBBB). These findings are consistent with the current review. Age at diagnosis of ALBBB was primarily in the third (29.4%) to the fourth (43.7%) decade. Associated conditions were hyperlipidemia and hypertension. Six (35.3%) had no follow up FDME after diagnosis of ALBBB. AEDR provided follow-up of 2 to 24 years in those on flying duty.

Conclusion: Review of the required cardiovascular evaluation required by regulatory agencies will be provided. Evaluation demonstrating no underlying cardiac disease may permit the aviator to be returned to full flying duty.

051

NEPHROCALCINOSIS AND MEDULLARY SPONGE KIDNEY IN AVIATION PILOTS: CLINICAL AND AEROMEDICAL PRACTICE

NEPHROCALCINOSE ET REIN MEDULLAIRE SPONGIEUSE DANS LES PILOTES D'AVIATION: PRATIQUE CLINIQUE ET AÉROMÉDIQUE

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Introduction: To investigate the clinical and aeromedical practice of nephrocalcinosis and Medullary sponge kidney (MSK) in aviation pilots. To formulate standard of diagnosis and treatment, propose the suggestions of prevention and follow-up.

Methods: To analyze the clinical data of 126 pilots with suspected kidney stones, who were diagnosed and treated from May 2013 to May 2017 in Civil Aviation General Hospital. Records were reviewed of 2 patients, all with endoscopic diagnosis of MSK and data collected pertaining to presentation, stone events and recurrences, stone composition, and metabolic profile to perform a descriptive study with median 12-month follow-up.

Results: 126 pilots underwent Flexible ureteroscopy examination. 120 (95.2%) pilots were verified to be kidney stones and the stones were taken out. Among them, 24 (19%) was diagnosed as nephrocalcinosis and stones, 6 (4.8%) pilots didn't find identified stones and diagnosis of nephrocalcinosis may be considered, and two pilots was diagnosed as MSK. Metabolic profile was obtained, including urine pH, urine analysis for 24 hours, and early kidney damage. The results of overall with flexible ureteroscopy that pass the medicine certification are qualified and they are all allowed to fly. There was no stone recurrence.

Discussion/Conclusion: MSK is a kidney malformation that generally manifests with nephrocalcinosis and recurrent renal stones. The diagnosis of MSK by radiology has become unreliable. Flexible Ureteroscopy is the gold standard for the diagnosis of nephrocalcinosis and MSK. These are the aviation pilots where metabolic evaluations and attempts at stone prevention are most critical. Nephrocalcinosis is more common than previously appreciated and does not necessarily indicate systemic disease or the specific developmental disorder of MSK. MSK is a complex and poorly understood disease in aviation pilots. Treatment strategies and aeromedical health management of MSK should be individualized.

052

ANTHROPOMETRIC COMPARATIVE STUDY OF OMAN MILITARY AIRCREW RECRUITS ÉTUDE

COMPARATIVE ANTHROPOMÉTRIQUE DES RECRUES DES ÉQUIPAGES MILITAIRES D'OMAN

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Introduction: Aircrew-aircraft compatibility is of prime importance in military aviation for task accomplishment and flight safety. Anthropometric aircrew selection standards in the Royal Air Force of Oman (RAFO) were imbibed from the selection standards of western defense forces as the aircrafts were imported from those developed countries. Henceforth efforts were made to fit the local native aviators into the aircraft not initially designed for them. In view of this, this study was carried out to obtain the anthropometric data of Oman aircrew recruits and compare these with published western and eastern aircrew data with a hope to understand and highlight the aircrew-aircraft mismatch issues.

Methods: The anthropometric data of 2296 Omani recruits from 2003 to 2012 were collected and their statistical distribution of data was collated. Further the anthropometric comparison was done with the published data from the USA, UK, and Singapore.

Results: Comparative distribution of 6 anthropometric dimensions among different population was done in this study. Minimal differences were noted between Oman and Singaporean recruits in Stature, Sitting Height and Leg Length whereas differences were most pronounced between Oman and Western population (UK & USA). Omani distribution of Thigh Length dimension was midway between Singaporeans and Western population. 95th percentile distribution of Arm Reach of Omanis was comparatively lower to all the population studied. Hip Breadth distribution of Omani population was noted to be similar to Western population whereas Singaporeans had comparatively lower distribution range.

Conclusion: This study has provided an opportunity to recognize the discrepancies involved in selection of Middle Eastern aircrew for western cockpits. This also adds impetus to the scope for application of military recruitment standards suitable to the native population in aiding the ideal man-machine interface. This approach shall consider national policy, the significant anthropometric trends of general population and the procured aircraft profile of the country.

053

RISING OVERWEIGHT TRENDS RAISE CONCERNS FOR OBSTRUCTIVE SLEEP APNOEA, IN TURN AVIATION SAFETY

L'AUGMENTATION DES TENDANCES EN SURPOIDS SOULÈVE DES PRÉOCCUPATIONS POUR L'APNÉE OBSTRUCTIVE DU SOMMEIL, À SON TOUR LA SÉCURITÉ AÉRIENNE

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Introduction: Association between overweight and obstructive sleep apnoea (OSA) and its higher incidence among males is known. Rising obesity trends, including among pilots, may indicate rising incidence of OSA. Thus regulators have the responsibility to ensure that pilots with OSA do not compromise aviation safety due to fatigue. Civil Aviation Safety Authority (CASA) mandates that those with body-mass index (BMI) more than 35 are assessed by their Designated Aviation Medical Examiner or General Practitioner using a questionnaire for referral for sleep study, if required. This paper aims to discuss CASA's approach to diagnose OSA.

Method: An analysis of randomly selected 136 medical files for one calendar year was undertaken. Controllers, females and those with established diagnosis of OSA or who did not provide the report were removed from the sample. This left a sample size of 94 pilots to find those referred for sleep study and diagnosed as OSA.

Results: 32.97% pilots with BMI more than 35 were referred for sleep study of which 29.78% were diagnosed as OSA. 53.57% had mild, 14.28% had moderate and 32.14% were diagnosed as severe case of OSA. 57.44% were given clearance by their DAME while 5.7% had BMI less than 35. Interestingly, 8.51% proactively reduced their weight.

Conclusion: Majority of pilots despite raised BMI did not require referral for sleep study. Yet nearly one-third pilots being diagnosed suggest the likely incidence of OSA. Admittedly, the applied tools may not be highly sensitive but serve the purpose as a useful screening tool for diagnosis of OSA, in turn contribute towards fatigue risk management in aviation. The need to focus on the objective variables rather than the subjective ones in the present protocol is commented upon.

054

A HISTORICAL OVERVIEW OF AIR CARRIER PILOT SELECTION

UN APERÇU HISTORIQUE DE SÉLECTION PILOTE DE TRANSPORTEUR AÉRIEN

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Introduction: The use of psychological tests in pilot selection emerged toward the end of WWI. Emphasis was on emotional stability and mental alertness. A unique feature involved assessment of changes in respiration following discharge of a pistol. A high level of attrition in the 1940s led to a job task analysis and selection of relevant tests (Otis Test of Mental Maturity, mechanical comprehension, serial reaction time, and two-hand coordination). Given the anticipated increased demand for air carrier pilots, it is important to consider the most efficient selection procedures. This presentation will provide a historical overview of air carrier pilot selection procedures.

Method: The international literature on air carrier pilot selection was reviewed. Information was gathered regarding existing job task analyses, test instruments and procedures, along with supporting validation data.

Results: Traditionally, U.S. carriers have relied on selecting former military pilots, with limited emphasis on the use of psychological tests. Most U.S. carriers focus their attention on a review of flight experience, interviews, and a flight in the simulator. One carrier has conducted a job task analysis and is using CogScreen, another recently introduced the use of an aptitude test battery. Internationally, there are a number of test batteries in use for screening candidates for entry into ab initio or MPL training programs. A review of the test batteries by Broach, Schroeder, & Gildea (2016) revealed a fairly high degree of overlap with respect to the domain/construct used as predictors. Of that group, the DLR pilot aptitude test battery has undergone the most extensive body of research to support its development and validation.

Conclusions: The anticipated growth in hiring of air carrier pilots represents a significant challenge, both in the U.S. and internationally. While there are a number of available test batteries, the validation data that appears in the scientific literature is generally weak. Results point to the need for additional job task analyses and more comprehensive validation efforts.

055

FEDERAL AVIATION ADMINISTRATION EXPERIENCE WITH “BASICMED” – AN ALTERNATIVE PROCESS TO THE THIRD CLASS MEDICAL CERTIFICATION OF U.S. GENERAL AVIATION PILOTS

FEDERAL AVIATION ADMINISTRATION EXPÉRIENCE AVEC « BASICMED » – UN PROCESSUS ALTERNATIF À LA CERTIFICATION MÉDICALE DE TROISIÈME CLASSE DES PILOTES D’AVIATION GÉNÉRALE AMÉRICAINNE

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Introduction: In the United States, the Federal Aviation Administration (FAA) Extension, Safety, and Security Act of 2016 was enacted on July 15, 2016. Section 2307 of this Act, Medical Certification of Certain Small Aircraft Pilots, directed the FAA to “issue or revise regulations to ensure that an individual may operate as pilot in command of a covered aircraft” without having to undergo the medical certification process under 14 CFR part 67, if the pilot and aircraft meet certain prescribed conditions as outlined in the Act, and to do so within 180 days.

Background: The FAA amended two and created one new federal regulation in order to comply with the law. This was accomplished on January 11, 2017, with an effective date of May 1, 2017. The final rule, Alternative Pilot Physical Examination and Education Requirements, implemented, without interpretation, the requirements of Section 2307 and described how the FAA will implement those provisions. This program has been named “BasicMed”. There are a number of possible individual applicant scenarios that are not addressed or described in this new Rule. The FAA will manage these on a case by case basis. One unanticipated situation occurred within the second week of implementation of the Rule, and more will surely follow.

Summary: This presentation will describe the BasicMed process, the medical, and aircraft requirements for participation in the program, in more detail, and will also recount the FAA’s experience with this new process during the first 4 months of its implementation. The implications for Aviation Safety of the BasicMed process will also be discussed.

056

MENTAL HEALTH: AN ISSUE THAT REQUIRES AN APPROPRIATE MANAGEMENT BY AME

SANTE MENTALE: A PROBLEME QUE L'EXIGE UNE APPROPIE GESTION AU AME

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Introduction: interview of aircrew/ATCO is critical in order to get a real knowledge of the psychosocial and psychopathological history of the candidate. EASA GW Task Force recommends that NA should strengthen the psychological and communication aspects of aeromedical examiners training and practice. EASA started in June 2016 the arrangements of a WG on "AME's: Management of Psychological issues in aircrews and ATCO's." Objectives of the WG were defined according to NA needs, gaps identified and experience. Among them, perception that candidate interview/questionnaire has very little impact in mental health, lack of adequate training in mental health problems and shortness of standardization in the psychological approach and assessment of candidates.

Objectives: To define a mini-questionnaire in order to help AME in the mental health evaluation of airmen/ATCO, to provide appropriate guidelines, to produce a comprehensive syllabus of training, and finally to standardize the psychological approach and psychometric testing of initial Class 1/ATCO exams.

Methods: WG composition was arranged with medical and psychologist experts in aviation. Also main related institutions were represented such AESA, AEMC's, SEMA, Psychology College, Spanish Society of Aviation Psychology and the University. Discussions were arranged by a monthly meeting and electronic communications. Results were finalized in January 2017.

Results: Mini-questionnaire and Open Questions were established, along with specific guidelines in order to carry out adequate assessment. Full Mental Health Guidelines were completed. A Mental Health Syllabus and training program were defined, and finally we concluded what psychological testing need to be standardized in the initial evaluation of pilot and ATCO candidates.

Conclusions: EASA recommendations in relation to assessment of mental health status by AME can be fully accomplished by following directions and procedures established by procedures established by the AESA Mental Health WG.

057

EASA CONCEPT PAPER: IMPLEMENTATION OF THE GERMANWING TASK FORCE RECOMMENDATIONS. STATISTICAL DATA FROM THE ITALIAN AIR FORCE-AEROMEDICAL CENTRE-ROME

EASA CONCEPT PAPER: MISE EN ŒUVRE DES RECOMMANDATIONS DU GROUPE DE TRAVAIL DU GERMAN WINGS. DONNÉES STATISTIQUES DE L'ARMÉE DE L'AIRE ITALIENNE DU CENTRE AÉROMÉDICAL-ROME

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Introduction: The tragedy of the flight GA-9525 has stimulated the international aviation community to implement specific actions to better detect the psychological conditions of airline pilots. For this purpose, a Task Force led by the European Aviation Safety Agency (EASA) delivered a set of 6 recommendations (see EASA Cp.16/FS3-07;20 January 2016).

Methods: The study aimed to collect the data regarding the implementation of: (Rec.#2) comprehensive mental health evaluation of the initial class 1; (Rec. #3) drugs and alcohol testing. Furthermore, in the view of a future implementation, we have also collected the subjective impressions of a pilot sample on the issues related to the Rec. #6 regarding mental issues, psychotropic medications, support and reporting systems on aircrew. Mental assessment for the initial examination for Class 1 consisted of: Psychological and/ or psychiatric interview, Personality testing (MMPI-2), and Neurocognitive testing. A urinary screening for drugs and an evaluation of haematological indicators for alcohol misuse were done for 1850 pilots. The survey related to the Rec. #6 was done through an anonymous, individual questionnaire.

Results: Among the 169 applicants examined for 1 class: 121 were fit (78%), 48 were unfit (22%). The main diagnoses found were: Mood, Anxiety and Personality disorders. No cases of drug and alcohol misuse were found. The analysis of the answers given in the survey showed that: 3% had taken psychotropic medication; 62% were coping with stressors; 33% has occasionally flown while not in good mental condition and 25% did it at the time of the survey; 77% considered useful the implementation of an independent aircrew support and reporting system.

Discussion: The prevalence of disqualifying mental conditions, as reported, appear to be relevant. The implementation of a specific psychological evaluation, both initial, then as part of a support & reporting system, in order to avoid, respectively, the recruitment of unfit people or to provide an early, appropriate treatment, could significantly contribute to enforce the operational safety.

058

JUST CULTURE AND PILOT MENTAL HEALTH: LEGAL AND ETHICAL CHALLENGES

'JUST CULTURE' ET LA SANTÉ MENTALE DES PILOTES DE LIGNE: LES DÉFIS LÉGALE ET ÉTHIQUE

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Introduction: Pilots should not face the risk of job or income loss because of mental health problems, but at the same time aviation safety should not be compromised by mental health risks. Both aviation authorities and experts in the field have proposed Just Culture principles to deal with mental health problems in airline pilots.

Background: Relevant literature on the legal and ethical challenges when applying Just Culture principles to (mental) health issues was examined. Just Culture was originally developed to increase the safety of organisations in general, not particularly to deal with (mental) health problems. In case of mishaps, Just Culture aims to identify flaws in work processes in order to increase future safety. Identifying and punishing those responsible is not its primary goal. In a Just Culture individuals are only punished in case of gross negligence or willful misconduct. This is different from most legal systems, which primarily aim to identify the individuals responsible for mishaps, to restore damages and to provide retribution. Whereas legal systems primarily look backwards to do justice, Just Culture primarily looks forward to increase future safety. Because Just Culture principles can interfere with general legal principles, they can be difficult to implement unless specific regulations are made. It is impossible to make legal exceptions for Just Culture on a case-by-case basis. However, medical-ethical standards, Just Culture and most legal systems share several common underlying ethical principles such as utilitarianism and the ethics of the human dignity.

Summary: When, as with pilot mental health issues, several interests have to be balanced against each other, it is essential to use an ethical framework to guide decision making. Just Culture can well be used to deal with mental health issues, as it shares common values with medical-ethical and legal principles.

059

FEATURES OF HEALTH PRESERVATION OF CIVIL AVIATION PERSONNEL IN RUSSIA

CARACTÉRISTIQUES DE LA PRÉSERVATION DE LA SANTÉ DU PERSONNEL DE L'AVIATION CIVILE EN RUSSIE

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Introduction: Research on aviation disasters reveals direct link between pilots' health fitness and flight safety. 70-80% of accidents and disasters with aircrafts are caused by "human factor" which is related to impaired health capability, tiredness and fatigue, aging. Surveys reflect increasing number of mishaps on long-haul flights, during night hours, in case of health disorders and aging. Medical examination is a part of governmental system of providing flight safety and it has the following tasks: 1) Assessment of medical fitness for flying, air traffic control duties and studying at civil aviation educational institutions; 2) Identifying early stages of illnesses, risk factors and health functional deviations in order to assign medical treatment.

Background: Traditionally Medical Aviation Examination in Russia has 3 levels: (1) pre-flight medical check-up of aircrew members (2) follow-up observation and treatment provided by an aviation medicine practitioner; (3) assigned medical examination of aviation personnel at Medical Aviation Examination Committee. High standards of Medical Aviation Examination are provided by advanced professional competency of medical examiners. For the last decade the average age of pilots evaluated as "unfit" has reached 50-55 years old, although in 1993 it was only 43.2 years old. Managing to keep pilots of elderly age group boosts economic efficiency and obviously provides flight safety in terms of medicine. Moreover, between medical assessments, obligatory (every 6 months) and extra assessments are provided (after illness (trauma), long-term vacation, suspended at pre-flight check-up, after flight accidents, when employed). Before every flight from base airport each aviation personnel takes pre-flight check-up where they are interviewed and their health condition is examined: cutaneous integument, pharyngeal mucous, pupillary response, heart rate and blood pressure and random alcohol and drug tests.

Summary: For the last 10 years, 2% of persons being examined by Medical Examination Committee are annually assessed as unfit (in previous period there were 2.8%). High quality of present Russian National Aviation Healthcare System provides optimal flight safety.

060

RANDOM DRUG TESTING - HELPING OR HURTING SAFETY?

ESSAIS DE DROGUES RANDOMATIFS - AIDER OU ENTRAIRE LA SÉCURITÉ?

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Introduction: Testing of pilots and other aviation personnel for the presence of Alcohol and Other Drugs (AOD) has been implemented or recommended by states as an aviation safety measure. Over 25 years' experience in the United States with AOD testing allows for observations and conclusions regarding the impact of testing programs on safety. Europe is currently considering implementing AOD testing.

Background: Testing of aviation personnel in the US falls into two categories, non-random for specific events and random in the conduct of routine duties. In theory, random testing is implemented to serve as a deterrent to use while potentially impaired. Rates for positive random AOD tests have been remarkably steady over years with no apparent deterrent effect on use. Rates for pilots are substantially lower than other airline personnel.

For pilots, a positive AOD test results in referral to a joint FAA, airline, union and medical professional rehabilitation program termed "HIMS". Pilots successfully participating in the HIMS are medically certified to return to flight duties with careful medical and operational monitoring for multiple years. AOD testing identifies approximately 6-12% of pilots in the HIMS program. The majority of pilot HIMS entrants come from self-referral to the well-known program, peer interventions or FAA review of pilot driving records. Airlines without HIMS programs do not allow pilots with AOD dependence problems to identify themselves and seek help with job protection benefits. Pilots employed by these airlines hide their AOD problem and restrict AOD use to avoid testing windows. They continue to fly with the medical sequelae and cognitive compromise of their disease. Operations safety is degraded.

Summary: Random AOD testing is a small source of identification of pilots with AOD dependence and has little deterrent effect on AOD use in pilots. When paired with programs allowing self and peer identification with job protection, AOD testing may enhance aviation safety.

061

REGULATORY ASSESSMENT BY THE UK CAA OF APPLICANTS DECLARING HIV SEROPOSITIVITY

EXAMEN RÉGLEMENTAIRE PAR LA CAA DU ROYAUME-UNI DES CANDIDATS DÉCLARANT LA SÉROPOSITIVITÉ DU VIH

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Introduction: The UK CAA published a protocol for the assessment of applicants with HIV in 2007. The EU Aircrew Regulations were implemented in the UK in 2012. There have been significant developments in the management of HIV infection since with data showing a near normal life expectancy for well-managed individuals. The aim of this study was to look at the assessment in the UK of applicants who have declared a positive HIV test to see whether there is a need to review and revise policy in light of developments in infection management.

Methods: A search was conducted on the CAA's electronic medical records system for applicants declaring HIV seropositivity. Data was gathered from individuals' records for a number of fields date of first certificate application after diagnosis, class of certificate applied for and type of medical (initial, revalidation/renewal), assessment outcome (including results of cognitive function testing) and any subsequent unfit assessment up to May 2017.

Results: The records for 33 people who applied for a medical certificate between 2002 and 2017 were reviewed. The number of applicants declaring a positive HIV test per year has increased from 1.4/year between 2002 and 2007 to 3.8/year between 2012 and 2017. Prior to 2007 most applicants were assessed as unfit and since 2012 most are assessed as fit. No initial class 1 certificates have been issued since 2012. Since 2002, 18 of 33 applicants were assessed as fit. In a further 7 cases, applicants successfully managed most of the components of the assessment but did not submit the results of cognitive function testing.

Conclusions: There is a need to review the role of cognitive function testing and reassess the route to initial Class 1 medical certification in light of the developments in infection management.

062

DOCTOR IN THE SKY: MEDICO-LEGAL ISSUES DURING IN-FLIGHT EMERGENCIES

UN MEDECIN DANS L'AVION: PROBLEMES MEDICO-LEGAUX EN CAS D'INCIDENT EN VOL

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Introduction: More people are traveling by air and in-flight medical emergencies are becoming more common. Some in-flight emergencies require assistance from passenger doctors including aviation physicians, who act as good Samaritans in the sky. Their liability and the associated medico-legal issues of providing assistance in mid-flight emergencies are unknown. Although provisions exist in theory about good Samaritans on the ground, it is unclear to what extent these doctrines are applicable to good Samaritans in the sky.

Background: This oral presentation reviews in-flight medical emergencies and their management. It examines the obligations, liability and legal protection of doctors including aviation physicians when acting as good Samaritans in mid-flight emergencies. It analyses the jurisdiction, existing legislation, case law in the United Kingdom and compares with their equivalence in the United States and to some extent, with the legal provisions in France. It appraises airlines' liability for injuries sustained by passengers during flight, with reference to case law.

This presentation derives from the LLM research thesis undertaken by the author at the Lancashire Law School, UK. A portion of the thesis has been accepted for publication at Medical Law International journal. An abstract has also been accepted for oral presentation at the UNESCO Chair in Bioethics 12th World Conference Bioethics, Medical Ethics and Health Law at Limassol, Cyprus from 21st-23rd March 2017.

Discussion: Aviation medical management of in-flight emergencies is not uniform; automated external defibrillator is not installed in all airliners. Medical data of mid-flight emergencies is scarce. Doctors' liability when volunteering assistance in these emergencies is unclear and uncertain; their legal protection is inadequate and inconsistent. Airlines' liability to passengers is restricted by the courts.

Summary: This presentation concludes with reforms proposed to address the aviation medical and legal deficiencies identified in this abstract.

063

U.S. ARMY MEDICAL EVACUATION INTERIOR SPACE STUDY

ÉTUDE DE L'ESPACE INTÉRIEUR PENDANT L'ÉVACUATION AÉROMÉDICALE EN L'ARMÉE DE TERRE DES ÉTATS-UNIS.

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Introduction: A recent analysis by the U.S. Army Medical Evacuation (MEDEVAC) Enterprise identified a need for new design guidelines for MEDEVAC critical care flight paramedic's (CCFP's) workstations in Army rotary-wing aircraft. The objectives of this study were to determine the adequacy of space available for CCFPs to perform advanced medical treatment on simulated critical care patients (manikins) in existing MEDEVAC aircraft.

Methods: Three flight medics wore motion capture suits while performing 43 critical flight paramedic-level medical tasks that were determined to be space consuming. Then, 17 CCFPs were tested to determine the vertical litter spacing required to accomplish the medical tasks adequately.

Results and Discussion: Approximately 75 percent of the medical tasks were successfully accomplished by CCFPs in the UH-60, while 91 percent of the tasks were successfully completed in the HH-60M medical interior. The 2nd percentile medic's neck angle was 66 degrees, on average, for 94 percent of the time during all tasks and scenarios. Surprisingly, the 99th percentile medic's neck angle was much lower (by 28 degrees), and the back angle was slightly higher than the 2nd percentile medic, suggesting that medics assumed complex postures to accomplish patient care tasks. Ergonomic specifications should be considered when designing vehicle medical interiors. Future studies will assess the workload involved in monitoring and treating 1-3 patients simultaneously, and will provide critical information on the design of U.S. Army aircraft medical evacuation interiors.

064

FLIGHT DIVERSIONS FOR NON-SHOCKABLE CARDIAC ARREST CASES. ARE THEY JUSTIFIABLE?

DÉROUTEMENTS DE VOL POUR LES CAS D'ARRÊT CARDIAQUE NON-CHOQUABLES. SONT-ILS JUSTIFIABLES?

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Introduction: Medical diversions impose a complex risk/benefit analysis. They are potentially life-saving although they almost always represent cost, operational disruption, and safety concern for the airline. If the anticipated benefit from a diversion is nil or very small, the risks associated might not be justifiable, from the affected passenger and airline standpoints. The purpose of this study is to review the prognosis of non-shockable cases of IFCA (NSIFCA) and discuss the need to adapt TOR criteria to the in-flight environment.

Methods: The 10-year experience with IFCA's as handled by MedAire was reviewed. End goals of survival-to-hospital and survival-to-hospital-discharge were correlated with other variables. A literature research was performed focusing on review and meta-analysis articles on prognostic data of survival in OHCA and comparing those to published data on IFCA.

Results: 394 consecutive cases of IFCA were available for analysis. In 297 cases no shock was advised by the AED. 7 (2.6%) cases survived to hospital. There was a positive, non-statistically significant association between diversions and survival to hospital with 5/101 (4.95%) survivors from diverted flights versus 2/196 for non-diverted ones (OR=5.05 95% CI= 0.96

Conclusion: Risks associated with a diversion may outweigh the potential benefit in cases of SIFCAs. Those risks include the rescuer's safety in case CPR needs to be continued during landing. The authors propose the following in-flight specific TOR guidelines adapted from accepted criteria for other OHCA scenarios to stop resuscitation and eliminate diversion: collapse not witnessed by flight attendants or other passengers, no shock advised during resuscitation, and no return of spontaneous circulation within 30 minutes.

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AEROMEDICAL EVACUATION OF PATIENTS WITH HIGHLY INFECTIOUS DISEASE IN ITALY: LESSONS LEARNED

ÉVACUATION AÉROMÉDICALE DES PATIENTS AVEC UNE MALADIE HAUTEMENT CONTAGIEUX EN ITALIE: LEÇONS APPRISSES

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Introduction: Highly Infectious Diseases pose a constant threat and have been a challenge for public health systems within recent years. Air evacuation (AE) of patients with potentially lethal, contagious infections poses unique challenges and risks to aircrews and medical personnel. The Italian Air Force during the past ten years has developed the biomedevac capability to transport safely patients with potentially lethal communicable diseases.

Methods: We describe the development of the program for AE of patients with highly infectious diseases and the summary of the missions carried out using the Aircraft Transit Isolator (ATI) system. The ATI is a sealed container in PVC, under negative pressure maintained by a battery-powered HEPA-filtered ventilation. Integrated gloves with long sleeves, allow patient handling from outside and basic monitoring and treatment interventions. The system is suitable for different aircraft (C-130J, C-27J, KC-767) and the airworthiness was evaluated by the Flight Test Center. The AE team is composed by anesthetists, infectious disease specialists, flight surgeons and flight nurses who underwent a specific training and follow regular exercising. All the activities are in coordination with the Public Healthcare System.

Results: In the past ten years the AE team of the Italian Air Force was involved in the evacuation of several patients. Most missions were flown in Italy, including a patient with EVD who developed the disease soon after coming back from Africa. One mission was an intercontinental flight from Sierra Leone to Italy by Boeing KC-7 to repatriate a doctor who developed EVD while working in Africa. All the missions were successful.

Conclusions: AE of patient with highly infectious disease is possible by proper equipment, procedures and training. In our experience the ATI showed to be effective for in-flight patient care, easy to implement and safe for the operators.

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MICROCIRCULATORY CHANGES DURING SHORT-TIME HYPODYNAMIA WHILE DIFFERENT DRINKING WATER TYPES ORAL INTAKE

L'EXPÉRIENCE DE L'UTILISATION DE L'EAU POTABLE ÉTUDIÉE EN TERMES D'INACTIVITÉ À COURT TERME.

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Introduction: In 1954 correlation between hypodynamia while flights and venous thrombosis risk was detected International recommendations «Traveler's thrombosis» (Schobersberger W., 2008) insist on minimum 250 ml isotonic fluid intake each 2 hours as prophylactic measure. We performed randomized single-blind placebo controlled study of blood microcirculation in healthy volunteers while short-time hypodynamia at a time of oral intake drinking water with or without additives.

Materials and Methods: 27 healthy volunteers were included in the study: 13 male and 14 female. Middle age amounted to 37.6 ± 13 years. Average BMI was 23.8 ± 4 kg/cm². We compared peroral intake of 2 same-mineralized drinking waters: with additives of hydrolates (extracts of haw berries, chestnuts and grape seeds), later «AVIA», and water without hydrolates, later «placebo» Chemical analysis demonstrated conformance to the standard SanRR 2.1.4.1116-02. Water was consumed as 10 ml/kg for 4 hours of sitting in a comfortable armchair under the medical supervision. Before and in 4 hours we performed digital capillaroscopy in eponychium of the 3-d and 4-th fingers (left hand) at 30° C. Capillary diameters of arterial, apex and venous segments, capillary blood velocity (CBV) and linear size of perivascular zone were detected.

Results: Distinction was considered as significant in shrink of perivascular area (105 to 98 μ m, $p=0.013$), while «placebo» water had no significant shifts (105 to 107 μ m, $p=0.081$). CBV for «AVIA» water increased: 1349 to 1604 μ m/sec ($p=0.900$), while for «placebo» decreased: 1547 to 1370 μ m/sec ($p=0.318$).

Conclusion: Short-time hypodynamia (4-hour) significantly influences at microcirculation in healthy volunteers. Adding above mentioned hydrolates in drinking water increases the capillary blood-flow velocity up to 20%, decreases edema in perivascular capillary zone and, as result, could reduce the risk of thrombosis.