[11] PEER PILOT VOLUNTEER TRAINING

Ellen Brinks
Air Line Pilots Association, International, McLean, VA, United States

(Education - Program/Process Review)

BACKGROUND: Current mandates and recommendations have been issued by governing states around the world for peer programs to be implemented in aviation to support flight crew members. Developing a training protocol that will be most effective for the crew members that are utilizing the services are key in making a successful peer program to be used by crew members. **OVERVIEW:** Recruiting and training effective volunteers for individual program models vary based on culture, country, and laws. Incorporating psychological, medical, and communication tools as well as aviation subject matter experts are imperative when building an effective education training program. Being able to quantify and demonstrate the level of knowledge needed in a peer with practical application is crucial in the foundation development. **DISCUSSION:** Discussion will include what makes a good volunteer, what makes a good training protocol, what type of oversight is required within peer program training, and what type of recurrent or continuing education and knowledge should occur for a peer to continue acting as a qualified peer.

Learning Objectives

1. The audience will learn about what information should be imparted on peer volunteers during a training.
2. The audience will learn about different training mechanisms for creating a confident peer within their peer program.
3. The participant will learn about practical application models that will demonstrate their mastery of effective communication when handling a peer interaction.

MONDAY, MAY 23, 2022

Monday, 05/23/2022 ***8:00 AM***
Tuscany C,D,E,

OPENING CEREMONIES AND 67TH
LOUIS H. BAUER LECTURE
Michael A. Berry, M.D., M.S.
"Historical Issues in U.S. Aerospace Medicine:
What did we know?
When did we know it? Could we have predicted it?"

Monday, 05/23/2022 ***8:00 AM***
Tuscany C,D,E,

ERIC P. KINDWALL MEMORIAL LECTURE
Lindell Weaver, M.D.
"Decision Making for Hyperbaric Oxygen
for Brain Injury"

Monday, 05/23/2022 ***2:00 PM***
Tuscany C,D,E

[S-04]: PANEL: UNDERSTANDING AND MODIFYING INTRACRANIAL PRESSURE, RESULTS OF A RANDOMISED CONTROL TRIAL MAY HAVE NOVEL IMPLICATIONS FOR SPACEFLIGHT

Chair: Susan Mollan

PANEL OVERIVEW: *Raised intracranial pressure (ICP) has the potential to cause significant morbidity and mortality in a range of conditions including idiopathic intracranial hypertension (IIH), traumatic brain injury (TBI) and spaceflight associated neuro-ocular syndrome (SANS). The full consequences of SANS are not yet comprehensively determined and cannot be reliably predicted, particularly in those undergoing longer duration space missions (>3 months). In those with SANS and prolonged optic nerve oedema of any cause there is a significant risk of visual loss. This loss can be permanent, as seen in patients with IIH. The medications currently used for raised ICP are not well tolerated, and indeed likely contraindicated for long-term use in space medicine. There are no current treatments or countermeasures for SANS. There are also wide-reaching consequences of elevated ICP, for example raised ICP affects cognitive performance acutely and in the longer term in people with IIH. This might also be a consideration in astronauts, where there may be the potential to impair performance. This panel will report the findings of the first human randomised control trial utilising telemetric, intraparenchymal ICP monitors to investigate the biological effect of a Glucagon-like Peptide 1 receptor agonist (GLP1-RA) on ICP in a cohort of participants with IIH: the IIH:Pressure study. Our pre-clinical work has demonstrated that the incretin, Exenatide, GLP-1RA, can cross the blood-brain-barrier and reduces cerebrospinal fluid secretion and consequently lowered ICP by 43% in vivo. Exenatide is an established drug, widely used to treat diabetes, with a favourable side effect profile. Hypoglycaemia does not occur with GLP-1RA administration. The associated studies of IIH:physiology and IIH:Pressure Medicine, will also be presented here. The importance of how ICP behaves in a raised ICP human model is invaluable, where we have gained new insights into both the physiology and the impact on cognitive performance. By providing evidence of a direct effect of drug therapies on ICP and cognition will allow physicians to select optimal treatment options when faced with raised ICP. The impact of SANS on astronaut health is a growing concern. Spaceflight duration is anticipated to increase, particularly in the context of missions to Mars and spaceflight commercialisation. A well tolerated therapy reducing ICP would be beneficial to alleviate SANS and the associated long-term sequelae.*

[12] EARLY DETECTION OF SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS) BY PRAGMATIC NON-INVASIVE METHODS

Susan Mollan[1], James Mitchell[2], Alex Sinclair[2]
[1]*University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom;* [2]*University of Birmingham, Birmingham, United Kingdom*

(Education - Program/Process Review)

BACKGROUND: Spaceflight Associated Neuro-ocular Syndrome (SANS) has been described in astronauts during and after long duration (>3 months) spaceflight. SANS describes a constellation of signs predominantly affecting vision. As intracranial pressure (ICP) elevation is a feature, many groups have sought to estimate ICP non-invasively. Determining a non-invasive method would be a key step forward for SANS which requires the method to be portable as well as exquisitely reliable. **OVERVIEW:** The following databases were searched: Embase <1980 to 2021 Week 44> and Ovid MEDLINE(R) <1946 to 2021 Week 44 >. The search terms for articles in all year ranges with multiple combinations of search terms, included: "papilledema", "Idiopathic intracranial hypertension", "pseudotumor cerebri", "intracranial hypertension", "pulsatile tinnitus", "raised intracranial pressure", "imaging", "optical coherence tomography", "doppler ultrasound", "ultrasound", "intracranial pressure monitor", "non-invasive", "tympanic membrane", "transcranial", "ocular", and "spontaneous venous pulsation". A further search was performed between week 44, 2021 and week 17, 2022 to update recent literature. Language was restricted to English and articles chosen were based on relevance to keywords. **DISCUSSION:** This analysis was divided into those non-invasive techniques that are earth based; those that have been utilized in SANS such as transcranial doppler before and after long duration spaceflight; and those that have been used in Space such as optical coherence tomography (OCT) imaging of the eye. There are

several limitations of the majority of studies, as they do not utilize telemetric ICP measures, have mixed disease models and differing reliability indices. Key findings include multiple linear regression models confirmed a statistically significant association between ICP and spontaneous venous pulsations as determined by observers grading infrared videos, and one study noting OCT optic nerve head volume measures (particularly central thickness) reproducibly correlated with ICP and surrogacy analysis demonstrated its ability to inform ICP changes. Prediction of papilledema with ocular OCT imaging is accessible and has a track record of being used in Space. OCT is reliable and the recent literature notes OCT imaging can detect the earliest minimal change (microns) and can predict ICP.

Learning Objectives

1. The participant will be able to evaluate the benefits and disadvantages of the commonly used non-invasive intracranial pressure methods.
2. The participant will be able to describe the recent advances in optic coherence tomography imaging of the optic nerve head which is currently used on the International Space Station.
3. The participant will be able to describe the common features on an optical coherence tomography eye scan of Spaceflight Associated Neuro-Ocular Syndrome (SANS).

[13] A RANDOMISED CONTROLLED, TRIAL OF THE GLP-1 RECEPTOR AGONIST EXENATIDE IN IDIOPATHIC INTRACRANIAL HYPERTENSION

James Mitchell[1], Susan Mollan[1], Jessica Walker[1], Hannah Lyons[1], Andreas Yiangou[1], Zerin Alimajstorovic[1], Olivia Grech[1], Georgios Tsermoulas[2], Kristian Brock[1], Alex Sinclair[1]

[1]*University of Birmingham, Birmingham, United Kingdom;* [2]*University Hospitals Birmingham, Birmingham, United Kingdom*

(Original Research)

INTRODUCTION: Raised intracranial pressure (ICP) causes significant morbidity and mortality in a range of conditions including idiopathic intracranial hypertension (IIH), traumatic brain injury (TBI) and is a recognised feature of spaceflight associated neuro-ocular syndrome (SANS). Exenatide is a GLP-1 receptor agonist; pre-clinical data demonstrates its ability to reduce ICP. GLP-1R agonists have also been shown to have neuro-protective properties in pre-clinical models of TBI. The objectives of this study are to assess the biological effect of a Glucagon-like Peptide 1 (GLP-1) agonist on ICP in a cohort of participants with IIH, a raised ICP model. **METHODS:** Randomised, placebo controlled, double-blind physiology study of Exenatide in women with active IIH (>25 cm CSF lumbar puncture opening pressure and papilledema). Telemetric, intraparenchymal ICP monitors were implanted to enable gold standard, long-term ICP monitoring (Raumedic p-Tel, Helmbrechts, Germany). Participants were randomised 1:1 to receive Exenatide (10 mcg BD sub-cutaneous) or placebo for 12 weeks. ICP was recorded over a 24-hour baseline visit, at two weeks and 12 weeks. Monthly headache diaries were completed at baseline and 8–12 weeks. Significance was set at $p<0.1$ as an early phase trial. Ethical approvals: IRAS 199418; REC reference 17/WM/0179. **RESULTS:** Of the 16 participants recruited, 15 were randomised and completed the study: age 29.5 ±9.5 years, BMI 38.1 ±6.2 kg/m^2, ICP 30.6±5.1 cm CSF. All ICP monitor implants were well tolerated and allowed successful ICP quantification. A significant reduction in ICP was noted at all timepoints: at 2.5 hours -5.7 cm CSF (p=0.031), at 24 hours -6.3 cm CSF (p=0.095), and at 12 weeks -5.6 cm CSF (p=0.064). **DISCUSSION:** We report the first human study to assess the biological effect of the GLP-1 agonist Exenatide on ICP in IIH utilising highly accurate implantable telemetric ICP monitors. Exenatide reduced ICP at all timepoints including acutely at 2.5 hrs and during chronic dosing. New therapies for ICP modulation are a significant unmet need in both military and civilian spheres and may have direct relevance to the treatment of SANS.

Learning Objectives

1. The audience will learn about the utility of GLP-1 agonists for intracranial pressure reduction.
2. The audience will learn about the future application of GLP-1 agonists for SANS.

[14] DETAILED INTRA-CRANIAL PRESSURE MONITORING IN IDIOPATHIC INTRACRANIAL HYPERTENSION PROBES DIURNAL AND POSTURAL VARIABILITY

Andreas Yiangou[1], James Mitchell[1], Susan Mollan[1], Hannah Lyons[1], Jessica Walker[1], Zerin Alimajstorovic[1], Olivia Grech[1], Georgios Tsermoulas[2], Kristian Brock[1], Alex Sinclair[1]

[1]*University of Birmingham, Birmingham, United Kingdom;* [2]*University Hospitals Birmingham, Birmingham, United Kingdom*

(Original Research)

INTRODUCTION: Idiopathic Intracranial Hypertension (IIH) has been used as a terrestrial comparator for space associated neuro-ocular syndrome (SANS). Telemetric ICP monitoring is providing new insight into the physiology of raised ICP states. The objectives of this study were to assess changes in Idiopathic Intracranial Hypertension (IIH) Intracranial Pressure (ICP) diurnally and with positioning. **METHODS:** Female participants were recruited with active IIH (>25 cm CSF lumbar puncture opening pressure and papilledema) age between 18-60. Participants underwent implantation of a telemetric, intraparenchymal ICP monitor (Raumedic p-Tel, Helmbrechts, Germany) and ICP was recorded during a 24 hour visit and evaluated with changing position. 1mmHg =1.36cm H2O. Ethical approval: REC ref 17/WM/0179. **RESULTS:** 16 participants, mean age 29.5 ±9.5 and BMI 38.1 ±6.2 kg/m2, were recruited. During the 24-hour monitoring period there was no significant change during waking hours. However, during the day there was a significant rise in ICP if the patient had a prolonged supine recording: after 30 minutes (21.3–24.8 mmHg, 16.4%, $p = 0.0002$), and after 3 hrs (23.8–25.9 mmHg, 8.8%, $p = 0.04$). During nocturnal recording (prolonged, continuous supine posture) ICP rose significantly (15.4–20.6 mmHg, 33.8% $p = 0.02$). Mean ICP was 21.2 mmHg (4.8) supine, 24.0 mmHg (3.8) left lateral (lumbar puncture position), 10.1 mmHg (5.1) sitting, and 10.3 mmHg (3.7) standing. ICP was higher in the lumbar puncture position compared to supine (13% difference, $p = 0.028$), significantly higher supine compared to standing (51.3% difference, $p = 0.0001$), but no difference standing to sitting ($p = 0.82$). **DISCUSSION:** Detailed ICP characterization in IIH has not been previously reported. We demonstrate that ICP does not vary diurnally but rises with time in the supine position. We confirm that ICP is higher in a lumbar puncture position compared to supine. The implications for clinical practice and research are that lumbar puncture diurnal timing is not relevant. It is only prolonged supine posture that causes ICP to rise and thus variability. Time in a supine position needs to be taken into account when interpreting ICP measures. These findings may have relevance to the physiology of SANS.

Learning Objectives

1. The audience will learn about the normal physiology of raised intra-cranial pressure states.
2. The audience will learn about the application of normal physiology of raised intra-cranial pressure states to SANS.

[15] IIH PRESSURE MED: A RANDOMIZED, SEQUENTIAL, TRIAL OF THE EFFECT ON INTRACRANIAL PRESSURE OF FIVE DRUGS COMMONLY USED IN RAISED INTRACRANIAL PRESSURE

Susan Mollan[1], James Mitchell[2], Jessica Walker[2], Hannah Lyons[2], Andreas Yiangou[2], Zerin Alimajstorovic[2], Olivia Grech[2], Georgios Tsermoulas[1], Kristain Brock[2], Alex Sinclair[2]

[1]*University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom;* [2]*University of Birmingham, Birmingham, United Kingdom*

(Original Research)

INTRODUCTION: There is minimal clinical data to guide treatment of raised intracranial pressure (ICP) conditions such as idiopathic intracranial hypertension (IIH) and spaceflight associated neuro-ocular syndrome (SANS). The aim of this study was to evaluate the action of five

commonly utilized medicines on ICP, as measured with a telemetric, intraparenchymal ICP device. **METHODS:** This was a randomized, sequential, open label trial in women with active IIH. Participants had Raumedic p-Tel ICP intraparenchymal device (Raumedic, Hembrechts, Germany) inserted utilising standard clinical practise under general anaesthetic. Following a baseline period, they were sequentially treated for 2 weeks with acetazolamide, amiloride, furosemide, spironolactone and topiramate. Order of treatment was randomised, and there was a minimum 1-week drug washout between rounds. ICP (mmHg) was recorded before and after using a standardized protocol. The raw data recording was then analysed by calculating mean ICP from the waveform for each block utilising proprietary software (Raumedic Dataview). Analysis was performed by hierarchical regression. Ethical approvals: IRAS 199418; REC reference 17/WM/0179. **RESULTS:** 14 participants were recruited, with a mean (standard deviation (SD)) (Standard error of the mean (SEM)) ICP of 24.4mmHg, SD 5.2, SEM 1.4 at baseline. ICP fell significantly with 4 drugs (mean (SEM)): acetazolamide -3.31 (0.95) mmHg (p=0.0009); furosemide -3.03(0.88) mmHg (p=0.0011); spironolactone -2.71(0.88) mmHg (p=0.0033); topiramate -2.29(0.85) mmHg (p=0.0095). The magnitude of ICP reduction was correlated with increasing baseline ICP, the higher ICP was at baseline the higher the reduction in ICP, R^2=0.1172 (p= 0.0139). There was no significant difference in the effect between any of the drugs that reduced ICP. **DISCUSSION:** This is the first randomized clinical trial to compare five commonly used medicines to lower intracranial pressure. Acetazolamide, furosemide, spironolactone and topiramate all reduced ICP significantly. There was no statistical difference between any of the medicines that reduced ICP. The adverse side effects of many of these drugs may prohibit their use in long duration spaceflight. Novel therapies for safe use in space medicine are sought to counteract SANS.

Learning Objectives

1. To describe the action of five commonly used medicines on intracranial pressure.
2. To understand the utility of intracranial pressure monitors in raised intracranial pressure conditions.

[16] EVALUATION OF COGNITIVE PERFORMANCE WITH MEDICINES FOR RAISED INTRACRANIAL PRESSURE: IMPLICATIONS FOR SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME

Olivia Grech[1], James Mitchell[1], Andreas Yiangou[1], Zerin Alimajstorovic[1], Kristain Brock[1], Susan Mollan[2], Alex Sinclair[1]
[1]*University of Birmingham, Birmingham, United Kingdom;* [2]*University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom*

(Original Research)

INTRODUCTION: Idiopathic Intracranial Hypertension (IIH) has been used as a terrestrial comparator for space associated neuro-ocular syndrome (SANS). Although there is no evidence that astronauts demonstrate impaired cognitive function anxiety exists for planning prolonged spaceflight missions. Cognitive performance is known to be impaired in IIH, with improvement noted following lumbar puncture. The aim of this study was to evaluate cognitive function when using medicines that modulate ICP. **METHODS:** IIH:Pressure (exenatide v placebo) and the IIH:Pressure Med (acetazolamide v amiloride v furosemide v spironolactone v topiramate) data is analysed. Cognitive evaluation utilised the validated NIH Toolbox Cognitive Battery (v1.11). Testing was performed at baseline at trial ends. Fully corrected T-scores of 50 is population mean and +/-10 is 1 standard deviation (SD) from mean. Scores are corrected for age, sex, educational attainment, and ethnicity. The effect of headache on performance was assessed. Ethical approval: REC ref 17/WM/0179. **RESULTS:** In the IIH:Pressure participants performance in the fluid domain was more than 1SD below expected, fully corrected T-Score (mean, standard error of the mean(SEM)) 37.2 (2.55). There were significant increases in scores in the fluid domains for exenatide and placebo groups with composite score (mean difference T-score (SD)), exenatide 14.4 (5.6), p=0.0005 and placebo 12.1 (4.5), p=0.0001 but no significant differences between arms at 12-weeks. IIH:Pressure Med noted a significant reduction in the fluid composite score with acetazolamide (mean T-score (SEM)), -5.00 (2.6), p=0.057 and topiramate -4.14 (2.0), p=0.061. Within this domain there were significant reductions in performance in the dimension change with acetazolamide -10.3 (3.2), p=0.002, spironolactone -6.2 (2.8), p=0.03 and topiramate -7.0 (2.7), p=0.012. Increasing headache severity at the time of testing significantly worsened cognitive performance in most of the fluid domains (Flanker R^2 0.151, p=0.0021, Dimension change R^2 0.098, p=0.0147, List sort working memory R^2 0.067, p=0.047, Picture sequence memory R^2 0.105, p=0.012). **CONCLUSION:** Cognitive deficits have a wider reaching cause of concern in raised ICP conditions. Cognitive side-effects were common with acetazolamide and topiramate, with none being found with exenatide. When preventing or treating SANS, cognitive side effects of medicines need to be considered.

Learning Objectives

1. To recognize medicines, such as acetazolamide and topiramate, that modulate intracranial pressure can have detrimental effects on cognitive performance as measured by the validated NIH Toolbox Cognitive Battery.
2. To be able to describe how headaches can significantly affect cognitive performance.
3. To understand that exenatide, a GLP-1 receptor agonist, that reduces intracranial pressure has no effect on cognitive performance as measured by the validated NIH Toolbox Cognitive Battery.

Monday, 05/23/2022, ***2:00 PM***
Tuscany A

[S-05]: PANEL: RIDING THE COVID-19 WAVE: A MULTI-DISCIPLINARY PANEL ON LATEST DATA ON COVID-19 IN US AIR FORCE AIRCREW

Chair: Dara Regn
Co-Chair: Eddie Davenport

PANEL OVERIVEW: *Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), also known as COVID-19, is a highly infectious, rapidly progressive predominantly respiratory disease, with multi-organ involvement. The United States Air Force has not been immune to the adverse impact of increased rates of COVID-19 infection with over 42K* active duty, guard and reserve members having had documented cases. The special physical requirements for aviators and the potential complications associated with aviation will in many cases necessitate additional evaluation for members who have had COVID-19. Based upon the medical literature, the USAF Aeromedical Consult Service (ACS) in conjunction with USAF Medical Readiness Agency (AFMRA) compiled comprehensive return-to-flying-status recommendations based on COVID-19 severity and crew position. Aeromedical concerns include the potential for cardiac complications such as myocarditis, as well as pulmonary complications resulting in inadequate lung ventilation in relation to exercise level and increased breathing resistance attributable to weak respiratory muscles, which in turn, result in a corresponding increased risk of hypoxia and hypercapnia. Additional safety-related concerns and longer-term sequelae which may interfere with performance of duties include neurologic and psychiatric sequelae such as olfactory dysfunction, "brain fog," poor sleep quality, depression, anxiety, and fatigue. The USAF ACS resumed in-person medical evaluations in June 2020, to include pilot applicant screening and return–to-flying-status waiver evaluations. Since that time, >1000 initial pilot applicants were seen and of those approximately 210 have had documented history of COVID-19 with numbers steadily increasing. Pilot applicants with a history of COVID undergo evaluation which includes full pulmonary function testing, 6 MWT, ECG, Holter monitoring,*

*troponin, and echocardiogram. Thus far, ~8% of applicants post COVID were found to have disqualifying findings on pulmonary or cardiac evaluation potentially attributable to COVID sequelae (data collection and analysis is ongoing). In this panel we will discuss the return-to-flying-status recommendations, medical evaluation data and aircrew case studies from Pulmonary, Cardiology, Psychiatry and Neurology aeromedical perspectives. *Data 27 SEPT 21.*

[17] PULMONARY MANIFESTATIONS OF COVID-19 IN USAF AIRCREW: 2022 UPDATE

Dara Regn, Stacey Branch, Rachel Girsch, Jared Haynes
U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Initial studies of lung function following COVID-19 have indicated objective pulmonary function testing abnormalities are present in up to half of COVID-19 patients up to 30 days after recovery. A reduction in diffusing capacity (DLCO) is the most common abnormality, with a reduction in respiratory muscle strength, total lung capacity (TLC) and obstruction less commonly seen. Interestingly, the pathophysiology of COVID-19 pneumonia is similar to what is seen in aviators in hypobaric conditions, exhibiting preserved lung compliance and the atypical presentation of "silent hypoxia' with tachypnea, high minute ventilation and subsequent hypocapnia, and lack of sensation of dyspnea in the setting of hypoxia. **METHODS:** Since the USAF ACS resumed in person medical evaluations in June 2020, pilot applicants with positive COVID history have been evaluated with full pulmonary function testing to include pre and post spirometry, lung volumes, DLCO, 6-minute walk test and chest x-ray imaging. The USAF ACS has also performed extensive multi-disciplinary in person evaluation on a pilot with critical illness COVID that required intensive care hospitalization to include mechanical ventilation. **RESULTS**: Since June 2020, >1000 initial pilot applicants were seen and of those >210 have had documented history of COVID-19. Thus far, ~8% of applicants post COVID were found to have disqualifying findings on pulmonary evaluation possibly attributable to COVID sequelae. These applicants are being re-evaluated at 3-month intervals to include repeat full pulmonary function testing and imaging in hopes they may have sufficient clinical recovery to meet aeromedical standards. Data collection and analysis is ongoing and will be presented. **DISCUSSION**: The timeline of long-term multi-organ sequelae and resolution in COVID 19 are largely unknown. Objective assessment prior to resuming flight duties in trained aviators is necessary given even asymptomatic or mild cases may have pulmonary sequelae in the recovery period. The special physical requirements for aviators and the potential pulmonary complications associated with aviation (risk of hypoxia, barotrauma) necessitate extensive investigation for members with history of COVID 19 prior to clearance to initiate pilot training given the significant monetary investment in training and to optimize the safety of the pilot and crew.

Learning Objectives

1. Understand the pulmonary manifestations of COVID19 to include long term sequela.
2. Learn the importance of various pulmonary testing modalities in the recovery setting of COVID19.
3. Detail an evidence based approach to getting aircrew flying again after COVID19.

[18] UPDATE OF PSYCHIATRIC MANIFESTATIONS OF COVID-19 IN USAF AIRCREW

Terry Correll
U.S. School of Aerospace Medicine, Englewood, OH, United States

(Original Research)

BACKGROUND: There are widespread assumptions that the COVID-19 pandemic has taken a significant toll on mental health whether it be from social isolation, fears of infection/dying, consequences of the viral infection itself and the associated healthcare received, or simply from the many drastic changes imposed on all of us. Unfortunately, the research is not definitive at this time. **OVERVIEW:** There is data in healthcare providers and the general population indicating both direct and indirect effects of COVID-19 causing increased stress, apprehension, fear, somatization, poor sleep quality, insomnia, mood swings, depression, anxiety, posttraumatic stress symptoms/disorder, obsessive-compulsive symptoms, psychosis, and even suicide. Worsening symptoms from pre-existing psychiatric disorders has also been described. Any of these symptoms or disorders could certainly impact safety of flight thus necessitating a careful interview which focuses on potential psychiatric symptoms (psychiatric review of systems) and utilizes available mental health screeners (PHQ-9, GAD-7, PCL-5, and possibly others). If any clinically significant concerns are identified, a full mental health diagnostic evaluation should be assertively pursued. If a bona fide psychiatric diagnosis is rendered, an immediate halt to aviation duties most likely will be required, and an optimal treatment plan must be obtained, potentially including psychotropic medication, psychotherapy, and/or healthy lifestyle interventions. When the aviator is restored to "best baseline" functioning per clinicians' judgment, an appropriate waiting period is recommended (often six months) to assure there will be no sudden recurrence of symptoms. At that time, a return to aircrew duties may be considered. Close follow up is necessary over time to assure there is no return of symptoms. **DISCUSSION:** With COVID-19 ramifications being so widespread, especially with potential aeromedical implications, it is imperative that meticulous and cautious medical care be provided. Focusing on resilience-building and healthy lifestyle interventions would seem to be prudent during all aviator-provider interactions throughout this pandemic.

Learning Objectives

1. Understand the psychiatric manifestations of COVID-19, to include chronic sequelae.
2. Plan how to evaluate and return aviators to flying status post-COVID-19.
3. Discuss the need for resilience-building and healthy lifestyle interventions in all aviators during this pandemic.

[19] AEROMEDICALLY CONCERNING NEUROLOGICAL MANIFESTATIONS OF SARS-COV-2, AN UPDATE

Aven Ford
U.S. Air Force School of Aerospace Medicine, Wright-Patterson AFB, OH, United States

(Original Research)

BACKGROUND: SARS-CoV-2 infection can manifest in acute neurologic complications affecting both the central and peripheral nervous system. A growing number of SARS-Cov-2 survivors, with minimal or no acute neurologic disease, have persistent neurologic and cognitive symptoms, often disproportionate to the initial illness severity. Some lingering symptoms are clinically subtle but could have adverse aeromedical consequences. This will provide an update regarding the neurologic manifestations of SARS-CoV-2. **OVERVIEW:** SARS-CoV-2 is a recently identified coronavirus with significant morbidity and mortality. Acute neurologic complications roughly correlate with the severity of initial infection, and include cranial neuropathies, encephalopathy, thrombotic and hemorrhagic stroke, and myopathy. However, an increasing number of SARS-CoV-2 survivors have reported persistent neurologic and cognitive symptoms that do not always correlate well with the initial disease severity such as anosmia/dysosmia, dysgeusia, cognitive slowing, and severe fatigue. Some of these long-lasting neurocognitive symptoms have been described even in cases with relatively mild initial infections. There are no reliable indicators that predict whether persistent symptoms will occur or how long they will last. There is currently no unified, accepted approach to managing or preventing persistent neurocognitive symptoms. These uncertainties support a conservative return to fly approach for SARS-Cov-2 survivors. A reasonable approach would include a targeted history, neurologic and

psychiatric systems review, in-office cognitive screening, and full neurologic examination. Further assessments would be performed on an individual bases as clinically indicated. An appropriate observation period of at least several months before recommending return to flying would be reasonable to ensure clinical stability. Following return to flying, continued clinical surveillance is recommended to assess for potential return of symptoms. **DISCUSSION:** SARS-CoV-2 is a recently recognized infectious agent that has both acute and chronic effects on the nervous system that can adversely affect aviation activities. Currently there are no reliable predictive factors for development of long-term neurocognitive sequelae. A conservative approach for return to flying is recommended. Further longitudinal experience with SARS-CoV-2 survivors should allow more precise prognostic and management strategies.

Learning Objectives

1. Update the potential neurologic manifestations of SARS-CoV-2, to include chronic sequelae.
2. Update the return to fly evaluation recommendations for SARS-CoV-2 patients.
3. Discuss future trends in evaluation and management of SARS-CoV-2 patients with neurocognitive symptoms.

[20] CARDIAC MANIFESTATIONS OF COVID19 IN USAF AIRCREW – YEAR TWO

Eddie Davenport, Edwin Palileo, Jared Haynes
U.S. Air Force, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Cardiac manifestations of Coronavirus 2019 (COVID19) infection have been widely reported. This is of paramount importance in high-risk occupations such as pilots and other aircrew. Given cardiac manifestations are seen in up to 80% of individuals with history of COVID19 in the published literature, the United States Air Force (USAF) has followed all positive COVID19 aircrew with cardiac evaluations since the inception of the pandemic. This data allows for evidence-based aircrew disposition processes and return to flying after COVID19. **METHODS:** The USAF has collected Electrocardiogram (ECG), troponin, echocardiogram, ambulatory event monitor, as well as some cardiac MRI data on COVID19 aircrew since March 2020. This cardiac data in aircrew with a COVID19 history was directly compared to normal controls. **RESULTS**: Data collection and analysis is ongoing. There appears to be significant changes on some cardiac chambers sizes on echocardiogram and increased heart rate after recovery from COVID19 based on ambulatory event monitoring. Decrease in exertional capacity was also seen. Fortunately, the majority of findings are subclinical and over 90% of aircrew have been returned to flight. **DISCUSSION:** Current evidence-based aircrew specific cardiac data status post COVID19 supports the safe return to flying for the majority of aircrew. Historic, current, and late-breaking USAF COVID19 research validates the most recent USAF recommendations for military aircrew.

Learning Objectives

1. Understand the latest cardiac manifestations of COVID19 to include "longhaulers."
2. Learn appropriate use criteria and cardiac testing modalities for COVID19.
3. Discuss findings from the USAFSAM COVID19 aircrew database over the previous 2 years.

Monday, 05/23/2022, ***2:00 PM***
Tuscany B

[S-06]: SLIDES: LIFE IN THE FAST LANE: ACCELERATION EFFECTS

Chair: Joseph Hudson
Co-Chair: Kathy Hughes

[21] SIMULTANEOUS ASSESSMENT OF BLOOD FLOW IN THE CAROTID AND DORSALIS PEDIS ARTERIES UNDER ORTHOSTATIC STRESS

Munna Khan[1], Abu Rehan[2], Kashif Sherwani[1]
[1]*Jamia Millia Islamia (Central University), New Delhi, India;* [2]*Al-Falah University, Faridabad, India*

(Original Research)

INTRODUCTION: Blood flow detection of carotid artery (CA) has many applications in the field of aerospace medicine. Dorsalis pedis artery (DPA) is a good alternative because of lower extremities of pilot are quite accessible. Detection and analysis of DPA blood flow (DPABF) may be useful in the aerospace medicine. An effort has been made for simultaneous assessment of CA blood flow (CABF) and DPABF during orthostatic stress from supine to 90-degree head-up tilt (HUT). **METHODS**: A simple system has been designed and developed to record CABF and DPABF changes in the human volunteers using piezoelectric sensors. Experiments were performed on 6 healthy human subjects with age from 20 to 25 years of both sexes. The subjects rested for 15 minutes before commencing the test on manually operated tilt table. The CA running by lateral side of throat was palpated and piezoelectric (PZT) sensor placed using medical adhesive tape. Similarly, DPA on the dorsal aspect of foot was palpated and other PZT sensor placed with same steps. Output of the PZT sensors was sent to the laptop connecting Arduino board (microcontroller system). Data were taken in three states: supine (resting), vertical (90-degree HUT) and supine again (recovering). Data of CABF and DPABF analyzed using AcqKnowledge software. **RESULTS**: Average CA values along with the standard deviation (±SD) for peak-to-peak voltage (V) for supine, vertical and recovery states were found as 1.900 ± 0.794, 1.133 ± 0.615 and 2.402 ± 0.788 volts respectively. Corresponding DPA values of V for supine, vertical and recovery states are 0.651±0.482, 1.086±0.978 and 0.532±0.347 volts respectively. Other parameter of CA, average area under curve (AUC) of PZT sensor waveform in the Supine, Vertical and Recovery positions was found as 8.087±3.457, 3.329±2.207 and 9.017±3.798 respectively. Corresponding AUC values of DPA for supine, vertical and recovery states are 4.842±2.720, 6.321±3.144 and 3.912±2.339 respectively. **DISCUSSION**: The CABF and DPABF changes were found to be significant comparing Supine vs Vertical ($p<0.05$), Vertical vs Recovery ($p<0.05$) and Recovery vs Supine ($p<0.05$) positions. Data from supine to vertical position shows a significant decrease in CABF and signifying the gravity-based blood flow towards lower limbs. Fact is corroborated by a corresponding increase in the blood flow of DPA. The recorded CABF/DPABF data and their analysis may be useful to study various simulated parameters of the pilot.

Learning Objectives

1. Investigation of blood flow pattern in the carotid artery during 90-degree head-up tilt (HUT).
2. Investigation of blood flow pattern in the Dorsalis pedis artery during 90-degree head-up tilt (HUT).
3. Correlation between blood flow in carotid and Dorsalis pedis arteries during part of simulated Push-Pull effect of an aircraft pilot.

[22] AIRCREW EQUIPMENT ASSEMBLY VERSUS "G-RAFFE" – A COMPARATIVE STUDY OF TWO HIGH-PERFORMANCE ANTI-G SUITS (AGS)

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(Original Research)

INTRODUCTION: In 2013, the AFCAMed conducted a scientific study to test the prototype of the new "G-RAFFE" AGS developed by iii solutions (Switzerland) for G-NIUS Ltd. In order to examine the strength and capabilities of the commercialized version of this AGS, the AFCAMed has repeated this study, with the Aircrew Equipment Assembly (AEA) (RFD Beaufort, UK) serving as control. **METHOD:** In total, 41 participants (19 Eurofighter pilots, 22 novices) completed 255

profiles (G-RAFFE familiarization run, gradual onset run (GOR) (0.1 G_z/s), rapid onset run (ROR) (6 G_z/s and +5, +7 and +9 G_z loads for 15 s) and an exhausting simulated aerial combat maneuver (ESACM) (150 s)) at the human-use centrifuge in Koenigsbrueck using both AGS. During all runs, G_z and physiological parameters (ECG, heart rate, pulse wave, etc.) were recorded. Subjective data characterizing key elements of G protection were collected during the ROR rest periods (2 min) and after the ESACM. **RESULTS:** The relaxed G_z-level tolerance (GOR) was nearly the same in both suits. In the ROR, all participants immediately fulfilled the requirements with the new suit, showing lower mean heart rates during the G-RAFFE runs. In the ESACM, the performance was nearly identical in both suits, whereas the load to the cardiovascular system in pilots and novices was significantly smaller with G-RAFFE. In the ROR, but also in the ESACM, the subjectively experienced G protection, safety and physical condition after the run were rated significantly better and the feeling of exhaustion after the run and the effort necessary to fulfill the mission were felt to be lower with G-RAFFE. There were also fewer cases of arm and foot pain with G-RAFFE in use. **CONCLUSIONS:** As in the 2013 study, also the new data suggest that the G-RAFFE performance was better or at least as good as the performance accomplished with AEA. Exclusive of integrated PBG and even though the familiarization period was pretty short (about 2–4 minutes) and the G-RAFFE suit could not be personally fitted, the subjective rating of the most important items was better and the cardiovascular load to the participants was smaller.

Learning Objectives

1. The participant will be able to understand the consequences of +Gz-acceleration.
2. The audience will learn about the objective and subjective evaluation of anti-G suits.

[23] ACCELERATION ATELECTASIS AFTER HIGH G FLIGHT BREATHING 60% OXYGEN AND INFLUENCE OF CABIN ALTITUDE

Nicholas Green[1], Henry Tank[2], Gareth Kennedy[1], Ross Pollock[3], Rebecca-Anne Sheppard-Hickey[4], Jeffrey Woolford[5], Alec Stevenson[2]

[1]RAF Centre of Aviation Medicine, Henlow, United Kingdom; [2]QinetiQ Ltd, Farnborough, United Kingdom; [3]King's College London, London, United Kingdom); [4]National Health Service, Manchester, United Kingdom; [5]Maryland Air National Guard, Warfield, MD, United States

(Original Research)

INTRODUCTION: Acceleration atelectasis has long been recognized as a potential hazard in fighter aircraft. Symptoms suggestive of atelectasis have recently been reported in aviators using modern pilot flight equipment and oxygen/anti-G systems. A flight trial was conducted to assess whether a breathing gas mix containing at least 40% nitrogen was sufficient to prevent atelectasis in aviators using contemporary flight equipment, and whether cabin altitude influenced atelectasis formation. **METHOD:** Pilots (n=14, male) conducted flights on 2 separate days in a jet trainer aircraft (Royal Air Force Hawk T Mk 1). Flights were conducted at HIGH (18,000ft-20,000ft) and LOW (6,000-8,000ft) cabin pressure altitude, and each flight included 16 manoeuvres at +5Gz sustained for 15 seconds. Participants wore standard flight equipment and breathed 60% oxygen throughout the flight. A safety pilot occupied the other seat. Forced Inspiratory Vital Capacity (FIVC) by spirometry, basal lung volume and FIVC by electrical impedance tomography (EIT), and peripheral oxygen saturation during transition from hyperoxia to hypoxia (pulmonary shunt fraction), were measured in the cockpit immediately before (PRE) and after (POST) flight. Data were analysed using repeated measures ANOVA. **RESULTS:** FIVC was significantly lower POST flight after HIGH (-0.24L) and LOW (-0.38L) sorties but recovered to PRE flight values by the fourth repeat (FIVC4). EIT-derived measures of FIVC decreased after HIGH (-3.3%) and LOW (-4.4%) sorties but did not recover to baseline by FIVC4. FIVC reductions were attributable to decreased inspiratory capacity. SpO_2 was lower POST flight than PRE flight in HIGH and LOW sorties. **DISCUSSION:** Breathing a maximum 60% oxygen during flight results in 3.8-4.9% reduction in lung volume (inspiratory capacity), associated with a slight decrease in blood oxygenation and an estimated pulmonary shunt of up to 5.7%. EIT measures of basal lung volume suggest mild persisting airway closure despite repeated FIVC manoeuvres. There was no meaningful influence of cabin altitude.

Learning Objectives

1. The audience will learn about the effect of acceleration atelectasis on lung function in pilots using typical flight gear after high G flying.
2. The audience will learn the effect of ambient pressure on the development of acceleration atelectasis.

[24] VISUAL SYMPTOMS AND G-LOC DURING CENTRIFUGE-SIMULATED SUBORBITAL SPACEFLIGHT

Joseph Britton[1], Ross Pollock[2], Nicholas Green[1], Peter Hodkinson[2], Stuart Mitchell[3], Alec Stevenson[4], Thomas Smith[2]

[1]Royal Air Force Centre of Aviation Medicine, RAF Henlow, United Kingdom; [2]King's College London, London, United Kingdom; [3]Civil Aviation Authority, Gatwick Airport, United Kingdom; [4]QinetiQ Ltd, Farnborough, United Kingdom

(Original Research)

INTRODUCTION: Commercial suborbital spaceflight presents new challenges with acceleration in both the +Gz and +Gx axes simultaneously that varies with the specific flight profile and seating orientation. As part of a wider study into the physiological effects of centrifuge-simulated suborbital spaceflight, visual and cognitive effects of acceleration were assessed. **METHODS:** 24 participants (age range: 32-80 years) undertook launch and re-entry profiles on a long-arm human centrifuge. One profile represented a vertically launched rocket with a seatback angle of 70° from vertical ('head level' peak +Gz 2.7, peak +Gx 4.2). Two profiles represented an air-launched spaceplane, with a common seated launch phase (seatback angle 20°, peak +Gz 3.7, peak +Gx 3.6) and re-entry in either a reclined (seatback angle 70°, peak +Gz 1.2, peak +Gx 5.9) or upright seated position (seatback angle 20°, peak +Gz 4.0, peak +Gx 4.5). Profiles were performed twice; in normoxia and mild hypoxia (15% O_2, 8,000 ft cabin pressure altitude equivalent). Participants were asked to remain relaxed in the absence of visual symptoms, and to perform muscle tensing if greyout developed. **RESULTS:** 90% of participants reported visual symptoms at least once. The majority noted greyout during spaceplane launch (mean G at onset when breathing air: +3.3 Gz, +2.5 Gx; with mild hypoxia: +3.4 Gz, +2.5 Gx) and likewise during seated re-entry (breathing air: +3.4 Gz, +4.0 Gx; mild hypoxia: +3.8 Gz, +4.3 Gx), but none when supine. One participant noted visual changes during the vertical launch profile. More than a quarter of participants experienced complete visual loss (blackout) and a small number noted pre-syncopal symptoms. One episode of G-induced loss of consciousness (G-LOC) occurred during seated spaceplane re-entry in a participant aged 80 years. **DISCUSSION:** Centrifuge-simulated suborbital spaceplane profiles are associated with visual symptoms in a large proportion of individuals and can cause G-LOC. Visual changes appeared to occur at lower levels of +Gz than expected, suggesting a possible reduction in relaxed +Gz tolerance with concurrent +Gx. The microgravity phase during actual suborbital flights may further decrease +Gz tolerance, and further research is required to investigate these effects and the potential role of pre-flight physiological training/exposure.

Learning Objectives

1. The participant will be able to understand the head-level effects of various sub-orbital spaceflight acceleration profiles, including visual symptoms and loss of consciousness.
2. The participant will be able to understand the potential implications of mixed +Gz and +Gx acceleration and identify where further research is required regarding possible mitigations.

[25] PHYSIOLOGICAL EFFECTS OF CENTRIFUGE-SIMULATED SUBORBITAL SPACEFLIGHT

Thomas Smith[1], Ross Pollock[1], Joseph Britton[2], Nicholas Green[2], Peter Hodkinson[1], Stuart Mitchell[3], Alec Stevenson[4]
[1]*King's College London, London, United Kingdom;* [2]*Royal Air Force Centre of Aviation Medicine, RAF Henlow, United Kingdom;* [3]*UK Civil Aviation Authority, Gatwick Airport, United Kingdom);* [4]*QinetiQ Ltd, Farnborough, United Kingdom*

(Original Research)

INTRODUCTION: Evidence suggests that the +Gx and +Gz acceleration experienced during suborbital spaceflight launch and re-entry may have meaningful effects on respiratory and cardiovascular physiology. The specific acceleration profile experienced by occupants depends on several factors including the spacecraft and launch platform, the flight trajectory and seat orientation. The use of airline-style cabin pressurisation may further influence physiological effects. This study aimed to investigate the physiological effects of relevant suborbital G profiles in healthy volunteers across a wide range of ages. **METHODS:** The study included 24 participants aged 32-80 years. Three suborbital flight profiles were studied on a centrifuge: vertical rocket-launched capsule with supine seat; air-launched spaceplane with seat reclined supine for re-entry; and air-launched spaceplane seated upright for re-entry. Profiles were conducted breathing air and breathing 15% oxygen to simulate a cabin pressure altitude of 8,000 ft. Arterial oxygen saturation (SpO_2), ventilation, respiratory gases, ECG and blood pressure were measured continuously, and subjective data were captured by a symptom questionnaire. **RESULTS:** G exposures were well tolerated overall, although participants commonly reported experiencing short periods of breathlessness and 'unpleasant' chest heaviness at peak G. SpO_2 fell with all profiles during both launch and re-entry phases. On average, minimum SpO_2 for each profile and phase was 90-94% while breathing air and 84-88% while breathing 15% oxygen. However, there was wide variation between individuals and profiles, and a fifth of participants desaturated to $SpO_2 < 80\%$ at some point. The lowest recorded value for SpO_2 was 69%. **DISCUSSION:** Centrifuge-simulated suborbital launch and re-entry is associated with distinct physiological effects including a variable degree of transient hypoxaemia. These effects may warrant consideration as part of the approach to medical fitness standards and guidance for crew and for prospective passengers, especially those who are considered susceptible due to medical status or age. Actual suborbital flights include an intervening microgravity phase, and in-flight measurements are required to determine the additional effects of these dynamic high/zero/high-G profiles.

Learning Objectives

1. Understand how high-G acceleration varies across different suborbital launch and re-entry profiles, and how cabin pressure conditions may also vary across suborbital platforms.
2. Understand the physiological effects associated with suborbital G profiles when simulated on a centrifuge, and the effect of simultaneously simulating cabin pressure conditions.

[26] AN OPERATIONAL SCALE MODEL SHORT-ARM HUMAN CENTRIFUGE AS A CUBESAT PAYLOAD

Donya Naz Divsalar, Kevin Burville, Caleb Gimpel, John Thomas, Andrew Blaber
Simon Fraser University, Vancouver, British Columbia, Canada

(Education - Tutorial/Review)

INTRODUCTION: Microgravity has been studied as one of the influential factors affecting astronaut health during space travel. With plans of long-term spaceflights, and the Moon and Mars as the next steps in human deep space exploration, missions could span from a few days to months. This imposes a wide variation to mission architecture and planning for commercial enterprises and national agencies as the spacecraft need to be equipped to protect astronauts against the effects of prolonged durations in microgravity. In the extreme, these could lead to potentially life-threatening physiological responses inflight and during return to Earth or other large gravitational bodies. **TOPIC:** Our team at Simon Fraser University's Aerospace Physiology Laboratory is currently in the process of designing a compact short-arm human centrifuge designed to be installed in a variety of spacecraft, using a minimal space allocation. To more thoroughly test the centrifuge prototype, we have proposed to implement a miniature version of this device as the payload of a CubeSat, a classification of Nanosatellites. **APPLICATION:** The CubeSat would use a single reaction wheel as an analog for the centrifuge. The reaction wheel would be used in combination with a series of magnetorquers to learn about how to cancel the torque effects of the centrifuge in a power-efficient manner. Although the centrifuge will primarily produce torques in a single axis any variations in loading or vibrations in the motor will cause minor torques off-axis. These will need to be actively monitored and cancelled in order to prevent unwanted rotation of the spacecraft. Using the information from the in-orbit testing, we will incorporate modifications to our subject-run studies on Earth using our ground-based centrifuge. This will enable us to more thoroughly develop and study countermeasures for space applications and will result in a more in-depth understanding of human physiological responses to artificial gravity in a microgravity environment.

Learning Objectives

1. The participants will be able to understand the importance of modelling human physiology innovation prior to prototyping and running human performance research.
2. Participants will learn about scaled, on-orbit testing of aerospace physiology equipment and its importance in mitigating risk in human performance research.

Monday, 05/23/2022 ***2:00 PM***
Tuscany F

[S-07]: PANEL: MEETING MENTAL HEALTH CHALLENGES IN AVIATION: THE ROLE OF EMPLOYEE SUPPORT GROUPS

Sponsored by the AsMA Aviation Mental Health Working Group

Chair: Quay Snyder
Co-Chairs: Kris Belland, David Scroeder

PANEL OVERVIEW: *Mental health of aviation professionals is critical to safe operations and personal mental wellness. Barriers to seeking mental health assistance include aviation personality types, implications on medical certification for seeking help, lack of resources and work-related scheduling challenges among others. Studies show that although aviation workers have significant mental health stressors and varying levels of distress, relatively few seek professional help. The evolution of aviation peer support programs has removed many barriers to seeking mental health support. Peer support can be very effective in resolving many mental health issues that arise. This panel will explore the research in to the magnitude of mental health challenges in aviation professionals and establishment of programs to address these challenges. Programs include assistance with mental health professionals, those exclusively administered with peers, those utilizing union-based Employee Assistance Programs and military mental health programs.*

[27] ROLES AND RESPONSIBILITIES OF PILOT SUPPORT GROUPS

Robert Bor
Centre for Aviation Psychology, London, United Kingdom

(Education - Program/Process Review)

BACKGROUND: Aviation is one of the operational settings where human factors and/or mental illness can impair mental acuity, performance,

and safety, with potential devastating consequences. This is especially true given the additional stressors associated with the pandemic. Pilot Peer Support Programmes are one of the tools that have been developed to address the safety hazards related to mental illness arising from an individual's life and job stresses. There have been several PPSPs developed internationally and EASA has mandated their establishment in Europe. **OVERVIEW**: This presentation will focus the primary features of PPSPs and the roles and responsibilities of the organization, the volunteers involved in providing peer support as well as all pilots. The EPPSI publication provides a more detail account of various elements and overall roles and responsibilities. A clear framework is needed to identify how the PPSP fits within the corporate structure along with evidence of a genuine commitment. Evidence of that commitment involves the provision of financial support for the program and the provision of time for peer supporters. A critical feature of PPSPs is the pilot colleague(s) with the same professional background, but additionally trained in appropriate skills to provide a friendly ear and assist as a link between the pilot requiring help and available support. A properly trained independent psychologist or other health provider is needed to provide guidance and support decision-making. The programme must be operated with the highest level of confidentiality. A monitoring group is needed to gather details concerning PPSP activities and the provision of anonymous feedback to management and crew members within the organization. **DISCUSSION:** Studies show that although pilots and other aviation employees have significant mental health stressors and varying levels of distress, relatively few seek professional help. The evolution of aviation PSPs has removed many barriers to seeking mental health support. Peer support can be very effective in resolving many mental health issues that arise. However, continued efforts are needed to create a culture with aviation organizations where pilots and others are willing to opening identify when they require additional support and to seek that support from the PPSPs.

Learning Objectives

1. Attendees will be able understand the different roles and responsibilities of the organization and volunteers involved in aviation peer support programs.
2. Attendees will understand that evidence of management commitment involves the provision of financial support for the program and the provision of time for peer supporters.
3. Attendees will understand the critical feature of PPSPs is the pilot colleague(s) with the same professional background need additionally trained in appropriate skills to provide a friendly ear and assist as a link between the pilot requiring help and available support. They will also understand that confidentiality is a critical feature of PPSPs.

[28] PILOT PEER SUPPORT TRAINING AND PROGRAM MODELS

Ellen Brinks
Air Line Pilots Association International, McLean, VA, United States

(Education - Program/Process Review)

BACKGROUND: Current mandates and recommendations from governing states around the world for peer programs to be implemented in aviation to support flight crew members. Overview: developing a peer program requires cooperation between all stakeholders and belief in the system by crew members. As the pandemic continues, the various stresses continue to build and having access to a successful peer program will improve safety and overall wellness within aviation. Program models vary based on specific needs; dictated by regulatory mandates, culture, and corporate models. **DISCUSSION:** Operationally, the significance of peer programs will save lives, improve safety across aviation, and benefit civilian, military, and international aviation stakeholders.

Learning Objectives

1. The audience will learn about different peer program models available and different mechanisms to implement various models.
2. The audience will learn about what should be incorporated in training peers by program creators.

[29] MENTAL HEALTH SUPPORT IN NAVAL AVIATION

Roderick Borgie[1], Robert Lippy[2]
[1]*Naval Air Force Reserve and* [2]*Naval Air Force, Coronado, CA, United States*

(Education - Program/Process Review)

BACKGROUND: Mental health of aviation professionals is critical to safe operations and personal mental wellness. Studies show that although aviation workers have significant mental health stressors and varying levels of distress, relatively few seek professional help. USN has a unique culture and aircrew mental health support network including, Flight Surgeons, Aeromedical Dual Designated Flight Surgeon/Pilots, Chaplains, embedded Aircraft Carrier Psychologists, Human Factors Boards, Cultural Workshops, and is considering Pilot Peer Support. **OVERVIEW:** Barriers to seeking mental health assistance include aviation personality types, implications on medical certification for seeking help, lack of resources and work-related scheduling challenges among others. **DISCUSSION:** The evolution of aviation peer support programs has removed many barriers to seeking mental health support. Peer support can be very effective in resolving many mental health issues that arise. This panel will explore the research into the magnitude of mental health challenges in aviation professionals and establishment of programs to address these challenges. United States Naval Aviation (USN and USMC) has several internal programs to assist with aircrew mental health, including embedded Naval Flight Surgeons (including Aeromedical Dual Designated Flight Surgeon Pilots), Training, Education, Squadron Briefs/stand owns, Human Factors Councils, and Cultural Workshops. Commander Naval Air Forces is interested in expanding into pilot peer support.

Learning Objectives

1. The participant will be able to understand the prevalence of mental health challenges in the aviation profession and it impact on safety and performance.
2. The audience will learn of different models of delivering mental health wellness support through aviation peer based programs.
3. The audience will understand how to help advance aerospace medicine mental support initiatives.

[30] THE VALUE OF PEER PROGRAMS IN AVIATION

Heather Healy
Association of Flight Attendants-CWA, Washington, DC, United States

(Education - Program/Process Review)

BACKGROUND: For over forty years, the Association of Flight Attendants has offered integrated peer support services to its 50,000-member Flight Attendants distributed across multiple US operators. Through a voluntary network of approximately 250 trained peers distributed across 17 airlines in over 80 locations, member Flight Attendants have received confidential assistance for mental health and substance use disorders, flying partner conflicts and stressful events (whether on and off the airplane) through one committee structure. Annually, one out of five AFA Flight Attendant members receives intervention and support services through AFA's EAP. Rather than waiting for a Flight Attendant to self-refer for assistance, AFA EAP reaches out to members based on the observations and concerns of others including family members, flying partners union leaders and airline managers. This approach predicts that a presenting personal and/or work issue may result in the assessment of a behavioral health related issue and provides opportunities for much earlier interventions. Unfortunately, the pandemic has created unusual demands and stressors on our member Flight Attendants. Many have needed urgent access to mental health services for newly diagnosed conditions or re-awakened symptoms at a time when traditional in-person care shrank exponentially. The pandemic has also created heightened secondary trauma and burnout risks for our own EAP peers. This presentation will provide the audience with an understanding of how AFA EAP leveraged technology during the pandemic to address the multiple needs of Flight Attendants requiring assistance and peers who deliver this assistance. The audience will also learn how AFA's, unique structure and early intervention approach allowed us to assist nearly 11,000 Flight Attendants across 2020.

Learning Objectives
1. This presentation will provide the audience with an understanding of how AFA EAP leveraged technology during the pandemic to address the multiple needs of Flight Attendants requiring assistance and peers who deliver this assistance.
2. The audience will also learn how AFA's, unique structure and early intervention approach allowed us to assist nearly 11,000 Flight Attendants across 2020.

Monday, 05/23/2022 ***2:00 PM***
Tuscany 3

[S-08]: PANEL: STATE OF PRE-CLINICAL RESEARCH ON THE EFFECTS OF HYPOBARIA DURING AEROMEDICAL EVACUATION IN MULTIPLE PRECLINICAL POLYTRAUMA RESEARCH MODELS

Chair: Catriona Miller
Co-Chair: Anke Scultetus

PANEL OVERIVEW: *During recent conflicts, aeromedical evacuation (AE) has been demonstrated to be an effective way to rapidly evacuate patients to the continental U.S. (CONUS). While there appears to be minimal to no mortality during an AE, there is a dearth of knowledge on the possible adverse effects associated with hypobaria, hypo- or hyperoxia and vibration during extended transport. Clinical providers along the continuum of care over the past 19 years have reported neurological degradation in wounded warriors with TBI and unexplained physiological complications concerning for the potential adverse effects of CCATT and aeromedical evacuation. Data related to these observations will be presented. During the panel we will also provide an update on the most recent findings on the effects of the stressors of flight in various laboratories, across multiple pre-clinical injury models in different species, and correlate them with clinical observations made by active-duty combat surgeons throughout the continuum of care. Exposure to hypobaria following traumatic brain injury (TBI) and hemorrhagic shock increased organ damage and mortality. Moreover, hypobaria adversely affected behavior and increased neuroinflammation in ferret polytrauma models. In a swine model of TBI with multiple flights, physiological instabilities were observed in the hypobaria animal group compared to normobaric control animals several hours into the flight, and there was a significant increase in white blood cells several days after the second flight. In a rat model of blast TBI with hypobaria and vibration we discovered that vibration reduced organ damage and modulated the inflammatory response. Overall, these clinical observations and basic science results could provide a possible explanation for unexplained clinical degradations upon arrival at CONUS hospitals or military treatment facilities, and upon further investigation could provide a platform for revisions of current clinical practice guidelines.*

[31] EFFECTS OF AIR-EVACUATION-RELEVANT HYPOBARIA ON FERRETS FOLLOWING POLYTRAUMA

Julie Proctor[1], Molly Goodfellow[1], Rao Gullapalli[1], Su Xu[1], Amanda Hrdlick[1], Boris Piskoun[2]
[1]*University of Maryland School of Medicine, Baltimore, MD, United States;* [2]*University of Maryland, Baltimore, MD, United States*

(Original Research)

INTRODUCTION: Rats exposed to aeromedical evacuation (AE) relevant hypobaria within seven days after traumatic brain injury (TBI) alone or in combination with hemorrhagic shock (HS) exhibit greater neurologic injury and mortality than those maintained under normobaria. The applicability of these results to humans may be limited, however, by differences in brain neuroanatomy. Like humans, ferrets have a gyrencephalic brain. We therefore developed a ferret polytrauma (PT) model consisting of controlled cortical impact (CCI) followed immediately with mild HS. The objective was to determine if the deleterious effects of AE-relevant hypobaria observed in rats after TBI are also observed in a distinctly different species with a gyrencephalic brain. **METHODS:** The ferret PT model was very similar to our rat PT model. Anesthetized adult male ferrets were subjected to CCI and HS by withdrawing blood to maintain MAP 35-45 mm Hg for 30 minutes. Resuscitation with Hextend was followed one hr later by blood re-infusion. At 24 hr, ferrets were placed in a "flight" chamber for 6 hr and exposed to normobaria or to hypobaria (= 8000 ft) under normoxic conditions (21-28% O_2). MRI and MRS measurements were performed prior to injury and 2 days later. Behavioral tests included a novel object location test for evaluation of spatial memory. Brains were perfusion-fixed on day 7, immunostained for IBA-1(microglia) and used for quantification of cortical lesion volume and activated microglia in the penumbra. **RESULTS:** In contrast to our rat PT model that results in 30–60% mortality, no ferret deaths occurred. Ferrets exposed to hypobaria after PT performed worse on the novel object location test compared to those maintained under normobaria. The lesion volume, expressed as a percent of total cortical volume, was similar to that of rats, whereas microglial activation was more extensive. MRS results obtained at 48 hr indicate significant reduction in cortical levels of creatine, N-acetyl aspartate, GABA and glutamate after polytrauma. **CONCLUSIONS:** To our knowledge this is the first ferret polytrauma model combining CCI plus hemorrhagic shock. Despite neuropathology that was comparable to that of rats, there was no ferret mortality. Preliminary results indicate that exposure to hypobaria adversely affects behavior and may increase neuroinflammation. **ACKNOWLEDGMENTS:** Supported by U.S. Air Force FA8650-15-2-6D21.

Learning Objectives
1. The participants will understand how exposure of lab animals to hypobaria can worsen outcomes following experimental traumatic brain injury.
2. The attendees will appreciate how the gyrencephalic brain of ferrets is distinctly different than the lissencephalic brains of rodents but close to the neuroanatomy of humans. The similarity between the brains of ferrets and humans could confer ferrets with a more clinically translational neuropathology following traumatic brain injury.

[32] REDUCTION IN CEREBRAL BLOOD FLOW DURING AEROMEDICAL EVACUATION-RELEVANT HYPOBARIA FOLLOWING TRAUMATIC BRAIN INJURY IN RATS

Gary Fiskum, Julie Proctor
University of Maryland School of Medicine, Baltimore, MD, United States

(Original Research)

INTRODUCTION: Simulated air-evacuation (AE)-relevant hypobaria (HB) worsens neurologic outcomes after traumatic brain injury (TBI) in several animal models and species; however, the mechanisms responsible for this secondary brain injury are unknown. This study tested the hypothesis that cerebral blood flow (CBF) is reduced during exposure to HB 24 hr post-injury (hpi). **METHODS:** Animal protocols were approved by the University of Maryland, Baltimore and the US Air Force. Controlled cortical impact (CCI) and sham injured (craniotomy) adult male rats were exposed to 6 hr simulated AE "flight" at 24 hpi. CBF was measured using arterial spin labelling MRI prior to and after CCI, and during and after hypobaria (HB), in a pressure chamber located in the bore of a 7 Tesla magnet. Measurements during normobaria (NB) (0 ft) and HB (=8000 ft altitude) were made under normoxic (30-40% O_2) and hyperoxic (100% O_2) conditions. **RESULTS:** Cortical CBF was reduced one day post-injury (dpi) and was not further inhibited during exposure to hypobaria. In contrast, while thalamic CBF was unaffected by CCI alone, it was reduced in sham and injured groups during exposure to HB, compared to the pre-flight scans. Further analysis of all groups during the flight period demonstrated that CBF was lower in rats that were exposed to HB compared to NB, regardless of ambient O_2 levels. Nevertheless, at 14 dpi, only injured animals that received 100% O_2 during

HB displayed lower cortical and thalamic CBF. **DISCUSSION:** Although CCI did not reduce CBF to the cortex, exposure to AE-relevant hypobaria one day after moderate TBI or Sham surgery resulted in lower CBF in the thalamus. CBF was least affected in rats maintained under normobaric conditions. These results, taken together with other lab animal studies and at least one clinical study indicate that TBI patients should either wait at least several days before flying or that AE aircraft should fly at cabin pressures higher than those typically used. In addition, the use of unnecessarily high levels of supplemental O_2 should be avoided during flights as hyperoxia can have a long-term dampening effect on CBF.
Supported by US Air Force FA8650-17-2-6H13

Learning Objectives

1. The participant will understand that exposure of rats to aeromedical evacuation relevant hypobaria following traumatic brain injury worsens both neuropathologic and neurobehavioral outcomes.
2. The audience will learn that exposure of rats to hypobaria can result in a significant reduction in cerebral blood flow that might cause secondary brain injury following traumatic brain injury.

[33] IMPACT OF HYPOBARIC EXPOSURE ON INFLAMMATION AND ORGAN INJURY IN A NON-HEMORRHAGIC MOUSE MODEL OF POLYTRAUMA

Kerri Lopez[1], Andrew Suen[2], Yang Yang[1], Sheng Wang[1], Brittany Williams[1], Jing Zhu[1], Jiang Hu[1], Gary Fiskum[1], Alan Cross[1], Rosemary Kozar[1], Wei Chao[1]
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(Original Research)

INTRODUCTION: Trauma remains a leading cause of death. Aeromedical evacuation, associated with hypobaria and hypoxia, is an important part of the care of civilians and soldiers with traumatic injuries. While hypoxia is often associated with poor outcomes, the effects of hypobaria are less understood. **METHODS:** Ten-week-old C57BL/6J mice underwent sham (laparotomy only) or polytrauma surgery of 3 components: 1) 40′ of superior mesenteric artery occlusion, 2) tibia fracture, and 3) 30′ of ipsilateral gastrocnemius muscle crush. Two hours later, mice were subjected to 6 h of hypobaric or normobaric conditions. The hypobaric chamber had 564 mmHg of pressure, equivalent to a flight at 8000 feet, and a functional FiO2 of 21%. At 8 h post-surgery, the following endpoints were examined: 1) cardiac ECHO, 2) broncheoalveolar lavage (BAL) protein/IL-6, 3) plasma IL-6, E-selectin, hyaluronic acid (HA), and thrombomodulin (TM), and 4) kidney injury markers (Ngal, KIM-1). Student's t-test or the Welsh's t-test were used. **RESULTS:** Compared with sham, trauma mice had higher plasma IL-6 (38±33 *vs.* 990±2240 pg/ml, p=0.03), E-selectin (39±16 *vs.* 70±27 ng/ml, p=0.03), HA (73±35 *vs.* 205±97 ng/ml, p=0.01), TM (24±3 *vs.* 63±27 ng/ml, p=0.005), and Ngal (1.0±0.2 *vs.* 9.4±8.8 fold, p=0.004). There were trends toward decreased cardiac function and increased BAL IL-6 in the trauma mice. Trauma mice that were exposed to hypobaria had a decrease in cardiac function when compared to those at normobaric conditions as evidenced by fractional shortening (42±9% vs. 51±8, p=0.01), cardiac output (8.6±5 vs.13±6 mL/min, p=0.02), and stroke volume (16±8 vs. 23±8 µL/beat, p=0.02). There was, however, no significant difference in plasma IL-6, E-selectin, HA, TM, NGAL and KIM-1, or BAL IL-6 between normobaria and hypobaria groups. **CONCLUSIONS**: Our preliminary data suggest that non-hemorrhagic mouse polytrauma led to a marked plasma cytokine production, endothelial injury, and AKI. Hypobaric exposure for 6 hours after traumatic injury appeared to worsen cardiac dysfunction but had no significant effect on endothelial, lung, or kidney injury at 8 hours.

Learning Objectives

1. The audience will learn about the effects of hypobaria and its association with poor outcomes after trauma in animal models.
2. The audience will learn about the impact of hypobaria on downstream organ systems after traumatic injury in animal models.

[34] HYPERHOMOCYSTEINEMIA-INDUCED PHYSIOLOGICAL STRESS EXACERBATES BLOOD BRAIN BARRIER DISRUPTION & PROMOTES INFLAMMATION IN A RAT MODEL OF BRAIN INJURY

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(Original Research)

INTRODUCTION: Many military service members suffer psychological and physiological stress during combat and routine practices. These stressful conditions may cause systemic biochemical changes such as increases in the neurotoxin homocysteine, which may exacerbate combat-related injuries. This study investigated the deleterious effects of pre-existing hyperhomocysteinemia (HHCY) on traumatic brain injury (TBI)-induced blood brain barrier (BBB) permeability and associated inflammation in rats. **METHODS:** A total of 85 Male Sprague-Dawley rats (250-300 g; Envigo, Denver, CO) received once-daily intraperitoneal injections of L-methionine (300 mg/kg), to induce HHCY, or saline as control for 7 consecutive days. They were then subjected to TBI by controlled cortical impact (CCI) method over the left parietal cortex or sham surgery under anesthesia. The impact velocity was 5 m/s and the penetration depth was 1.5 mm. CCI and sham rats were euthanized at different time points and brain tissue was collected for histological and biochemical analyses. There were four to six animals per group and statistical analysis was performed by one-way analysis of variance with Tukey-Kramer post-test analyses. The study was approved by the University of Maryland Institutional Animal Care and Use Committee. **RESULTS:** Methionine injections induced a sustained six-fold increase in homocysteine levels both in sham and CCI rats ($p < 0.001$), compared to controls. Histological and biochemical analyses performed on brain tissues at days 1 and 7 post-surgery to assess the integrity of the BBB demonstrated increased nitrotyrosine expressing astrocyte-like cells and reduced the expression of the cerebral tight junction protein occlusion in HHCY rats compared to control rats. HHCY also caused an upregulation of the intracellular adhesion molecule 1 ($p < 0.05$) and increased Evans Blue extravasation ($p < 0.01$), both suggestive of increased BBB permeability. Moreover, HHCY increased the expression of the pro-coagulation markers von Willebrand factor ($p < 0.05$) and plasma-thrombin, resulting in diffuse presence of ferric ion positive cells and of activated microglia/macrophages prominently in HHCY rat-TBI brain sections. **DISCUSSION:** HHCY exacerbates nitrotyrosine-induced astrogliosis and BBB permeability and promotes blood clotting and diffuse inflammation following mild TBI in rats.

Learning Objectives

1. The audience will learn about how many military service members suffer psychological and physiological stress during combat and routine practices.
2. The audience will learn about the changes that stressful conditions may cause systemic biochemical changes such as increases in the neurotoxin homocysteine, which may exacerbate combat-related injuries.

[35] INDUCTION OF ENDOTHELIAL BARRIER DYSFUNCTION BY SERUM FACTORS OF TRAUMATIC BRAIN INJURY IN RATS

Yunbo Ke[1], Julie Proctor[1], Juliana Medina[1], Catriona Miller[2], Junghyun Kim[1], Thomas Grissom[1], Anna Birukova[1], Gary Fiskum[1], Konstantin Birukov[1]
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(Original Research)

INTRODUCTION: Acute respiratory distress syndrome (ARDS) can be induced by traumatic brain injury (TBI), & potential effects of aeromedical evacuation hypobaria exposure of wounded personnel on severity of TBI-induced lung injury and breach of lung blood-gas barrier

remain unknown. **METHODS:** The adult male rat polytrauma model consisted of controlled cortical impact (CCI)–induced TBI followed by 30 minutes of hemorrhagic shock (HS, mean arterial pressure, 35–40 mm Hg) induced by blood withdrawal. The animals were exposed to either hypo- or normobaric conditions. 48 hours after TBI, serum samples were collected from the right ventricle. Diluted sham or TBI serum were used to treat endothelial cells in culture. The endothelial barrier dysfunction was assessed by a decrease of electrical resistance across endothelial cell monolayers, measured via electrical cell impedance sensor (ECIS). **RESULTS:** Pronounced barrier-disruptive effects were registered in sera of TBI animals exposed to both, hypo- and normobaric conditions. However, hypobaric conditions decreased mortality compared to normobaric groups. Serum from TBI rats but not sham induced significant barrier dysfunction in human pulmonary artery endothelial cells. Compared to sham, serum samples from the TBI rats induced a resistance decrease 3 hrs after serum addition from 23.6±17% to 35.5±4.9%. Further study indicated that thrombin was responsible for a transient early-phase barrier disruptive activity in TBI-serum because both thrombin inhibitor & thrombin receptor antagonist attenuated the TBI-serum-induced EC barrier dysfunction only during the early stages. There were more sustained late-phase barrier disruptive activities following thrombin. It was found that both early & late-phase barrier disruptive activities were inhibited by heparin. In addition, late phase barrier disruptive activities were depleted by heparin-sepharose. Moreover, AUY954, OxPAPC, and 8CPT, the EC barrier protective agents, partially inhibited/reversed the barrier disruptive activities of TBI-serum. **CONCLUSION**: Serum from TBI rats contains both early & late-phase barrier disruptive activities that are reversible by exogenous intervention. Studies in our group are underway to identify late phase disruptive factors activated by hypobaric conditions, define severity of injury & associated levels of vascular barrier dysfunction.

Learning Objectives

1. The participants will learn about how Mild to severe acute respiratory distress syndrome (ARDS) can be induced by traumatic brain injury.
2. The participants will explore the potential effects of hypobaria associated with air-evacuation of wounded personnel on severity of TBI-induced lung injury and breach of lung blood-gas barrier remain unknown, and no effective drug-based therapeutics are currently available.

Monday, 05/23/2022 ***2:00 PM***
Tuscany 4

[S-09]: PANEL: OPERATIONAL VISION THREATS AND REQUIREMENTS

Chair: Adam Preston
Co-Chair: Micah Kinney

PANEL OVERIVEW: *Aircrew rely heavily on their visual system to maintain situational awareness and aircraft control during critical phases of flight and operational events. Military vision standards exist to ensure all aircrew can meet the visual demands of operational flying. However, a balancing act is necessary – arbitrarily strict standards can be detrimental to applicant pools and military readiness; standards that are too lenient could put aircrew at risk in degraded visual environments. Furthermore, adversarial threats to vision safety, such as lasing events and neurotoxin attacks, can jeopardize mission success. This panel will discuss original research on operational vision threats and requirements for aircrew. The first two panelists will report on aeromedical threats including: (1) lasing attack & event statistics to military aircrew and (2) visual and ocular effects and impact to pilot performance after exposure to low-level neurotoxin analogue. Presentation (3) will discuss data detailing the impact of reduced monocular visual acuity on stereopsis and traffic identification with respect to current pilot vision requirements. Presentation (4) will explain the development of the 55% Cone Contrast threshold requirement for DoD aircrew, with emphasis on task performance. Finally, Presentation (5) will discuss data on the impact of stereoacuity on virtual-reality induced motion sickness and impacts related to flight simulators and unmanned aircraft control.*

[36] UPDATE ON INFLIGHT LASER ILLUMINATION EVENTS

Micah Kinney
Naval Air Warfare Center Aircraft Division, Patuxent River, MD, United States

(Original Research)

INTRODUCTION: Laser illumination events that occur inflight degrade visual situational awareness and crew resource management. As handheld lasers become more readily available to the general public, the threat they pose to aircrews remains prevalent. **METHODS:** Events from 2017-2020 reported to the Federal Aviation Administration (FAA) and Naval Safety Center on laser illumination was obtained and will be presented focusing on trends in perceived color, phase of flight, aircraft platform, and location. **RESULTS:** Over the period of review, laser illumination events steadily increased in both civil and military reporting. Green remains the most reported color type. During 2020, the daily US average reported to the FAA was 18.7/day with a peak of 55 on November 5th. **DISCUSSION:** While laser illumination events are again on the rise, it is important to educate both the public and aircrew on potential hazards these events cause. In addition, discussion will be presented on inflight mitigation and procedures to follow after a laser illumination event.

Learning Objectives

1. The participant will learn about laser illumination events and common laser terminology.
2. The participant will better understand what to do following a laser illumination event and how to report the event.

[37] AIRCRAFT PILOTING PERFORMANCE AFTER SIMULATED EXPOSURE TO LOW LEVELS OF CHEMICAL WARFARE AGENTS

Michael Reddix[1], Adam Preston[2]
[1]*Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States;* [2]*Wright-Patterson Air Force Base, OH, United States*

(Original Research)

INTRODUCTION: Miosis is one of the most sensitive and easily observable signs of exposure to chemical warfare nerve agents, especially for a low-level exposure to acetylcholinesterase inhibitors such as sarin, soman, and VX. Few studies have been specifically designed to assess the impact of chemical agent exposure on visually mediated task performance, and none have specifically addressed aviator task performance. Little is known about the extent of the degradation in military task performance associated with various degrees of pupil constriction and accommodative spasm of the lens. **METHODS**: Fourteen trained pilots aged 22-54 with turbo-prop aircraft experience and normal ocular health were recruited to fly a fixed-base flight simulator configured with head and eye tracking, T-6A Texan II controls, a 10-Fresnel lens collimated display (providing distance accommodative demand for out-of-cockpit viewing), and an instrument panel displayed on an LCD screen at arm's length (to provide a near demand). Over four days, participants underwent two familiarization flights, a control flight, and an experimental flight. The experimental condition consisted of administration of pilocarpine eye drops to simulate the ocular effects of low-level neurotoxin exposure. Pilots were directed to take off, fly specific headings and altitudes, and execute standard rate turns, approaches, and landings. Eye tracking recorded in-and-out of cockpit gaze and gaze duration on each primary flight instrument. Flight performance, visual acuity, and accommodative amplitude were also assessed. **RESULTS**: Data collection was completed in September 2021. Initial analyses and pilot reports indicate that simulated low-level neurotoxin exposure has a marked adverse effect on distance and near acuity, moderate to intense visual symptoms, and adverse impacts on piloting performance. Formal analysis of flight and eye tracking data is ongoing. Initially, deleterious effects appear to be more prominent in younger individuals. **DISCUSSION**: The adverse ocular effects of low-level neurotoxin analogues in fixed wing aircraft were observed in ideal flight simulation conditions. Further research is needed

under other operational conditions, especially in rotary wing aircraft, which have more exposure to degraded visual environments, operate closer to the ground with less room for error, involve high workload, and in which aircrew frequently utilize night vision devices.

Learning Objectives

1. Participants will understand the physiology of acetylcholinesterase inhibitor neurologic chemical warfare agents.
2. Participants will understand the visual and ocular effects and operational impacts of low-level neurotoxin exposure.

[38] IMPACT OF REDUCED VISION IN ONE EYE ON PILOT STEREOPSIS AND TRAFFIC IDENTIFICATION

Micah Kinney[1], Dain Horning[2]
[1]*Naval Air Warfare Center Aircraft Division, Patuxent River, MD, United States;* [2]*Naval Medical Research Unit Dayton, Dayton, OH, United States*

(Original Research)

INTRODUCTION: Currently, stereopsis of 40 arcsec or better is required for U.S. Navy and Marine Corps aviation. Clear visual acuity in each eye is necessary for ideal stereopsis and binocular vision. This study aimed to evaluate pilot performance with simulated reduced vision in one eye. Having operationally based vision standards and data-driven waiver policy will ensure appropriate military aviation recruitment and retention. **METHODS:** Thirty-two military pilots performed vision tasks under normal visual conditions and with reduced monocular vision using Bangerter foils over either their dominant or non-dominant eye of standard issue clear flight glasses. The experimental design was totally within subjects and participants were divided equally between dominant and non-dominant blurred vision with each task counterbalanced. Vision tasks were distant visual acuity, contrast acuity, stereopsis, and ocular dominance. A simulated traffic identification task in the T-6A Texan II (Flite Advantage) was flown using a high-fidelity cockpit (Bugeye Technologies) with three LG 65" OLED 4K out-the-window displays. Participants were required to maintain heading and altitude while scanning for multisector off-the-nose traffic. **RESULTS:** Stereopsis measurements (arcsec) increased from baseline for all participants in the obscured vision condition compared to normal vision. In the reduced vision condition, 13 (40.6%) participants had reduced stereopsis worse than 40 arcsec, and thus were out of current standards. For traffic identification, the average time to spot traffic for normal vision was 53.05 sec (SD = 31.50) compared to obscured vision 64.65 *sec* (SD = 27.39). A binomial test revealed that participants in the Dominant group were significantly more likely to miss traffic in the obscured vision condition than in the normal vision condition, p = 0.006. For the non-dominant group, a binomial test revealed that participants were not significantly more likely to miss traffic in the obscured vision condition than in the normal vision condition, p = 0.34. **DISCUSSION:** Mildly reduced monocular vision does appear to show a significant degradation in stereopsis performance and traffic identification of experienced pilots. Study results will be discussed from a vision standards standpoint and the importance of data-driven operationally relevant waiver policy.

Learning Objectives

1. Participants will learn about operationally relevant vision standards for military aviation.
2. Participants will better understand how binocular vision is important in the aerospace environment.

[39] U.S. MILITARY COLOR VISION STANDARDS AND VISUAL PERFORMANCE

Hong Gao[1], Micah Kinney[2], Adam Preston[3], Michael Reddix[3]
[1]*Tri-Service Vision Conservation & Readiness, Aberdeen Proving Ground, MD, United States;* [2]*Naval Air Warfare Center-Aircraft Division, Patuxent River, MD, United States;* [3]*Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States*

(Original Research)

INTRODUCTION: Color vision deficiency (CVD) is a disqualifying condition for military special duty occupations. The U.S. military color vision standards were updated in recent years. Paper-based pseudoisochromatic plates (PIP) remain the primary color vision screening method; and the Farnsworth Lantern test (FALANT) and its variants (e.g., Optec-900) will be gradually phased out. Current standards also include three computer-based color-vision tests (CVT): Cone Contrast Test (CCT), Colour Assessment and Diagnosis (CAD) test, and Waggoner Computerized Color Vision Test (WCCVT). The objective of this presentation is to compare military color vision testing and passing criteria. **METHODS:** Color vision tests and two military relevant In- and Out-of-cockpit color discrimination tasks were administered. Analysis of Variance was used to describe effects on the color discrimination task performance. Inverse efficiency score was used to combine reaction time and error rate for data analysis. **RESULTS:** The U.S. military PIP and CVT standards agreed mostly on passing the same color vision normal individuals (CVN), except one subject who passed the PIP (1/136) would have failed the "6 SNU" CAD standard. Of those who failed the PIP (n=55), five subjects (9%) were re-classified as CVN. By lowering the CCT passing criterion from 75% to 55%, it would pass 22% red-green individuals with color vision deficiency (CVDs). Pairwise comparison with Bonferroni adjustment showed that the "<55%" group was significantly slower and less accurate than the "≥55% and <75%" or the "≥75%" group in both color discrimination tasks ($p<0.001$). Furthermore, the "≥55% and <75%" group was slower than the "≥75%" group by 1,831±2,179 and 72±65 msec of the In-cockpit and Out-of-cockpit color discrimination tasks, respectively, but were not statistically significant ($p>0.05$). **DISCUSSION:** The paper-based PIP is adequate color vision screening tool; however, the CVTs are much better in selecting and grading CVDs. Although it was not statistically significant, mild CVDs trended slower and less accurate than CVN in color demanding visual tasks.

Learning Objectives

1. Understand color vision tests and standards for United States Military Personnel.
2. Understand the relationship between severity of color-vision deficiency and operationally relevant visual performance.

[40] STEREOACUITY & VIRTUAL-REALITY-INDUCED CYBERSICKNESS

Adam Preston
Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Stereoacuity is one of the most sensitive assessments of visual function. High stereoacuity requires excellent visual acuity, fine oculomotor control, and high-level neural processing. Sensory conflicts within and between sensory systems can result in cybersickness symptoms in virtual reality users. In this study, we examined the role of stereoacuity in predicting cybersickness symptoms in a provocative virtual reality experiment. **METHODS:** Thirty-six participants engaged in a custom virtual reality (VR) task requiring horizontal head rotations for 20 minutes on three different days. Stereoacuity was assessed prior to VR exposure using the Randot® Stereotest. To provoke a potentially nauseogenic response, the gain of updated visual shift in relation to the demand of head rotation was manipulated to be 50%, 100% (control) and 200% of predicted visual shift. An Oculus Rift headset rendered the visual input and an integrated eye tracking system monitored the head rotation velocity and gaze position relative to the head to measure the participants' vestibulo-ocular reflex. Participants' long-term and pre-game cybersickness propensity were assessed with the Motion Sickness Assessment Questionnaire, and momentary discomfort measured with an analog scale every minute. **RESULTS:** Individuals with even slightly reduced stereoacuity (25 arcseconds or worse) had statistically significant and clinically relevant higher maximum nausea ratings than those who had excellent stereopsis (20 arcseconds or better, the maximum limit of the test; $F(1,34) = 4.809$,

P = .037) across all three experimental conditions. Furthermore, individuals who had a higher vestibulo-ocular reflex adaptation to the required demand had lower symptom scores. **DISCUSSION:** Individuals with higher stereoacuity may utilize stereopsis to more accurately track targets in VR, resulting in less motion sickness. Many of the participants in this study maxed out the test at 20 arcseconds, which was more sensitive than most clinical tests which assess only to 40 arcseconds. Stereoacuity could be a quick assessment to identify individuals that may be more prone to developing symptoms in training or operational settings that utilize VR. Future studies should utilize a more sensitive stereoacuity test that can test to finer thresholds.

Learning Objectives

1. Participants will have an understanding of how stereoacuity can predict virtual-reality induced cybersickness symptoms.
2. Participants will have an understanding of how vestibulo-ocular reflex neuroadaptation can predict cybersickness symptoms.

Monday, 05/23/2022 ***2:00 PM***
Tuscany 12

[S-10]: PANEL: BRINGING A RESEARCH PROJECT TO FRUITION: FROM CONCEPT TO JOURNAL PUBLICATION

Sponsored by the Education and Training Committee

Chair: Douglas Boyd
Co-Chair: Frederick Bonato

PANEL OVERIVEW: INTRODUCTION: *In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career.* ***TOPIC:*** *Herein, this Panel, sponsored by the Education and Training Committee, will discuss the multiple steps involved in taking a research project from a novel concept through to publication.* ***APPLICATION:*** *Research starts with an idea/concept posed by the investigator. The first presentation will address how to determine if the idea is novel via a literature search and designing an appropriate experimental approach, data acquisition and analysis towards answering the question. In the second presentation, the issue of whether the research represents human subjects research and navigating the required approval process will be covered. In the third presentation, the editor of the "Aerospace Medicine and Human Performance" journal will discuss statistical methods and statistical packages commonly used in aeromedical research projects. The following session, journal selection manuscript preparation, reference managers and the Editorial process for submitted papers will be discussed. In the final presentation, the manuscript review process will be addressed. In this regard, by far the majority of manuscripts require at least one round of revision and how best to respond to critiques towards getting a manuscript accepted will be addressed.*

[41] THE NUTS AND BOLTS OF A RESEARCH PROJECT FROM CONCEPT THROUGH TO DATA ANALYSIS

Douglas Boyd
Embry Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career. **TOPIC:** Herein, the author will discuss the steps involved in a research project from the germinating seed of an idea to data acquisition. **APPLICATION:** Research starts with an idea/concept posed by the investigator. One of the first steps is to determine whether this question has been addressed previously-this is important as priority in research is accorded more to novelty than a confirmation of older findings. Towards answering this question, various literature search platforms (e.g. PubMed, Google Scholar) will be discussed and how to bypass the fee required by some journals for non-subscribers. Consequently, selection of research methods which most directly answer the question posed will be addressed as well as data collection and analysis. Will research funding be required? Does the research lend itself to multiple experiment approaches to corroborate each other? What factors affect the population size needed? Importantly, is the allotted experimental time frame (including approvals for human subjects' research, acquisition of research funds) within that achievable by the investigator? This presentation will segue to the next two where human subject research approval and manuscript preparation are addressed.

Learning Objectives

1. Trainees will learn how to generate a novel research question which advances scientific knowledge.
2. Audience will learn how to determine if the question posed is novel: how to conduct a literature search? Has similar work been done previously or does yours differ in a specific way?
3. Participants will hear about what experimental design/methods are appropriate for the research question posed.

[42] NAVIGATING INSTITUTIONAL REVIEW BOARDS AND SURVIVING THE JOURNEY

Michael Wiggins
Embry Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: Research involving human subjects is required by law to be reviewed and approved by an institutional review board (IRB). Understanding the requirements and insuring your application contains the necessary information are the keys to success. **TOPIC:** Any research involving human subjects is required by law to be reviewed and approved by a qualified IRB to ensure that the rights and welfare of participants who volunteer in research activities are protected. IRBs are federally mandated by the Department of Health and Human Services to regulate this protection by the respective institution. This presentation will firstly define what constitutes human subjects research. Thereafter, the key components of the regulations governing human subjects research encapsulated in Title 45 of the Code of Federal Regulations (CFR) Part 46 (and based on the "Common Rule" and 45 CFR Part 46) will be described. These components set the basis for the review process. Noteworthy is that each institution has a unique process flow based on these components. Understanding both the regulatory requirements and navigating the institutions' specific process flow will minimize the applicant's effort/time in preparing/revising an application towards an expedient approval. **APPLICATION:** Attendees will learn how best to follow their institution's process for gaining approval in an expedient manner but at the same time protecting the rights, dignity, and safety of participants. **RESOURCES:** Office of Human Research Protections, U.S. Department of Health and Human Services, https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/index.html.

Learning Objectives

1. Attendees will gain an understanding of what research constitutes human subjects research?
2. Trainees will be educated as to how best to navigate the IRB application process for an expedient review/acceptance.

[43] AEROSPACE MEDICINE STATISTICS

Federick Bonato
Saint Peter's University, Jersey City, NJ, United States

(Education - Tutorial/Review)

INTRODUCTION: In most research projects scientific rigor requires statistical testing of the data to draw any conclusion as to whether an endpoint has changed. Unfortunately, statistics is commonly given short shrift in in aerospace medical training. **TOPIC:** Herein, the author will give an overview of the types of data commonly generated in aerospace medicine studies, appropriate statistical tests and interpretation of their output. Exemplars drawn from published studies will be used for illustrative purpose. **APPLICATION:** Typically, any research project will generate volumes of data requiring statistical analysis to determine whether a perceived change is real or anomalous. The type of statistical test used will be predicated partly on the question posed and whether data are parametric (normally distributed) or non-parametric. The following common research data scenarios are discussed (1) Do two/multiple populations differ in their average/median values for a particular parameter? Such differences can be tested using Students T test/ANOVA (parametric) or Mann-Whitney U (non-parametric) tests. (2) Is a population over-represented for a particular trait/parameter? This can be answered using proportion analyses (e.g., Chi-Square or logistic regression (for multiple variables)). Interpretation of statistical outputs to determine the strength of an association, confidence intervals and significance levels will be discussed. Finally, the suitability of various statistical packages for the non-statistician, aerospace medicine professional in context of ease-of-use will be addressed.

Learning Objectives

1. Attendees will learn that statistical test depends on the type of data and the difference between parametric and non-parametric data.
2. The interpretation of statistical outputs for commonly used tests used in aerospace medicine will be discussed.
3. The audience will be educated as to some of statistics packages with emphasis on their ease of use for the non-statistician.

[44] PREPARING AND SUBMITTING A MANUSCRIPT TO A SCIENTIFIC JOURNAL

Frederick Bonato
Saint Peter's University, Jersey City, NJ, United States

(Education - Tutorial/Review)

PROBLEM STATEMENT: Publication in a scientific journal (such as *Aerospace Medicine and Human Performance*) has potential benefits to one's career and can also provide valuable information to others in one's field/specialty. Choosing the right journal is important—a decision that can depend on journal indexing, impact factor (or other metrics), 'fit', whether or not the journal offers Open Access, and turnaround time. How does one maximize the chances of getting successfully published? Also, how can requests for revised manuscripts best be handled? **TOPIC:** This talk will address the following: 1) Appropriate journal(s) your work should be submitted to, 2) Writing and formatting a submission, 3) Ethics committee approval (e.g., Institutional Review Board or Institutional Animal Care and Use Committee) 4) The editorial process—including peer-review, 5) Turnaround times, 6) Corresponding with the journal office/editor. **APPLICATIONS:** Careful preparation prior to submitting a manuscript for consideration by a scientific journal is essential. After selecting a journal to submit to, following simple steps in preparing, submitting, and revising manuscripts can maximize the probability that a given manuscript will be accepted and published. These guidelines are broadly applicable to many scientific journals.

Learning Objectives

1. Trainees will be provided a systematic approach to writing and submitting a manuscript for publication.
2. The audience will be given a "behind-the-scenes" look at the editorial review process.

[45] A BEHIND THE SCENES LOOK AT THE MANUSCRIPT REVIEW PROCESS-HOW BEST TO HANDLE REVISIONS (AND REJECTIONS)

Douglas Boyd
Embry Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: In academia, peer-reviewed published papers represent one of the benchmarks used for peer recognition/career advancement. After submission, a research manuscript is subjected to at least one round of reviews by subject matter experts/reviewers/referees and rarely accepted "as is." **TOPIC:** In this presentation, the author, (a reviewer for over 30 journals in as many years), will discuss the various elements that reviewers scan for and how best to deal with referee critiques. **APPLICATION:** A manuscript Introduction should be concise, state the gap in knowledge and the research question posed. Too often, Introductions read like a graduate thesis and/or contain irrelevant material (red herrings). In the Results, how consistent are the data with each other? For example, if data from 200 and 230 subjects were presented in two separate tables/graphs, the discrepancy warrants explanation. In the Discussion, were the conclusions drawn by the author(s) supported by the data? Did this section represent a regurgitation of the Results - suggesting a poorly read author out of touch with the literature? Also in the Discussion, did the author address how the new research fits in with the bigger picture and importantly other work? Were the limitations of the research clearly stated? Commonly, authors are invited to revise/resubmit a manuscript after addressing a reviewer's concerns. Shortcomings highlighted by the referee should be addressed via new data acquisition/analysis/experiments. Finally, responding to the reviewer in a non-confrontational manner will improve one's chances of final acceptance.

Learning Objectives

1. Trainees will gain an understanding of what a reviewer is looking for in terms of pertinent elements manuscript Introduction and logical presentation of the Results section.
2. The audience will learn the importance of highlighting the "take home" message in the Discussion and discussing the findings in context of the bigger
   picture and practical applications.
3. Attendees will be schooled as to the best strategies for revising and resubmitting a manuscript to the satisfaction of the reviewer.

Monday, 05/23/2022 ***4:00 PM***
Tuscany C,D,E

[S-11]: PANEL: CLINICAL AND RESEARCH INSIGHTS INTO SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS)

Chair: Tyson Brunstetter
Co-Chair: Mary Van Baalen

PANEL OVERIVEW: *First discovered in 2005, Spaceflight Associated Neuro-ocular Syndrome (SANS; formerly known as "VIIP") is a condition unique to long-duration spaceflight. SANS is associated with a multitude of signs such as optic disc edema and retinal nerve fiber layer thickening; globe flattening; shifts in refractive error; and chorioretinal folds. Other potential signs include brain anatomical changes, retinal cysts, retinal pigment epithelial detachments (PEDs), and optic nerve sheath distention; however, it is unclear whether these signs are truly associated with SANS. While the pathogenesis and pathophysiology of SANS remain elusive, several theories exist. This panel will explore the latest technologies in detecting, diagnosing, and monitoring SANS; present recent SANS/neuro-ocular clinical surveillance and research findings from long-duration crewmembers and terrestrial subjects; and explore potential physiological factors that may contribute to the generation of additional neuro-ocular risk during exploratory spaceflight.*

[46] SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS): 2022 CLINICAL OVERVIEW

Tyson Brunstetter[1], Sara Mason[2], Emily Miller[1], Julia Wells[3], Janejit Gensler[1], Elizabeth Talburt[3], William Misek[3], C. Robert Gibson[4], Amirah Mathin[3], Daniel Marburgh[3], Lorraine Gibson[1]
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(Original Research)

INTRODUCTION: Spaceflight Associated Neuro-ocular Syndrome (SANS) is a condition unique to spaceflight, with unclear pathophysiology and no perfect terrestrial analog. Over two-thirds of long duration spaceflight (LDSF) astronauts present with some SANS finding, including: 1) optic disc edema (ODE); 2) chorioretinal folds; 3) globe flattening; and/or 4) refractive error shifts. Each presents risk to crewmember vision and mission effectiveness. Brain anatomical changes also occur during LDSF and are being monitored. An update will be provided on the latest SANS clinical surveillance statistics, diagnostic technologies, and program initiatives. **METHODS**: Pre-, in-, and post-flight astronaut ocular data were analyzed for the latest prevalence statistics. SANS experts also compiled an update on: 1) recent spaceflight-associated ocular findings, 2) repair of the on-orbit optical coherence tomography (OCT) device; 3) activation of a new on-orbit fundoscope; and 4) clinical efforts for 2022 and beyond. **RESULTS**: 70% of LDSF astronauts present with SANS signs, including 67% with ODE (defined as ≥20 micron increase in peripapillary total retinal thickness); 21% with chorioretinal folds; 21% with globe flattening; and 15% with refractive error shifts. **DISCUSSION**: Clinical Update – OCT is a critical tool for SANS surveillance and research by providing high-resolution, cross-sectional images of eye structure, and retinal photographs mimicking standard fundoscopy. Beginning in Nov 2020, on-orbit OCT errors were experienced, resulting in additional crew time, incomplete datasets, or rescheduled exams. In all cases, all critical data were obtained. Troubleshooting was initiated, and in Jun 2021, an on-orbit repair was performed, successfully eliminating the errors. Since 2019, OCT MultiColor Imaging has replaced standard fundoscopy for nominal on-orbit photodocumentation of the posterior pole of crewmembers. Currently, standard fundoscopy is performed "as clinically indicated" or if OCT data are unobtained. A new fundoscope was delivered to the ISS in 2020, successfully activated in Aug 2021, and subsequently deemed worthy for on-orbit operations. Current efforts include: 1) completing clinical validations and initial operational testing of the prototype Goggle-Based Visual Field (GBVF) device and determining its usefulness in exploration missions, and 2) deploying a commercial visual field device to the ISS to detect any visual performance losses in SANS cases.

Learning Objectives

1. Understand the current (new) case definition of Spaceflight Associated Neuro-ocular Syndrome (SANS).
2. Understand the value of evaluating the ocular anatomy of crewmembers with optical coherence tomography (OCT) and retinal photography, in additional to evaluating visual performance with visual field testing.

[47] TERRESTRIAL PATHOLOGIES EXHIBITING RETINAL PIGMENT EPITHELIAL DETACHMENTS (PEDS), RETINAL CYSTS, AND SEROUS CHORIORETINOPATHY: APPLICABILITY TO SANS

David Mampre[1], John Briggs[2], William Tarver[3], Sara Mason[3], Charles Gibson[4], Mary Van Baalen[3], Tyson Brunstetter[3]
[1]*University of Florida, Gainesville, IA, United States;* [2]*HealthPartners Occupational Medicine Residency Program, St. Paul, MN, United States;* [3]*NASA Johnson Space Center, Houston, TX, United States;* [4]*Coastal Eye Associates, Webster, TX, United States*

(Original Research)

INTRODUCTION: Signs of Spaceflight Associated Neuro-ocular Syndrome (SANS) include optic disc edema (ODE), chorioretinal folds, globe flattening, and hyperopia. The prevailing hypothesis for SANS pathogenesis has been elevated intracranial pressure (ICP) due to cephalad fluid shifts in microgravity. However, an ICP etiology remains inconclusive; SANS attributes differing from terrestrial idiopathic intracranial hypertension (IIH) include demographics, symptomatology, posteriorly deflected Bruch's membrane, higher prevalence of choroidal folds than retinal folds, and normal-to-mildly elevated post-flight ICP. Additionally, pachychoroid is an almost universal finding during spaceflight. And while choroidal volume expansion has been proposed as an alternative etiology of SANS, the pathophysiology has not been discussed in detail, and signs of pachychoroid spectrum disease (PSD) (e.g., serous chorioretinopathy [SCR], pigment epithelial detachments [PEDs], and retinal cysts) haven't been widely reported. We report on these novel ocular findings in astronauts and discuss potential contributions of pachychoroid to the development of SANS. **METHODS:** Astronauts received pre-flight, in-flight, and post-flight optical coherence tomography (OCT) imaging. We also conducted a literature review with search terms relevant to SCR, retinal cysts, PEDs, and pachychoroid. **RESULTS:** PEDs, retinal cysts, and SCR were identified by in-flight OCT testing. These novel ocular defects are well explained by a pachychoroid etiology, and furthermore, PSD has been associated (terrestrially) with nearly all other signs and symptoms of SANS including the characteristic ODE, chorioretinal folds, globe flattening, and hyperopia. Terrestrial PSD is thought to be due to choroidal circulation congestion with resulting elevated hydrostatic pressure and hyperpermeability that disrupts posterior chamber fluid dynamics and the retinal pigment epithelium. PSD ranges from uncomplicated pachychoroid to the development of PEDs, SCRs and neovascularity. Terrestrial PSD has multifactorial risk factors in common with spaceflight including hypercapnia, decreased venous outflow, increased gluco- and mineralocorticoids, catecholamines, and mildly elevated CSF pressure. **DISCUSSION:** In-flight pachychoroid may play a role in SANS pathophysiology, and a pachychoroid etiology may help explain several SANS features that remain unexplained by an ICP etiology. PSD may be a worthy terrestrial analog for future study.

Learning Objectives

1. Recognize recently identified ocular defects in astronauts including pigment epithelial detachments, serous chorioretinopathy, and retinal cysts.
2. Understand the contribution of pachychoroid to these ocular defects in terrestrial pathology and understand the potential connection between terrestrial pachychoroid and signs of SANS including optic disc edema, choroidal folds, globe flattening, and hyperopic refractive shifts.

[48] DO ASTRONAUTS WITH SANS SHOW COGNITIVE TEST CHANGES IN-FLIGHT AND POST-FLIGHT WHEN COMPARED TO BASELINE?

Ann Tsung[1], Bill Tarver[2]
[1]*UTMB KBR NASA, Houston, TX, United States);* [2]*NASA, Houston, TX, United States*

(Original Research)

INTRODUCTION: The Spaceflight Associated Neuro-ocular Syndrome is defined by optic disc edema (total retinal thickness change≥20μm or Frisen Grade 1), globe flattening, chorioretinal folds, and change in refractive error≥0.75 diopters. Our study is interested in examining the cognitive test results of SANS cases. Currently, the occupational cognition surveillance test used inflight is the WinSCAT (Space Flight Cognitive

Assessment Tool for Windows). It has been implemented in all ISS (International Space Station) expeditions. The components include Code Substitution Learning, Continuous Processing Task, Mathematics, Matching to Sample, and Code Substitution Delayed Recall. The test lasts 11-15 minutes and assesses visual search, processing speed, learning, sustained attention and concentration, verbal working memory, visual short-term memory, and delayed recall. It is performed six times preflight, monthly in flight, and once 30 days postflight. There have also been brain structural and ventricular changes observed in post-flight MRI. These changes have been correlated with a postflight decrement in postural control, prolonged completion time on Seat Egress and Walk Test, and increased reaction time in Continuous Processing Task on WinSCAT. SANS cases had smaller changes in total ventricular volume than non-SANS cases, but this has not been correlated with the WinSCAT results. Anecdotally there have been no changes observed in SANS cases on WinSCAT, though this has not been formally examined. **METHODS**: Our study seeks to answer two questions: 1.) Are there cognitive test differences when we compare preflight WinSCAT data to in-flight and postflight data? 2.) Are there WinSCAT test differences when we compare the SANS population to a non-SANS population who has flown for a similar duration? Data were obtained through the approval of the Astronaut Occupational Health Management Group. Analysis was performed by the NASA Behavioral Health Program. **RESULTS**: The study describes the SANS population WinSCAT data preflight, in flight, and postflight, and compares them to a control population. **DISCUSSION:** The results will allow the operational team to determine whether there are cognitive changes associated with SANS. And if not, there may be a need to implement a more sensitive test to detect any cognitive changes.

Learning Objectives

1. Understand the current cognitive testing protocols for the astronauts pre-flight, inflight, and post-flight.
2. Determine if there are any cognitive test differences in the SANS cases.

[49] COMPARISON OF MULTISPECTRAL WITH COLOR FUNDUS IMAGING FOR THE DETECTION OF OPHTHALMIC FINDINGS OCCURING DURING AND/OR POST-SPACEFLIGHT

Jorge E. Nagel[1], Saghar Bagheri[2], Aditya Verma[3], Alex Huang[3], SriniVas Sadda[3], Sara Mason[4], C. Robert Gibson[5], William Tarver[6], Mary Van Baalen[6], Tyson Brunstetter[6]

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(Original Research)

INTRODUCTION: The purpose of this investigation was to evaluate if MultiColor Imaging (MCI) can replace color fundus photography (CFP) as a diagnostic screening tool during spaceflight. MCI significantly reduces crew time (approx. 115 minutes/session, 36 hours/year) by eliminating nominal on-orbit fundoscopy sessions, while also providing the option to capture a larger field of view (55° vs. 35°). **METHODS**: A comprehensive PubMed literature search was conducted using the following key words: multicolor, multispectral, imaging, retina, choroid, optic nerve, optic disc, and papilledema. Publications were filtered based on optic nerve and chorioretinal pathologies matching those seen during or immediately after spaceflight: optic disc edema (ODE), cotton wool spots (CWS), retinal hemorrhage, pigment epithelial detachment (PED), and serous chorioretinopathy (SCR). In a separate effort, 44 multicolor images (30 abnormal) of terrestrial patients were graded and compared to corresponding color fundus images acquired at the Doheny Eye Centers and UCLA. **RESULTS**: The search identified 340 articles; 9 describing MCI in relevant pathologies, 6 comparing MCI to CFP. MCI is superior in detecting CWS (1 paper), PED (2 papers), retinal hemorrhages (2 papers), and choroidal folds (1 paper), and can better delineate extent or boundaries of subretinal fluid and identify areas of RPE damage in SCR (2 papers). On MCI, ODE was described as a hyperreflective ring with a green shift and indistinct disc margins, with equal detectability as using CFP (3 papers). Grading at Doheny Eye Institute confirmed these findings. **DISCUSSION**: MCI can effectively detect all retinal and optic nerve findings detectable by CFP during and immediately post-spaceflight and represents a suitable replacement as an on-orbit diagnostic screening tool. Additionally, by eliminating the nominal on-orbit fundoscopy sessions, dozens of crew hours are spared per year by utilizing MCI.

Learning Objectives

1. Become familiarized with retinal pathologies and defects that have been detected in astronauts during and immediately following long-duration spaceflight and what methods are used in screening and evaluation of clinically similar terrestrial pathologies.
2. Understand the difference between multispectral imaging and traditional fundoscopy techniques and how they compare with respect to their utilization as screening tools.

[50] COUNTERMEASURES TARGETING REVERSAL OF THE WEIGHTLESSNESS-INDUCED HEADWARD FLUID SHIFT TO MITIGATE SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME

Karina Marshall-Goebel[1], Jason Lytle[1], Steven Laurie[1], Stuart Lee[1], David Martin[1], Millennia Young[2], Alan Hargens[3], Ashot Sargsyan[1], Doug Ebert[1], Scott Dulchavsky[4], Brandon Macias[2]

[1]*KBR, Houston, TX, United States;* [2]*NASA, Houston, TX, United States;* [3]*University of California San Diego, San Diego, CA, United States;* [4]*Henry Ford Hospital, Detroit, Michigan, United States)*

(Original Research)

INTRODUCTION: The etiology of the spaceflight associated neuro-ocular syndrome (SANS) is unknown, but the chronic headward fluid shift that occurs during exposure to weightlessness is hypothesized to be the primary initiating factor. Research focused on the development of mechanical fluid shift countermeasures to mitigate SANS includes examination of the efficacy of lower body negative pressure (LBNP). Here we present the cardiovascular response to LBNP during spaceflight in astronauts who participated in the Fluid Shifts Study and also discuss SANS fluid shift countermeasures. **METHODS:** Internal jugular vein (IJV) cross-sectional area, an indicator of cerebral venous congestion, was measured using 2D ultrasound, and hemodynamic measures were acquired with an automated brachial blood pressure cuff. Measurements were acquired before flight (seated and supine) and during spaceflight on flight day 45 with and without use of 25 mmHg LBNP. **RESULTS:** Preflight, IJV area in the seated posture was 9.8 mm^2 (95% CI: -1.2 to 20.7) and increased to 80.7 mm^2 (95% CI: 69.9–91.5). Inflight, LBNP decreased IJV area from 70.3 mm^2 (95% CI: 59.3–81.2) to 44.7 mm^2 (95% CI: 33.2–56.2, $P < .05$). In the seated and supine postures before flight, heart rate was 59 beats per minute (bpm, 95% CI: 55–63) and 53 bpm (95% CI: 49–57) and mean arterial pressure (MAP) was 93 mmHg (95% CI: 87–99) and 85 mmHg (95% CI: 82–89), respectively. During spaceflight, heart rate from was 59 bpm (95% CI: 56–62) and increased to 69 bpm (95% CI: 67–72, $P < .001$) during LBNP use, while MAP decreased from 93 mmHg (95% CI: 90–96) to 81 mmHg (95% CI: 77–86, $P < .001$). **DISCUSSION:** Low-level LBNP partially mitigates the spaceflight-induced fluid shift and can be accommodated by the cardiovascular system. Current and future investigations will study prolonged daily use of LBNP and additional mechanical countermeasures to determine if the fluid shift reversal is sufficient to mitigate SANS findings.

Learning Objectives

1. The audience will learn about recent developments in mechanical countermeasures that target the headward fluid shift during spaceflight.
2. The audience will learn about lower body negative pressure (LBNP) and recent findings on the ability of LBNP to mitigate SANS.

Monday, 05/23/2022 ***4:00 PM***
Tuscany A

[S-12]: PANEL: AERONEUROSCIENCE 2022-2032

Chair: Roger Hesselbrock
Co-Chair: Aven Ford

PANEL OVERIVEW: *The 21st century has seen an explosion in medical knowledge, with exciting advances in diagnostic and therapeutic capabilities. This has been especially true in the neurosciences, where continual strides have resulted in improved management and outcomes in many potentially debilitating conditions. Many neurologic conditions that formerly were considered permanently unfitting are now routinely safely recommended for medical certification, both in military and civilian settings. Continued rapid advances in the neurosciences are anticipated, and some future capabilities are undoubtedly yet unknown. The unrelenting pace of knowledge expansion requires expedient aeromedical cognizance for review and consideration, with subsequent incorporation into aerospace medical standards as soon as safely permissible. This panel will present information on current and projected diagnostic and therapeutic advances in selected neurologic conditions and will discuss how these advances will impact aeromedical dispositions. Topics to be covered include the use of monoclonal antibodies and biologic agents in neurologic conditions, neuroscience informatics and AI, default networks (using MRI and mEEG data), man/machine interface, and space neuroscience. Current clinical evidence and research data and future trends will be presented. Audience participation and discussion are highly encouraged.*

[51] AERONAUTICAL ADAPTABLILTY AND THE FUTURE OF THE MAN MACHINE INTERFACE

Peter Letarte
No institution, Akron, OH, United States

(Education - Tutorial/Review)

INTRODUCTION: When the Wright Brothers invented flying, the man machine interface was very tactile and physical. The new skills learned involved manipulating the physical feedback from the control surfaces. These skills became the art of flying. The "Right Stuff" was possessed by those with high intelligence but also superior physical skills, eyesight, and hand eye coordination, those with superb physical instincts. The role of the flight surgeon was the care and maintenance of this most critical component in the aircraft system, the pilot. Screenings for selection and continued duties as an aviator soon evolved to identify and select those with aptitude, resilience, and the best of these skills and attributes. These criteria are deeply embedded in aerospace culture and are often encapsulated in the concept of Aeronautical Adaptability or the "Right Stuff." Brain Computer Interface technology is poised to significantly morph this paradigm. **TOPIC:** The "Man Machine Interface" is now a Man Computer Interface, with artificial intelligence managing the control surfaces and tedious mission planning details. High performance flight today requires that pilots partner with Artificial Intelligence systems to achieve mission success. The "Right Stuff" today demands the aptitude and skills to manage sophisticated Artificial Intelligence systems. The next ten years will likely yield an exponential acceleration of this evolution with the introduction of the much higher bandwidth, and more intimate, connections between man and aircraft made possible by the introduction of Brain Computer Interface technology to the cockpit. This introduction may significantly change the ways we model human neurology and neurological output and could radically change and evolve the neurological characteristics of those who are determined to possess "The Right Stuff." **APPLICATION:** This presentation will review the history of the aviation man machine interface, discuss current initiatives in the Brain Computer Interface, point to ways this interface may change our thinking about Neurology and discuss some potential neurological screening and health maintenance ramifications of this evolving technology.

Learning Objectives

1. The learner will have a sense of the current directions of Brain Computer Interface research.
2. The learner will understand the potential applications of Brain Computer Interface technology to the flight environment.
3. The learner will appreciate how the evolving Brain Computer Interface will change the way we think about human Neurology, Aeronautical Adaptability and Fitness for Flight.

[52] THE USE OF ADVANCED BRAIN MAPPING TECHNIQUES IN THE ASSESSMENT OF OCCUPATIONAL INJURY IN AEROSPACE MEDICINE

Christopher Skinner
University of Ottawa, Ottawa, Ontario, Canada

(Education - Program/Process Review)

BACKGROUND: The evolution of advanced modalities of analysis of brain function and structure enables the use of these tools to assess the effect on the brain of occupational exposure in hostile environments experienced by military members, aviators, and astronauts. **OVERVIEW:** This paper will review current advanced imaging and neurophysiological techniques such as default mode networks using both fMRI and MEEG and how they can be applied to measure occupational exposure in hostile environments. Other brain mapping techniques including Graph Theory Analysis, and Voxel-Based Analysis of cortical thickness and white matter connectivity will be reviewed and how they have been used to analyze subclinical brain injury in individuals at risk. **DISCUSSION:** These approaches can potentially be adapted to be used in real time operational environments to provide operators with guidance with respect to exposure to mitigate neurological damage.

Learning Objectives

1. Learn about advanced modalities of analysis of brain function and structure.
2. Learn how how these modalities can be applied to measure occupational exposure in hostile environments.
3. Learn how these approaches can potentially be adapted to be used in real time operational environments.

[53] NEUROINFORMATICS AND ARTIFICIAL INTELLIGENCE IN NEUROLOGY 2022 - 2032

Eilis Boudreau
Oregon Health & Science University, Portland, OR, United States

(Education - Tutorial/Review)

INTRODUCTION: Core concepts in neuroinformatics and artificial intelligence (AI) will be covered as well as the role advances in brain-computer interfaces are likely to have on neurologic diagnosis and care. **TOPIC:** The rapid advances in computer power and integration of computationally based approaches to the diagnosis and management of neurological conditions will become more wide-spread in the next decade. Neuroinformatics advances will include the development of large deidentified datasets ("Big Data") and the use of machine learning algorithms (ML) for identifying subpopulations of individuals (sub-phenotypes) who may have similar clinical outcomes and responses to treatments. Substantial advances are being made in the area of brain-computer interfaces including implanted devices for the detection and treatment of seizures, and the development of computer directed prosthetics for the treatment of disabilities related to neurological injuries and disorders. These advances are expected to reduce neurologically related disabilities but their use also raises ethical issues. **APPLICATION:** The use of neuroinformatics approaches and AI technologies is likely to enhance our ability to identify and more effectively treat individuals for a variety of neurological conditions. Advances in brain-computer interfaces are expected to improve neurological function to the extent that it is likely individuals with previously disqualifying conditions will be requesting medical clearance for flying activities. Therefore, our concept of medical fitness for flying is going to be pushed to co-evolve with these advancing technologies.

Learning Objectives
1. The audience will learn about core concepts in neuroinformatics and artificial intelligence.
2. The audience will learn how the deployment of these technologies in neurology on the practice of aerospace medicine.

[54] NEW THERAPIES IN NEUROLOGICAL DISEASE: AEROMEDICAL CONSIDERATIONS

Edwin Park
Naval Aerospace Medical Institute, Pensacola, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: New therapies in neurological disease include the monoclonal antibodies (mAbs) for autoimmune disorders, such as multiple sclerosis, and prevention or acute treatment in migraine. Gepant and ditan drugs for acute treatment of migraine. The mAbs were developed using hybridoma technology, the process first described in the 1970s. Today, mAbs are produced using newer technologies and have expanding indications for the diagnosis and treatment of many types of medical disorders, including cancers, autoimmune disorders, infectious diseases, and in the management of organ transplant. Gepants are calcitonin gene-related peptide receptor antagonist drugs. Ditans are similar to triptans but with more specific activity that may be better tolerated in certain patients. Several neuromodulation devices have been developed in recent years for both preventive and acute treatment of migraine and other headaches. **TOPIC:** This presentation will describe these new therapies, their mechanisms of action, their indications and the evidence supporting or discouraging their use in flight personnel to date. **APPLICATION:** The presentation will continue by outlining the aeromedical considerations for certification of individuals who are using or may wish to use these agents.

Learning Objectives
1. The audience will learn about recently approved therapies for neurological conditions and their indications.
2. The audience will learn about the characteristics of recently approved therapies and the potential impacts on aircrew performance and aviation safety.

[55] SPACE AERONEUROSCIENCE ADVANCES

Jonathan Clark
Baylor College of Medicine, Houston, TX, United States

(Education - Tutorial/Review)

INTRODUCTION: Neurologic effects have involved human spaceflight from its beginning 60 years ago to the present. Spaceflight hazards affecting neurologic function include microgravity, radiation, and vehicle environment constraints. Spaceflight related effects on nervous system function have adversely influenced human performance, occasionally with operational implications. Space-flight associated neurologic effects are associated with gravito-inertial transitions (ascent/reentry), and orbital flight, and post-flight. The spaceflight associated deconditioning generally increase with mission duration, with obvious implications for future long duration multi-year deep space missions. **TOPIC:** A top neurologic concern is Spaceflight Associated Neuro-ocular Syndrome (SANS). SANS encompasses optic disc edema, increased optic nerve sheath diameter, choroidal folds, hyperopic shift, and visual field alterations. Since its recognition in 2005 SANS has been identified in 2/3rds of astronauts. Neuroimaging using Magnetic Resonance Imaging is used extensively pre and post flight to ascertain SANS effects. Post-flight MRI changes noted in long duration crew include upward cerebral hemisphere shift, reduction in grey matter in certain regions, and increase in lateral ventricle size. On-orbit neurologic assessment includes ultrasonography and neuro-ocular assessment have evolved from technologic advances, allowing their use in remote and isolated environments like space. Post-flight neurologic effects such as disrupted gaze control, ataxia and disequilibrium have significant implications for planetary surface exploration after a long deep space transit. The biggest unknown hazard is the Deep Space Radiation effect on neurologic function. Of the 161 crew years in space, less than 0.7 crew-years have been in deep space. A personalized Astro-omics Precision Medicine is being considered to better safeguard long duration exploration missions using systems biology approach. **APPLICATION:** Neurologic assessment tools have been broadly used in astronaut selection, training, countermeasures, and fitness for duty assessment. Continued advancements in medical technology, particularly in non-invasive imaging and precision medicine holds great promise for our continued human presence in space, particularly on longer deep space and planetary missions.

Learning Objectives
1. The participant will become familiar with spaceflight associated neurologic effects.
2. The participant will become familiar with medical assessment tools to evaluate neurologic effects associated with spaceflight.

Monday, 05/23/2022 ***4:00 PM***
Tuscany B

[S-13]: SLIDES: FATIGUE IN MILITARY AND COMMERCIAL AVIATION

Chair: Thomas Hoffman
Co-Chair: Andrew Woodrow

[56] USING A SINGLE PSYCHOMOTOR VIGILANCE TASK (PVT) TO IDENTIFY INDIVIDUALS AT HIGH-RISK FOR PERFORMANCE IMPAIRMENT DURING CHRONIC SLEEP RESTRICTION

Erin Flynn-Evans[1], David Rockman[2], Crystal Kirkley[1], Kevin Gregory[1], Sean Pradhan[3]
[1]*NASA Ames Research Center, Moffett Field, CA, United States;* [2]*San Jose State University, Moffett Field, CA, United States;* [3]*Menlo College, Atherton, CA, United States*

(Original Research)

INTRODUCTION: Prior studies have shown that lapses (reaction times >500 ms) on a single rested daytime Psychomotor Vigilance Task (PVT) can be used to identify individuals who are vulnerable to performance impairment during acute sleep deprivation. Whether or not this approach is robust in identifying individuals who are vulnerable to the effects of chronic sleep loss is unknown. As astronauts routinely sleep less than the recommended 7-8 hours per night, we sought to determine whether performance on a single daytime PVT would be able to discriminate individuals who are vulnerable to performance impairment during chronic sleep restriction. **METHODS:** Healthy participants (n = 20; 30–55 years of age) were assigned to 5 crews of 4 people each in the Human Analog Research Environment (HERA) where they were monitored during a 45-day simulated space mission. Participants were afforded 8-hour sleep opportunities on weekends and 5-hour sleep opportunities on weeknights. Participants completed a 5-minute PVT five times per day, approximately every three days. **STATISTICAL ANALYSIS:** A negative binomial mixed-effects model controlling for time of day was used to determine the relationship between lapses on Mission Day 2 (4-10 h after waking) and overall performance throughout the duration of the 45-day study. Based on these analyses, baseline cut-offs to identify those vulnerable to chronic sleep restriction were identified. **RESULTS:** Lapses on a single test taken on Mission Day 2 were positively associated with PVT performance over time (Marginal Pseudo $R^2 = 0.18$, Conditional Pseudo $R^2 = 0.58$). A baseline lapse score of > 0 lapses on the 5-minute PVT accurately identified all vulnerable participants within the sample (lowest performing 36%, n = 7), while only miscategorizing one non-vulnerable participant as vulnerable. **CONCLUSION:** Total lapses on a single daytime 5-minute PVT test can be used to identify individuals who may be vulnerable to the effects of chronic sleep restriction. Further research is needed to understand whether this metric is robust enough to identify individuals experiencing chronic variable sleep loss and circadian misalignment.

Learning Objectives
1. The participant will learn how baseline performance on the psychomotor vigilance may be able to discriminate vulnerable and resilient individuals during chronic sleep restriction.
2. The participant will learn about limitations to using the psychomotor vigilance test to identify vulnerabilities to sleep loss.

[57] THE MEASUREMENT OF FATIGUE IN UK C-17 PILOTS: ASSESSMENT OF OPERATIONAL RISK MATRIX EFFICACY (ORM) & RELATIONSHIP TO FLIGHT DATA MONITORING PARAMETERS

Ian Mollan[1], Emma Smith[2]
[1]*Royal Air Force, Carterton, United Kingdom;* [2]*RAF Centre of Aviation Medicine, RAF Henlow, United Kingdom*

(Original Research)

INTRODUCTION: Fatigue kills and accidents are more likely with increasing levels of fatigue. Fatigue is the number 1 UK C-17 air safety concern. **METHODS**: This longitudinal study objectively measured C-17 pilot fatigue using actigraphy and the SAFTE-FAST model. It analysed its relationship with (1) the existing Squadron Operational Risk Matrix (ExORM), (2) a separate study ORM, (3) the Samn-Perelli Scale (SPS) at the Top of descent (TOD), and (4) specified Flight Data Monitoring parameters. All UK C-17 pilots were invited to participate. Data was collected during a 3-month window between 27 Feb and 7 Jun 21. A total of 560 sectors were flown during the period: 99 training, currency and test flights, and 16 positioning flights were excluded from analysis, as they were non-operational and short duration. A further 7 sectors were cancelled and 2 sectors were in-flight re-filed and therefore ineligible for analysis. A total of 436 Operational sectors were eligible for analysis. **RESULTS**: A total of 29 pilots participated; from the 42 operationally current pilots, the response rate was 69%. Because pilots did not fly equally, a sector participation rate was calculated. Operational sectors flown by participating pilots numbered 261: the sector participation was 60%. Pilots were male (97%), aged 36.4 years (SD 5.6) and 34% held a Squadron Executive role. None lived in the Officers' Mess permanently. Small children lived at home for 55% of pilots. The median service length was 13.5 years (IQR 11-18), and total flight experience was a median of 2900 hrs (IQR 2100-3800). From the 436 operational sectors, there were 159 flight rotations undertaken: Over half (51%) were from the Broader Middle East. Forward-based aircraft rotations comprised 29% of the total flight rotations. The median FAST effectiveness at TOD for all approaches was 85 (IQR 77-91) and on landing was 85 (IQR 76-90). The number of landings were 191 (73%) in 'safe' category (FAST effectiveness > 77%), 43 (16%) in 'sub-optimal' (FAST 70-77%), and 27 (10%) in 'unsafe' (FAST < 70%). SPS at TOD was related to effectiveness ($p<0.001$). There was no relationship between effectiveness and the ExORM ($p=0.54$). **DISCUSSION**: Window of Circadian Low (WOCL) departures/arrivals comprised the majority of sub-optimal/unsafe subsequent landings. Previous modelling work was validated in this study. Improvements to task scheduling could reduce fatigue risk. Further refinements could be made to the study ORM.

Learning Objectives
1. Understand the current fatigue experience of UK C-17 pilots, by this objective measure.
2. Understand the UK methodology in assessing fatigue and its risk mitigation.

[58] EVALUATION OF SUVOREXANT AS AN ALTERNATIVE TO SHORTER-ACTING OPTIONS

J. Lynn Caldwell[1], Nicole L. Beasley[2], Kayelin L. Tiggs[3], Megan I. Boltz[2]
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(Original Research)

INTRODUCTION: The Navy does not currently offer a long-acting hypnotic to aid and maximize sleep when necessary. Instead, only short-acting medications are allowed (e.g., zolpidem, zaleplon). While these medications have benefits, they may not be the best choice for all situations or for all service members. Although the efficacy of both zolpidem and zaleplon is well-established, a newer option—suvorexant—could offer a longer-acting alternative. The current study compared zolpidem and suvorexant with a placebo control and hypothesized that suvorexant would maintain sleep better than zolpidem or placebo without next-day "hangover" effects. This study was reviewed and approved by the Naval Medical Research Unit Dayton Institutional Review Board. **METHODS:** In a repeated-measures design, participants were administered suvorexant (10mg), zolpidem (10mg for men, 5mg for women), or placebo, one during each of three visits. The sleep period was delayed to mimic a phase-advanced sleep schedule. Bedtime was at 0200 and wake time was at 1000. Cognitive performance and subjective mood were measured every 2 h starting at 1100 for a total of 4 test sessions. Sleep architecture was assessed via polysomnography. **RESULTS:** Preliminary analyses of the cognitive tests, questionnaires, and sleep metrics from 5 participants (men=3) indicated no statistically-significant condition or session differences on any measures except the Visual Analogue Scale Alert metric in which scores during session 1 were higher than all other sessions, regardless of drug condition ($F(3,12)=6.814$, $p=.006$). Effect sizes as measured by partial eta squared ranged from small (the majority of the drug main effects) to large (all the drug by session interaction effects). **DISCUSSION:** These preliminary results suggest that neither the short-acting zolpidem nor the longer-acting suvorexant affected performance or mood 10+ hours postdose. Sleep onset and sleep maintenance also were not significantly affected by either drug. Since these are preliminary results, it is possible the final larger sample may lead to different conclusions. However, should the present findings be confirmed in a larger sample, suvorexant may be a good alternative to zolpidem for military operations.

Learning Objectives
1. Having choices for medications to address sleep issues allows physicians to use the best medication for the person and situation.
2. Hang-over effects from medication are important to assess, making sure performance and mood are not affected after the use of the drug.

[59] A SURVEY OF THE IMPACT OF COVID-19 ON FATIGUE IN U.S. COMMERCIAL PILOTS

Cassie Hilditch[1], Erin Flynn-Evans[2]
[1]*San Jose State University, Moffett Field, CA, United States;* [2]*NASA, Moffett Field, CA, United States*

(Original Research)

INTRODUCTION: The COVID-19 pandemic has had a significant and widespread impact on the aviation industry. The resultant reduced flying capacity may be interpreted as a reduced fatigue risk by way of fewer flight hours and duty days. The actual impact of the COVID-19 pandemic on pilot fatigue, however, is unknown. **METHODS:** Using a longitudinal approach, we surveyed US commercial airline pilots in late 2020 (n=669) and early 2021 (n=135) to assess the impact of the COVID-19 pandemic on schedules, sleep, fatigue, and sleepiness. **RESULTS:** As expected, most pilots reported a reduction in flight hours and duty days compared to pre-pandemic, although this varied by operation, with those flying cargo more likely to report an increase than those operating passenger flights only. Sleep on workdays was slightly shorter in late 2020 (6.88 h, $p = .034$) and recovered to pre-pandemic levels in early 2021 (6.95 h, $p > .05$). Similarly, the frequency of sleepiness both on days off and in-flight increased in late 2020 but recovered to pre-pandemic levels in early 2021. The type and frequency of in-flight countermeasures used to combat sleepiness on the flight deck remained the same across the assessed time points. Pilots used the comments section of the survey to highlight other factors which impacted their sleep and job performance during the COVID-19 pandemic, including: limited access to nutritional food during duty days and layovers, increased stress due to job insecurity and health concerns, increased

distractions and workload due to COVID-19 related procedures, and reduced access to exercise facilities during layovers. **DISCUSSION:** Despite a general reduction in monthly flight hours and duty days, during the COVID-19 pandemic, sleepiness on days off and in-flight was increased. This was potentially due to the negative impact of lack of access to essential needs and heightened stress on sleep. Operators need to be aware of the fatigue risks associated with changes during the COVID-19 pandemic, and should monitor the evolution of these risks as the aviation industry returns to full service.

Learning Objectives

1. The participant will be able to describe the impact of the COVID-19 pandemic on the amount of sleep obtained, and frequency of in-flight sleepiness experienced by US commercial pilots.
2. The audience will learn about the most commonly reported fatigue factors experienced by US commercial pilots during the COVID-19 pandemic.

[60] HOW PROFESSIONAL PILOTS PERCEIVE INTERACTIONS OF ROSTERS, STRESS, SLEEP PROBLEMS, FATIGUE, MENTAL HEALTH AND WELLBEING. A QUALITATIVE CONTENT ANALYSIS

Marion Venus
Universität Bern, Bern, Switzerland

(Original Research)

INTRODUCTION: This research analyses pilots' perceptions of working-conditions, flight time limitations (FTL), resulting rosters, stress, fatigue, aviation safety, and how regulations like FTL can affect flight safety, safety management, Fatigue Risk Management and pilots' mental health and wellbeing. So far, no qualitative content analysis (QCA) has analyzed pilots' experiences and perceptions regarding weaknesses of fatigue risk management (FRM), FTL, rosters, fatigue-severity, sleep problems, mental health and wellbeing. **METHOD:** 119 international pilots answered the open question of a cross-sectional online survey and described their experiences of FTL, rosters, aviation safety, fatigue and health. The QCA was conducted to analyze perceived interactions of working conditions, stressors, fatigue, sleep problems and mental health of short- and long-haul pilots based in EASA member states and Australia. **RESULTS:** Although pilots were rostered for only 60.8% to 62.5% of the legally allowed duty and flight hours/month, 78.6% reported severe or high fatigue, 22.8% significant depression symptoms (PHQ8≥10), 12.3% significant anxiety symptoms (GAD7≥10), 10.5% reported both, positive depression and anxiety screening results. Pilots uttered severe concerns about FTL, sleep restrictions associated with flight duties, especially due to early starts, minimum rest between flight duties etc. Pilots also expressed distinct fears regarding more impending fatigue-related crashes, and how they perceive interactions of working conditions, work-related and psychosocial stress and their physical and mental health. **DISCUSSION:** This QCA provided valuable insights into interactions of working conditions, stress, fatigue, sleep restrictions, physical and mental health, in line with the theory of allostasis. Today, economic pressure has led to significant acute and chronic stress for pilots. Time pressure, minimum turnaround times, short layovers, minimum rest between flight duties, consequent sleep restrictions, circadian disruptions and sleep problems lead to psychophysiological wear and tear, which was well described by pilots' qualitative and quantitative data. Progressive health impairment due to stress, lack of sleep and accumulated fatigue promote burnout, mental and physical health problems, which not only threaten flight safety, but also pilots' fitness to fly and sustainability of aviation.

Learning Objectives

1. The participants will be able to understand, how stress, sleep, fatigue, mental health and wellbeing interact, based on the theory of allostasis. The audience will learn, how high levels of fatigue affect pilots' physiological and mental health and wellbeing.
2. The audience will learn about modern pilots' acute and chronic stressors, associated with flight duties and rosters, as they are reported by pilots.
3. The audience will learn, where pilots' perceive the biggest problems with flight time limitations, Fatigue Risk Management, fatigue reports, safety culture and consequently reported high levels of fatigue.

Monday, 05/23/2022 ***4:00 PM***
Tuscany F

[S-14]: PANEL: SHOW ME THE EVIDENCE! AN INTERNATIONAL DEBATE ON OPTIMAL NON-INVASIVE METHODS OF SCREENING FOR CARDIOVASCULAR DISEASE IN AIRCREW

Chair: Eddie Davenport
Co-Chair: Joanna d'Arcy

PANEL OVERIVEW: *Should all aircrew get a screening ECG? How about a screening Echocardiogram? If cardiovascular disease is the leading cause of death and loss of licensure in aircrew, then should we be screening all aircrew with an exercise or nuclear stress test with or without a coronary calcium score? Why not just get a CT coronary angiogram or cardiac MRI? These are some of the great debates in aerospace cardiology that span all races, genders, and nationalities. Since 2015 the NATO sponsored Aerospace/Operational Cardiology Working group (HFM 251 then 316) brought together specialists from over 7 countries to reach a consensus on aircrew disposition regarding all aspects of cardiovascular disease. The purpose of this panel is to have three debates regarding possible screening policies between members of the group. This fun and educational debate with focus on three areas of cardiovascular screening; Electrical, structural, and vascular. One country member will present their evidence based rationale for or against a given topic then the other member will take the opposing view followed by the original presenter having a time for rebuttal. After all presentations, the evidence based group consensus will be discussed. There will be ample time after all presentations for the audience to ask questions to the entire 7-nation panel.*

[61] A GREAT SCREENING MACHINE - ECHOCARDIOGRAPHY AND ITS VALUE IN FLIGHT SAFETY AND RISK STRATIFICATION OF AVIATORS

Joanna d'Arcy[1], Edward Nicol[1], Norbert Güttler[2], Thomas Syburra[3], Olivier Manen[4], Denis Bron[5], Eddie Davenport[6], Rienk Rienk[7]
[1]*Royal Air Force, Henlow, United Kingdom;* [2]*Air Force Centre of Aerospace Medicine, Fuerstenfeldbruck, Germany;* [3]*Luzerner Kantonsspital, Luzern, Switzerland;* [4]*Percy Military Hospital - Aeromedical Centre, Clamart (Paris), France;* [5]*Aeromedical Centre Swiss Air Force, Dübendorf, Switzerland;* [6]*Wright-Patterson AFB, Dayton, OH, United States;* [7]*University Medical Centre Utrecht and Central Military Hospital, Utrecht, Netherlands*

(Education - Program/Process Review)

BACKGROUND: Many cardiac conditions, such as cardiomyopathies and valve disease, may be asymptomatic and with no physical signs in the early stages. These conditions may expose aircrew to increased risk of distraction or incapacitation in flight, and may be incompatible with unrestricted flight duties, or a bar to entry to flight training. To avoid adverse outcomes for aircrew, and to protect organisations' investments in their training, detecting these conditions as early as possible is an attractive option. Using transthoracic echocardiography (TTE) as a screening tool may meet this need. **OVERVIEW:** TTE is a non-invasive, accessible, low-cost, and reproducible method for assessing the heart. It can be used to detect valve defects or congenital anomalies, and quantify systolic function. It can be used for risk stratification, by quantifying valve disease and chamber dilatation, measuring hypertrophy or detecting outflow tract obstruction. Conversely, a structurally normal heart on screening with TTE can provide a very high degree of reassurance. As well as direct effects of

structural abnormalities, which may affect G tolerance or cause symptoms, cardiomyopathies or advanced valve disease may trigger arrhythmias, which in turn might impact on flight safety. Despite our reliance on physical examination for picking up cases of valve disease in particular, there is ample evidence that even "expert" cardiologists do not reliably detect heart murmurs. Bicuspid aortic valve disease, which is a bar to entry into training in some organisations, will have normal physical findings if the valve function is normal, or only mildly abnormal. Likewise, early phenotypes of cardiomyopathy are very likely to be missed on examination, and ECG appearances may be completely normal. TTE screening would detect the majority of such cases, potentially saving time and money for employers, as well as potentially preventing morbidity and mortality in would-be aviators. It might even be considered a useful addition to periodic cardiac screening, as degenerative valve conditions and occult cardiomyopathy may be detected later on in an aviator's career. **DISCUSSION:** TTE is an effective, low cost, and accessible tool for screening for many structural heart diseases. Wider use of it may improve risk stratification and optimise flight safety for aviators and employers alike. This presentation will present the argument for wider use of echocardiographic screening.

Learning Objectives

1. Understand the utility of echocardiography in screening for cardiovascular disease in aviators.
2. Understand the pitfalls of echocardiography in risk stratification of aviators.

[62] ECHOCARDIOGRAPHIC SCREENING FOR AIRCREW – GIMME A BREAK!

Thomas Syburra[1], Denis Bron[2], Jo D'Arcy[3], Ed Nicol[3], Olivier Manen[4], Gary Gray[5], Rienk Rienks[6], Norbert Güttler[7], Eddie Davenport[8]

[1]*Luzerner Kantonsspital, Luzern, Switzerland;* [2]*Swiss Air Force, Dübendorf, Switzerland;* [3]*Royal Air Force, London, United Kingdom;* [4]*French Air Force, Paris, France;* [5]*Canadian Air Force, Ottawa, Canada;* [6]*Dutch Air Force, Amsterdam, Netherlands;* [7]*German Air Force, Fürstenfeldbruck, Germany;* [8]*U.S. Air Force, Centerville, OH, United States*

(Education - Program/Process Review)

BACKGROUND Small air forces, like Switzerland, favour echocardiographic screening of all aircrew candidates. The rationale behind it is to avoid a costly drop-out after training completion. A large air force like the USAF does not perform systematic echocardiographic screening of their aircrew candidates, due to the sheer amount of screening which would be required, which is likely to be out of proportion to the benefit of avoiding the drop-out of a trained aircrew member due to cardiac and aortic surgery. **OVERVIEW:** Screening is a process – one that begins with invitation to participate and ends with treatment for appropriately identified individuals. The screening test (e.g. echocardiography) is characterized by its sensitivity and specificity. It is all about the ability to rule in or out a specific feature (e.g. bicuspid aortic valve). The most accurate test is neither 100% sensitive nor 100% specific, but somewhere in-between. However, the use of such an approach does not clearly apply to aircrew. Systematic echocardiographic screening before aircrew selection is not looking for a specific disorder. In the absence of a leading clinical condition, it puts this population at risk of false positive findings and unnecessary subsequent testing, without clear therapeutic benefit. This is the result of the lack of a clear pre-test likelihood when keeping the example of the bicuspid aortic valve in mind, with a maximal prevalence of 2% in the population, leaving 98% of screening tests pointless. Additionally, as only a minority of bicuspid aortic valves will ever require surgery during a typical active flying career, carrying out undifferentiated systematic echocardiographic screening wastes time, money and energy. **DISCUSSION:** The 2013 Tromsø study concluded that "*Echocardiographic screening for structural and valvular heart disease in the general population provided no benefit for mortality or for the risk of myocardial infarction or stroke*". Therefore, a similar use of echocardiographic screening in aircrew is likely to be a waste of resources. Only where there is a positive likelihood of a finding based on clinical knowledge, does low-threshold echocardiographic investigation (and *not* screening) make sense. Clinicians shall praise their great clinical judgment again instead of following blindly pre-set routines.

Learning Objectives

1. The participants will learn about the positive predictive value of a screening test.
2. The participants will learn about the differences in screening requirements for small versus large air forces.

[63] ROUTINE ECG SCREENING FOR AIRCREW – FOR WHOM AND HOW OFTEN?

Norbert Guettler[1], Rienk Rienks[2], Edward Nicol[3], Thomas Syburra[4], Denis Bron[5], Olivier Manen[6], Eddie Davenport[7], Joanna d´Arcy[3]

[1]*Air Force Centre of Aerospace Medicine, Fuerstenfeldbruck, Germany;* [2]*Central Military Hospital & University Medical Centre Utrecht, Utrecht, Netherlands;* [3]*Royal Air Force, Henlow, United Kingdom;* [4]*Luzerner Kantonsspital, Luzern, Switzerland;* [5]*Aeromedical Centre Swiss Air Force, Dübendorf, Switzerland;* [6]*Percy Military Hospital - Aeromedical Centre, Clamart (Paris), France;* [7]*Wright-Patterson AFB, Dayton, OH, United States*

(Education - Program/Process Review)

BACKGROUND: A 12-lead resting ECG is the only routinely performed machine-aided cardiological examination in a flight physical exam. It can be carried out quickly and easily, and provides information about rhythm, axis, atrioventricular conduction, bundle branch blocks, hypertrophy, ventricular preexcitation, possible ischemia, and inherited channelopathies. ECG screening of young individuals mainly concentrates on signs of inherited channelopathies, cardiomyopathies or delta waves, whereas in individuals above age 40, it focuses on the diagnosis of coronary artery disease. Currently, it is a point of discussion as to what age and how often a resting ECG should be carried out as a routine examination. This abstract presents the disadvantages of frequent routine ECGs and their limited use. **OVERVIEW:** According to the FAA guide for AMEs, a 12-lead resting ECG is required for first-class medical certification at the first application after reaching the 35th birthday, on an annual basis after reaching the 40th birthday, and on indication. For second-class and third-class medical certification a routine ECG without clinical indication is not required. The European Union requires an ECG for a flight medical exam, if clinically indicated, and for a class 1 medical certificate, at the initial examination, then every 5 years until age 30, every 2 years until age 40, annually until age 50, and at all revalidation or renewal examinations thereafter. For a class 2 medical certificate, it has to be carried out at the initial examination, at the first examination after age 40 and then at the first examination after age 50, and every 2 years thereafter. **DISCUSSION:** There have been reports of considerable interobsever variability between experienced physicians in the interpretations of screening ECGs. This resulted in a number of false-positive and false-negative results, reducing the effectiveness and increasing the social and economic costs of the screening. Labeling individuals with an uncertain diagnosis originating from a false-positive ECG finding can lead to psychological effects, as well as possible impacts on insurance policies and employment. Studies analyzing ECG screening for aircrew found out that the vast majority of those ECGs were entirely normal or represented likely normal physiological changes. Changes in the same individual over time were rare. To reduce the number of false-positive and false-negative results, standardized ECG criteria are needed.

Learning Objectives

1. Be aware that there is a debate as to what age and how often a resting ECG should be carried out for screening without a specific clinical indication.
2. Learn that there are differences between agency regulations regarding the intervals between resting ECGs.
3. Learn the social and economic disadvantages and the limited effectiveness of too frequent resting ECGs.

[64] AIRCREW SCREENING WITH ECG

Rienk Rienks[1], Norbert Guettler[2], Eddie Davenport[3], Thomas Syburra[4], Olivier Manen[5], Ed Nicol[6], Joanna DÁrcy[6]
[1]*Central Military Hospital, Utrecht, Netherlands;* [2]*German Air Force, Fürstenfeldbruck, Germany;* [3]*U.S. Air Force, Dayton, OH, United States;* [4]*Luzerner Kantonsspital, Lucerne, Switzerland;* [5]*French Military Health Service, Percy, France;* [6]*Clinical Aviation Medicine Service, Royal Air Force, Henlow, United Kingdom*

(Education - Program/Process Review)

BACKGROUND: The electrocardiogram (ECG) has been part of the screening process of asymptomatic aircrew for a long time. However, recently its usefulness for the screening process is being questioned. **OVERVIEW:** an ECG is a non invasive, simple, rapid, reproducable, cheap and reliable way to look for cardiac diseases that carry the risk of life-threatening arrhythmias. This includes channelopathies (long QT and Brugada syndromes), cardiomyopathies (hypertrophic and dilated cardiomyopathy, arrhythmogenic (right) ventricular cardiomyopathy, A(R)VC) and conduction abnormalities (Wolff Parkinson White, left bundle branch block). Although the ECG is not the primary tool to diagnose coronary artery disease (CAD), it may very well diagnose its consequences, like silent myocardial infarction. ECGs may also contribute to risk stratification (left ventricular hypertrophy, presence of frequent and/or complex premature ventricular contractions), and to the determination of the severity of valvular disease (left and right atrial dilatation, left and right ventricular hypertrophy). The physical and aeromedical demands that are part of some functions (particularly hypoxia, and above all G forces in high performance aircrafts) may increase the vulnerability of the aircrew as a triggering factor for theses arrhythmias, and thus a screening finding of an abnormal ECG may save lives. Finally, in the case of HCM and/or A(R)VC, exposure to heavy exercise, as is often the case in a military function, might even accelerate the cardiac deterioration, which makes an applicant unfit for such a function. **DISCUSSION:** the ECG remains an interesting tool with many advantages to find cardiac disease with the risk of potentially life-threatening arrhythmias and other cardiac conditions. It may safe lives and should therefore remain a cornerstone of the screening in asymptomatic aircrew.

Learning Objectives

1. the participant will learn about the various ECG patterns that may occur in heart disease.
2. the participant will learn about risk stratification in aircrew using ECG.

[65] EXERCISE STRESS TEST AND CALCIUM SCORING IS ALL THAT IS NEEDED FOR CV RISK ASSESSMENT IN AIRCREW

Edward Nicol[1], Joanna d'Arcy[1], Norbert Guettler[2], Thomas Syburra[3], Olivier Manen[4], Denis Bron[5], Eddie Davenport[6], Rienk Rienks[7]
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(Education - Program/Process Review)

BACKGROUND: Cardiovascular disease is the leading cause of restriction to flying in both civil and military professional flying. Background rates of aircraft loss secondary to cardiovascular disease however is low, mainly due to the exclusion of those with abnormal family history, resting EKG, mild symptoms or abnormal exercise EKG. Evidence would suggest that the current strategy of cardiovascular risk assessment is adequate to maintain flight safety. **OVERVIEW:** Exercise stress testing (ExEKG) has been the cornerstone of cardiovascular risk assessment in aircrew for decades. It provides a comprehensive assessment of cardiovascular health and exercising to 9 minutes of the Bruce Protocol has an excellent prognostic outcome. Whilst some may argue that the sensitivity of the positive predictive value of the ExEKG is limited, combining it with a coronary artery calcium score (CACS) provides a potent combination that will exclude prognostically important coronary artery disease in virtually all aircrew. **DISCUSSION:** The speaker will present evidence for both ExEKG and CACS for the exclusion of significant coronary artery disease and argue that this is sufficient for cardiovascular screening in professional flying, maintains flight safety and allows truly non-invasive assessment of cardiovascular risk.

Learning Objectives

1. Delegates will be able to understand the strengths and limitations of the exercise stress test (ExEKG) in cardiovascular risk assessment.
2. Delegates will be able to understand the strengths and limitations of coronary artery calcium scoring (CACS) in cardiovascular risk assessment.
3. Delegates will be able to understand the strengths and limitations of CACS in combination with the ExEKG cardiovascular risk assessment.

[66] CT CORONARY ANGIOGRAPHY IN AIRCREW – THE LATEST AND GREATEST WAY TO SCREEN FOR CORONARY ARTERY DISEASE

Eddie Davenport[1], Edward Nicol[2], Joanna d'Arcy[2]
[1]*U.S. Air Force, Wright-Patterson AFB, OH, United States;* [2]*Royal Air Force, Henlow, United Kingdom*

(Education - Program/Process Review)

BACKGROUND: Cardiovascular (CVD) disease is a leading cause of death and attributed to over 19 million deaths a year globally and has increased by 14.5% in the last 10 years. The most common presenting symptoms of severe CVD is sudden cardiac death and thus coronary artery disease is a leading cause of disqualification or denial of licensure in both civilian and military pilots. Optimal screening for CVD is very controversial and must be evidence based. **OVERVIEW:** Screening ECG and echocardiogram as well as exercise stress testing with or without imaging are very poor predictors of CAD with a positive predictive value of 16%. A global cardiac risk score is a better predictor of risk for major adverse cardiovascular event (MACE) however, it is also limited in an asymptomatic population with a false positive and false negative rate that exceeds true positives. Coronary artery calcium scoring (CACS) has emerged as a way to further characterize cardiac risk with a sensitivity and specificity over 90% for MACE over 10 years. However, CACS is still a limited assessment of the coronary artery anatomy and can miss significant coronary artery disease. CT coronary angiography (CTCA) provides a complete assessment of degree of CAD and thus perhaps the best screening modality for aircrew and all high risk occupations. **DISCUSSION:** A thorough investigation including aircrew data on the sensitivity, specificity, and positive and negative predictive valves of stress testing with CACS verses CTCA will be presented. Only invasive catheterization and coronary artery angiography image the coronary artery lumen better that CTCA. There is emerging data that a non-invasive CTCA may even perform better than invasive angiography for prognostic information in all degrees of CAD.

Learning Objectives

1. Understand the limitations of Cardiovascular Global Risk Scores and Cardiac Stress Testing (with or without imaging) in aircrew.
2. Learn the importance of coronary artery calcium scoring and CT coronary angiography in the assessment of asymptomatic coronary artery disease.
3. Learn an evidence based approach to screening for coronary artery disease in asymptomatic aircrew.

Monday, 05/23/2022 ***4:00 PM***
Tuscany 3

[S-15]: PANEL: COVID-19 PANDEMIC ASM CONTROVERSIES AND LESSONS LEARNED

Sponsored by the Air Transport Medicine Committee

Chair: Rui Pombal
Co-Chair: Elizabeth Wilkinson

PANEL OVERIVEW: *Aviation has been greatly impacted by the COVID-19 pandemic. Right from the outset organizations, businesses and individuals*

within the aviation industry have faced unique and complex challenges. As the pandemic evolved, so did knowledge, attitudes and expectations. Contingency planning has had to adapt constantly. Controversy has not been rare, especially around the relative weight of preventive measures and harmonization. On the other hand, the pandemic has created unique opportunities for learning in both scientific and organizational terms. Procedures have been assessed, reassessed, implemented and made more robust, which may serve the aviation community well in years to come. In this panel we discuss controversies and lessons learned from the perspective of the medical side of frontline organizations: the International Civil Aviation Organization (ICAO), the International Airline Transport Association (IATA), the Federal Aviation Administration (FAA), AsMA and its Air Transport Medicine Committee.

[67] MANAGING THE COVID-19 PANDEMIC: ICAO PERSPECTIVE

Ansa Jordaan
ICAO, Montreal, Canada

(Education - Program/Process Review)

BACKGROUND: The COVID-19 pandemic necessitated urgent action by ICAO to maintain global air connectivity. ICAO implemented the Council Aviation Recovery Taskforce (CART), in partnership with its Member States, international and regional organizations, and industry to address the fast-evolving challenges posed by the pandemic. As States prioritized protecting the health of their citizens, travel restrictions, border closures and other public health mitigation measures had a significant effect on medical certification, training and licencing of aircrew. Confronting the extended challenges of the pandemic, ICAO needed to address medical fitness aspects related to COVID-19. **OVERVIEW:** This presentation provides an overview of the complex challenges experienced from a standard generating perspective in human factors and aviation medical certification resulting from the pandemic. It describes the principles, recommendations and guidance material included in the CART reports, the *Take-off: Guidance for Air Travel through the COVID-19 Public Health Crisis* (TOGD) and the ICAO Manual on COVID-19 Cross-border Risk Management. These documents continue to evolve as the pandemic evolves, addressing mitigating disease transmission while protecting the health and safety of crew and passengers, aviation medical certification and licensing challenges, psychological and human factors issues, and providing support programmes to crew in order to maintain flight safety and fitness to fly. **DISCUSSION:** Multi-disciplinary collaboration is critical, involving international industry organisations, States and frontline stakeholders, when considering solutions to complex challenges. ICAO had to provide guidance for global harmonization on several controversial issues, including access to aviation medical examiners, extension of medical certificates without physical examination, acceptance of medical certificates issued by other licensing authorities, the use of telemedicine solutions, access of crew to training facilities, extension of pilot licenses, recognition of pilot licences by different authorities, resuming flight duties after long periods of not flying and the effects of testing and vaccination on pilots. With the prolonged duration of the pandemic, mental and physical fitness to fly following COVID-19 infection became important. The presentation discusses lessons learned, revised procedures and innovative solutions to ensure an effective response in future emergencies.

Learning Objectives

1. The audience will be able to gain useful insights for the management of the current and future health related contingencies affecting the aviation industry.
2. The audience will learn about strategies for pandemic contingency planning as applied to aviation and space medicine.

[68] MANAGING THE COVID-19 PANDEMIC: IATA PERSPECTIVE

David Powell
International Air Transport Association, Auckland, New Zealand

(Education - Program/Process Review)

BACKGROUND: The COVID-19 pandemic has presented four phases for the airline industry each presenting one key question. First, in early 2020, what is the risk of transmission during travel and how can it be managed? Second, later in 2020, is there a way to use methods such as testing in association with travel, to avoid the quarantine requirements or border closures that effectively prevent travel? Then early in 2021, will vaccination permit relaxation of border restrictions and thereby facilitate travel? Finally in late 2021, the key question became, now how can countries transition safely from pandemic to endemic? This phase dealt with two parallel developments - increasing (although inequitable) vaccination rates, and increasing domination of more transmissible variants, most notably Delta. The transition to endemic infection was made inevitable by Delta but different epidemiological situations, government approaches, risk appetites, and vaccination coverage, made this a complex and changing challenge. The global situation is reviewed here from the perspective of the world's airlines.

Learning Objectives

1. The participant will be able to describe the key phases of the pandemic from an airline aviation perspective and describe the key question which was grappled with in each phase.
2. The audience will be understand the challenges presented by this pandemic and the questions which are raised regarding the optimal management of a future pandemic.

[69] MANAGING THE COVID-19 PANDEMIC: FAA PERSPECTIVE

Susan Northrup
Federal Aviation Administration, Washington, DC, United States

(Education - Program/Process Review)

BACKGROUND: COVID-19 had an unprecedented significant impact on the aviation industry. It is vital that lessons learned are captured to allow for adequate planning for future communicable disease epidemics. **OVERVIEW:** The US Federal Aviation Administration's Office of Aerospace Medicine was central to the US aviation response and contributed to the international efforts and policy development. Lessons learned will be leveraged to create and update aviation communicable disease response plans. **DISCUSSION:** From the outset of the COVID pandemic in the US, the integrity of the National Air Space and international routes became critical to allow the safe movement of critical supplies and people. Protecting travellers and employees was paramount in light of the evolving understanding of the disease. The US used a variety of options, including but not limited to extend the validity of medical certificate and airman licenses, rapid approval of vaccinations approved under Emergency Use Authorizations, scheduling modifications, and assuming a public health role for employees to meet requirements. The FAA worked closely with our industry partners and stakeholders to ensure clear and concise information flow. A multilayered approach has proven successful for protecting the aviation community. Capturing the lessons learned will allow planners will allow a more rapid and unified response.

Learning Objectives

1. The audience will be able to gain useful insights for the management of the current and future health-related contingencies affecting the aviation industry.
2. The audience will learn about strategies for pandemic contingency planning as applied to aviation and space medicine.

[70] MANAGING THE COVID-19 PANDEMIC: AIRLINE AND AIRPORT MITIGATION MEASURES

Kris Belland
Aerospace Medical Association representative to ICAO, CAPSCA, CSAG, Fort Worth, TX, United States

(Education - Program/Process Review)

BACKGROUND: Worldwide aviation has been greatly and negatively impacted by the COVID-19 pandemic. Right from the outset, organizations, businesses and individuals within the aviation industry have faced unique and complex challenges. This influential panel of Aerospace Medicine Experts will reflect back on the COVID-19 pandemic response and discuss controversies and hard-won lessons learned in preparation for future pandemics. **OVERVIEW:** As the pandemic evolved, so did knowledge,

attitudes and expectations. Contingency planning has had to adapt constantly. Controversy has not been rare, especially around the relative weight of preventive measures and harmonization. On the other hand, the pandemic has created unique opportunities for learning in both scientific and organizational terms. Procedures have been assessed, reassessed, implemented and made more robust, which may serve the aviation community well in years to come. **DISCUSSION:** In this panel we discuss controversies and lessons learned from the perspective of the medical side of frontline organizations: the International Civil Aviation Organization (ICAO), the International Airline Transport Association (IATA), the Federal Aviation Administration (FAA), AsMA and its Air Transport Committee. As AsMA represetative to ICAO, Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA), and the CAPSCA Science Advisory Group, the author will discuss lessons learned, controversies and more specifically the evoluation of the risk mitigation strategic tool of James Reason, Swiss Cheese Model which was sucessfully adapted to international COVID-19 pandemic response (CAPSCA, WHO, ICAO, CSAG).

Learning Objectives

1. The audience will be able to gain useful insights for the management of the current and future health-related contingencies affecting the aviation community.
2. The audience will learn about stratifies for pandemic contingency planning as applied to aviation and space medicine.
3. The audience will see the evolution and application of aerospace medicine risk mitigation strategies and the application of the James Reason, Swiss Cheese model to pandemic risk reduction. This knowledge will be directly applicable to future pandemics.

[71] MANAGING THE COVID-19 PANDEMIC: ASMA AIR TRANSPORT MEDICINE COMMITTEE PERSPECTIVE

Rui Pombal
UCS - TAP Air Portugal Group Health Services, Lisbon, Portugal

(Education - Program/Process Review)

BACKGROUND: Aviation has had to adapt to the COVID-19 pandemic and to an unstable and rapidly evolving scenario of air transport constraints and priorities. Directly or indirectly, aviation medicine inputs have been at the core of critical decision making and contingency planing. Risk assessment and risk perceptions have posed significant challenges. **OVERVIEW:** In this presentation, to conclude a COVID-19 pandemic aerospace medicine controversies and lessons learned panel, the author describes with actual examples the role of the Aerospace Medicine Association Air Transport Medicine Committee in bringing together and providing expertise and support for information and education addressing the aviation and broader medical communities, as well as the general public, during critical pandemic times. Following on the other talks in this panel, lessons learned from real-life issues arising around airline transport will be reviewed and discussed: implementation of constantly changing procedures for air crews, ground staff and passengers, dealing with the impact of evolving stressors, dealing with risk perception as a modulator of attitudes and behaviour, managing communication at different levels and with varying degrees of certainty. **DISCUSSION:** A critical reflection on challenges faced by airlines throughout the pandemic will hopefully provide pointers for greater resilience in tackling future crises of a health-related nature in which air transport medicine has a central supporting role.

Learning Objectives

1. The participant will undertand the role of the Aerospace Medicine Association Air Transport Medicine Committee with the COVID-19 pandemic as a case in point.
2. The participant will undertand how dealing with some of the challenges posed by the COVID-19 pandemic can provide pointers for dealing with risk perception and management issues in the future.

Monday, 05/23/2022 ***4:00 PM***
Tuscany 4

[S-16]: PANEL: FACTORS IMPACTING CYBERSICKNESS IN AVIATION TRAINING

Chair: Brennan Cox
Co-Chair: Alexandra Kaplan

PANEL OVERIVEW: *Cybersickness refers to a constellation of symptoms that emerge through use of immersive virtual environments. The experience of cybersickness has undesirable consequences beyond the sickness itself, as it could discourage personnel from using certain devices, leading to reduced training efficiency, or compromise safety, as when users become sick or disoriented. With the recent surge in use of virtual reality (VR) devices for aviation training, knowing in advance the factors impacting cybersickness and how to mitigate them could lead to strategies for optimizing the use of these training tools. This panel includes five presentations on factors impacting cybersickness in aviation training. The first presentation provides an overview of the technological features of VR devices that may lead to cybersickness. The second presentation offers insights from operational use of these tools among military flight personnel. The third presentation examines aspects of the human visual system which relate to the experience of cybersickness. The fourth presentation discusses research on self-report and physiological symptoms. Lastly, the fifth presentation will address cybersickness mitigation strategies. The panel will conclude with a question and answer session with audience participation encouraged. Questions from the panel chair will address measurement of cybersickness; comparisons of experiences across flight simulations systems (e.g., head-mounted VR systems vs fixed or motion-based simulators); strategies to reduce cybersickness prevalence and severity; and remaining gaps for how to advance research and applied use of VR devices throughout the aerospace industry.*

[72] CYBERSICKNESS: EXTENDED REALITY TECHNOLOGICAL FEATURES AFFECTING OUR PHYSIOLOGY

Michael Natali[1], Brennan Cox[2]
[1]*Naval Air Warfare Center Training Systems Division, Orlando, FL, United States;* [2]*Naval Medical Research Unit Dayton, Dayton, OH, United States*

(Education - Program/Process Review)

BACKGROUND: Cybersickness refers to symptoms that can emerge through use of extended reality (XR) environments, primary the use of Head Mounted Displays (HMDs) commonly referred to as Virtual Reality (VR) "goggles". In the aerospace industry, a number of available XR devices are being incorporated into training and operational use without much thought to potential adverse physiological reactions. The rapid development and innovation of these products introduces a range of ever-changing features that influence the user's experience, including susceptibility and severity of cybersickness. To develop strategies for use of XR tools requires knowledge of these features to effectively evaluate benefits and limitations. **OVERVIEW:** With the potential of safer, lower cost, and more immersive training across multiple platforms, the Navy needs to understand the viability and utility of XR technologies and how they can improve warfighter readiness. The Navy is examining the technical capabilities and physiological effects of HMDs to determine feature requirements to maximize training benefit and limit adverse physiological reactions such as cybersickness. There are hundreds of available models, all with different specifications for features like: visual acuity, field of view, frame rate, etc. These features can have drastic effects on how a person responds physiologically as the brain interprets and integrates what is seen and felt. With rapid expansion and improvements in these technologies, it leaves little time to effectively evaluate what effects they may be having. Though many features linked to cybersickness like frame rate or video lagging have largely been engineered-out of systems, others rely on customizable settings so an individual can tailor to their needs for sickness mitigation. **DISCUSSION:** Discussion will address key features of XR technology and its impact on an individual's

physiology, primarily in terms of cybersickness. Mitigation strategies will be reviewed as well as what users should understand if integrating XR into training or other work tasks. Recommendations will be made based on the tradeoffs that exist among device features, simulation fidelity, training effectiveness, and the user's experience. The discussion will conclude by highlighting gaps and future directions.

Learning Objectives

1. Describe the key features of Extended Reality devices that are associated with the experience of cybersickness.
2. Understand the tradespace between Extended Reality device features, simulation fidelity, and the user's experience.

[73] CYBERSICKNESS AMONG NAVAL FLIGHT STUDENTS WHO USE EXTENDED REALITY (XR) TRAINING DEVICES: PREVALENCE AND SEVERITY

Todd Seech

Naval Aviation Training Command, Corpus Christi, TX, United States

(Original Research)

INTRODUCTION: Integration of extended reality (XR) devices into military training programs has become a common method of modernizing and maximizing training. While the benefits of these new technologies (e.g., targeted training, low cost, no downtime for weather or maintenance) are well supported in the literature, the potential negative effects have not been sufficiently documented. In particular, cybersickness as a result of using XR technologies requires additional examination with special focus on prevalence, intensity, and specific symptom sets. **METHODS:** As part of an ongoing program evaluation, Naval Aviation Training Command (NATRACOM) has included the Simulator Sickness Questionnaire as part of all students' anonymous end-of-training feedback survey 2021. These data have been used to inform commanders' decisions regarding the continued deployment of XR technology in support of NATRACOM's mission to train future naval aviators. For the first time, these program evaluation data will be presented in a public forum for educational purposes. **RESULTS:** In premilinary samples, the frequency of self-reported simulator sickness symptoms among students who used XR as part of their training was low (~17% reported any symptoms). Oculomotor symptoms were most common, followed by Disorientation and Nausea. Additionally, students had the opportunity to describe their symptoms in their own words, which were qualitatively analyzed. **DISCUSSION:** With an initial understanding of the prevalence, severity, and symptom types of cybersickness among naval flight students, leadership can begin to weigh the overall impact of XR training on human performance. Additionally, the specific types of symptoms may inform future aeromedical research regarding the detection and mitigation of cybersickness.

Learning Objectives

1. The participant will be able to understand the most common types of cybersickness among naval flight students who use extended reality and their relative intensity and frequency.
2. The participant will understand the structure and application of the Simulator Sickness Questionnaire as well as its application in survey research.

[74] OCULUS ET MACHINA: THE VISUAL SYSTEM AND ITS CONTRIBUTIONS TO CYBERSICKNESS

Adam Preston

Naval Medical Research Unit - Dayton, Wright-Patterson Air Force Base, OH, United States

(Education - Tutorial/Review)

INTRODUCTION: The visual system provides a significant amount of sensory information required for the safe operation of manned and unmanned aircraft. Virtual, augmented, and mixed reality (VR, AR, and MR) head mounted displays (HMDs) are being increasingly employed in aircrew training and operational environments. However, these HMDs can create conflict both within the visual system and between sensory systems, resulting in cybersickness symptoms, including (but not limited to) eye strain, nausea, and headache. It is critical for aerospace medicine clinicians and scientists have an understanding of the visual system in order to mitigate symptoms for aircrew. **TOPIC**: This presentation will review optical properties of VR/AR/MR HMDs including visual acuity, visual field, and accommodation requirements. Next, we will review ocular anatomy and physiology of the accommodative and binocular vision sensory subsystems with respect to intra-system conflicts present within HMDs. Subsequently, we will discuss the neuroanatomy of the horizontal rotational vestibulo-ocular reflex as an example particularly prone to inter-system sensory conflict and its cerebellar neuroadaptation. Finally, the discussion will conclude with clinical recommendations for aircrew experiencing visually-induced cybersickness symptoms and recommendations for further research. **APPLICATION:** This presentation has applications for all students and operators utilizing VR, AR, and MR HMDs, their clinicians, and researchers interested in cybersickness.

Learning Objectives

1. Participants will have a basic understanding of the visual system in relationship to current VR/AR/MR HMD technology and its contribution to cybersickness.
2. Participants will have a basic understanding of clinical recommendations and strategies for mitigating visually-induced cybersickness symptoms.

[75] TOOLS FOR MEASURING AND QUANTIFYING CYBERSICKNESS IN AVIATION TRAINING

Sarah Beadle[1], Alexandra Kaplan[1], Brennan Cox[2]

[1]*Naval Aerospace Medical Institute, Pensacola, FL, United States;* [2]*Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States*

(Education - Program/Process Review)

BACKGROUND: Simulator sickness, or cybersickness, continues to pose a challenge to those using virtual environments for training. One particular challenge is the appropriate quantification and monitoring of symptoms. When thinking of cybersickness or motion sickness, nausea often comes to mind first, but other symptoms such as disorientation and oculomotor disturbances are more often associated with virtual environments. Proper quantification of symptoms can be used to reduce or avoid negative effects for the trainee, and can help to inform aeromedical policies regarding the time needed between a simulator event and in-flight training. With the growing use of virtual environments for modern aviation training, improper monitoring of cybersickness is a continuing threat to safety. **OVERVIEW**: This presentation provides an overview of the different measurement tools for detecting cybersickness, with use-case scenarios for informing how these measures can best be employed in the training environment. A series of subjective and physiological measures will be discussed, along with their relative advantages and disadvantages, as informed by research and applied use. Efforts to quantify cybersickness in student aviators will be presented, with lessons learned from both subjective and physiological measures. **DISCUSSION:** Discussion will center on the decision processes for selecting measures of cybersickness in accordance with the user's research or training objectives. Specific to aviation training, different types of training programs may be better suited for one cybersickness measure over another. We will discuss the benefits of longitudinal measurement and tracking, which may help to inform aeromedical policy regarding cybersickness as well as the iterative development and refinement of virtual technologies to reduce cybersickness-inducing features. Recommendations for future research and applied use will be provided.

Learning Objectives

1. Participants will learn considerations for selecting a measure of simulator sickness in accordance with their organizational goals and technological concerns.
2. Participants will be able to weigh the advantages and disadvantages for using given subjective and physiological measures to quantify simulator sickness.

[76] CYBERSICKNESS MITIGATION AND THE NEED FOR IMPROVED COUNTERMEASURES

Sarah Sherwood
Naval Medical Research Unit Dayton, Wright-Patterson AFB, OH, United States

(Education - Program/Process Review)

BACKGROUND: The use of head-mounted display (HMD) based virtual environments for training is a focus of numerous Department of Defense entities, including U.S. Navy Chief of Naval Air Training (CNATRA) and U.S. Air Force Air Education and Training Command (AETC). The latest generation of commercially available HMDs are low cost, high quality, and far more portable than conventional projection display simulators. The small size of virtual reality (VR) HMDs enables flexible training in a variety of environments. However, while VR HMD systems are valuable tools that give rise to vivid experiences of immersion, the propensity of even the latest headsets to induce cybersickness (CS) limits their widespread adoption. **OVERVIEW:** Cybersickness symptoms are estimated to be three times more severe than simulator sickness and include: disorientation, nausea, headache, pallor, sweating, vomiting, eye strain, and sopite syndrome. In a VR environment, the most common symptom is disorientation. While symptom onset can occur within 10 minutes, ill effects can linger for hours (Stanney et al., 2000; Stanney, Kennedy, & Drexler, 1997). Moreover, the side-effects of pharmacologic interventions, particularly the drowsiness associated with anti-nausea medications, can further degrade training outcomes and delay trainee progress through the pipeline. Numerous countermeasures have been proposed to contend with this mission-impacting problem. **DISCUSSION:** The discussion will address updates to HMD hardware, including headset ergonomics; content design; and visual techniques (e.g., display changes to reduce optical flow) intended to reduce the incidence of CS. In addition, current research into non-invasive, wearable CS countermeasures will be presented. Finally, research gaps and future research and development needs will be discussed.

Learning Objectives

1. The audience will learn about the limitations of anti-nausea medications for treatment of cybersickness.
2. The audience will learn about the current state of non-invasive/wearable cybersickness countermeasure development and current research gaps.

Monday, 05/23/2022 ***4:00 PM***
Tuscany 12

[S-17]: PANEL: PAST, PRESENT, & FUTURE OF NASA'S BIOMEDICAL FLIGHT CONTROLLERS

[77] SPACE SHUTTLE BME FLIGHT CONTROL

Robert Janney
KBR, Houston, TX, United States

WITHDRAWN

[78] EARLY ISS BME FLIGHT CONTROL

Ted Duchesne
KBR, Houston, TX, United States

WITHDRAWN

[79] CURRENT ISS BME FLIGHT CONTROL

Jamie Moore
KBR, Houston, TX, United States

WITHDRAWN

[80] FUTURE OF BME FLIGHT CONTROL (ORION, GATEWAY, LUNAR)

Chris Van Velson
NASA, Houston, TX, United States

WITHDRAWN

[S-86] RESIDENT GRAND ROUNDS: AAMIMO & UTMB

Chair: Salvatore Pelligra

PANEL OVERVIEW: *Resident Grand Rounds consists of 6 Case Presentations. Each Case Presentation is presented by current AAMIMO and UTMB RAMs who will review the clinical case presentation, diagnosis, treatment pathway and current policies from different agencies. They will discuss the clinical and waiver outcome (if appropriate). These unique Case Presentations describe clinical aviation medicine as well as policy updates for common medical and mental health conditions encountered in the practice of our specialty. (Note: Session and abstract numbers are out of sequence order.)*

[455] HANDL SYNDROME IN A MILITARY UNDERGRADUATE PILOT: A CASE REPORT

Martin Gutierrez[1], TzuHua Fu[2]
[1]*Chilean Air Force, Santiago, Chile;* [2]*Air Force of R.O.C., Pingtung, Taiwan (Greater China)*

(Original Research)

INTRODUCTION: This case report describes a Transient Headache and Neurologic Deficits with Cerebrospinal Fluid Lymphocytosis (HaNDL syndrome) in an Undergraduate Pilot. **BACKGROUND:** Headache is a common chief complaint in pilots on active duty. This symptom may represent a more severe underlying condition. HaNDL syndrome is a rare neurologic disorder of unknown origin, characterized by severe headache attacks with neurological symptoms and cerebrospinal fluid with lymphocytic pleocytosis. **CASE PRESENTATION:** The subject, a 22-yr old Chilean Undergraduate Pilot (history of isolated headaches, without aura or neurological deficit, that he had not previously disclosed), was in the instrument phase of flight training (T-35 "Pillan"). Between routine daytime sorties, he presented with a transient headache associated with an expressive aphasia and right lower extremity paresis. He was admitted to the hospital for evaluation due to the severity of his symptoms. Initially stroke was suspected and, following negative CT, thrombolysis performed without complications. Symptoms resolved however a second headache, without any neurological deficit, occurred while still hospitalized and follow up CT as well as MRI scans were unremarkable. Consequently, further workup included a spinal tap which revealed lymphocytic pleocytosis and diagnosis of HaNDL Syndrome was made. **DISCUSSION:** Military pilots are a unique population requiring top physiological condition to help safeguard the sizeable government training investment. The US Air Force Medical Waiver Guide, utilized in determining disposition, considers any headache associated with a neurological deficit disqualifying (DQ) for all flying duties. Because the pathophysiology was unclear, the limited number of reported cases made it difficult to reasonably estimate recurrence, and the fact this was an undergraduate (not fully trained) pilot, the Chilean Aeromedical Center recommended permanent DQ. The poster presents characteristics of HaNDL Syndrome and the decision-making process used to determine this aviator's fitness for continued pilot training. In addition, HaNDL syndrome, a transient condition with suspected low recurrence rate, will be discussed as will the possibility of whether a waiver could, or should, be considered following an adequate period of observation.

Learning Objectives
1. Recognize red flags for headache in aircrews that requires additional work up.
2. Review the aeromedical policies of the US Department of Defense, Federal Aviation Authority, and the international aviation standards for headache.

[456] EOSINOPHILIC CHRONIC RHINOSINUISTIS

Yoshiaki Inuzawa[1], Medhat Abdallah[2]
[1]*Surgeon General, Shinjuku-ku, Japan;* [2]*Air Force Hospital, Cairo, Egypt*

(Education - Case Study)

INTRODUCTION: This case report describes a military jet aircraft pilot with eosinophilic chronic rhinosinusitis (ECRS) treated by endoscopic sinus surgery (ESS). **BACKGROUND:** ECRS is a subgroup of chronic rhinosinusitis with nasal polyps (CRSwNP). Pathogenesis is related to the Th2 system to promote IgE production and eosinophil infiltration. Symptoms can include nasal obstruction, hyposmia, headache, recurrent bacterial sinusitis and when recurrent or severe can result in a need for sinus surgery. Recurrent polyposis is common, resulting in long term use of saline lavage, topical nasal medications including steroids and leukotriene receptor antagonists, and sometimes even oral steroids. Asthma coexists about 50 percent with ECRS, resulting in more severe disease and requiring more aggressive treatment. Aviators with nasal polyps are at a significantly increased risk of sinus barotrauma, primarily during descent. Asthma, if present, may lead to respiratory compromise in the face of environmental challenges aviators may encounter. **CASE PRESENTATION:** The subject pilot was a 50-year-old high-performance jet aircraft pilot. He was undergoing treatment for chronic sinusitis, but when he failed conservative management, the otolaryngologist judged that the patient was a candidate for surgical treatment Accordingly, he underwent ESS and was diagnosed as having ECRS by the criteria based on imaging, blood tests, and pathological examination of the nasal polyps removed at surgery. No complications of asthma or aspirin intolerance were observed. Following surgery, he has followed a regimen of saline lavage, topical nasal steroids, and leukotriene receptor antagonists with no evidence of recurrence. Following assessment by the Aeromedical Consultation Service, he was returned to flight status approximately four months after surgery. **DISCUSSION:** ECRS is a disease that can recur even after surgery and is sometimes associated with asthma and aspirin intolerance. Aviators with this disease need to be strictly evaluated, managed, and followed carefully because of the risk of nasal polyposis with its attendant increased potential for sinus barotrauma and rhinosinusitis and to monitor for the presence of potential side effects from medications. This poster presentation will discuss the potential manifestations of ECRS and the decision making process involved in making waiver determinations for this condition.

Learning Objectives
1. Understand threat of Chronic eosinophilic rhinosinusitis for aircrews and management strategies.
2. Review the aeromedical policies of the US Department of defense, federal aviation Authority for chronic rhinosinusitis.

[473] CHRONIC SINUSITIS AND DEVIATED NASAL SEPTUM IN A POTENTIAL COMMERCIAL SPACEFLIGHT PARTICIPANT

Quinn Dufurrena; John Marshall
UTMB, Galveston, TX, USA

(Education - Case Study)

INTRODUCTION: This case involves a spaceflight participant (SFP) with a history of asymptomatic chronic sinusitis and deviated nasal septum who presented for medical certification for an orbital commercial spaceflight. **BACKGROUND:** Though the International Space Station (ISS) and visiting vehicles normally maintain a sea level cabin atmosphere, spaceflight presents the risk of contingency cabin pressure changes. Additionally, training for spaceflight involves undergoing hypobaric exposure in an altitude chamber and often zero-g flights. A known physiologic risk associated with cabin pressure change events is barotrauma, including barosinusitis. Risk of barosinusitis is increased in individuals with chronic sinusitis. Additionally, individuals with chronic sinusitis, sinus ostia blockage, and mucosal edema may be at increased risk for symptomatic sinus infections while on orbit. **CASE DESCRIPTION:** A 30-year-old male being evaluated for a potential commercial spaceflight mission to the ISS was noted to have asymptomatic chronic sinusitis and a deviated nasal septum. Computed tomography (CT) of the sinuses revealed chronic pansinusitis. Endoscopic evaluation by an ENT specialist revealed hyperemic mucous membranes of the nasal cavity, a deviated septum, mucosal edema in the maxillary and frontal sinuses and multiple obstructed ostia. Courses of oral antibiotics, antihistamines, oral and intranasal steroids were administered. Repeat imaging indicated no resolution of the previous findings, precluding successful medical flight certification. Septoplasty and Functional Endoscopic Sinus Surgery (FESS) were recommended prior to reconsideration for flight approval. Though the SFP was asymptomatic and able to fly in commercial aircraft without issue, he elected to proceed with the surgery. **DISCUSSION:** This case presents a dilemma since the SFP was asymptomatic but chronic sinusitis and multiple obstructed ostia placed him at risk for barotrauma with exposure to hypobaric environments. Additionally, without definitive treatment, the risk for symptomatic sinus infection during spaceflight remained a concern. A case of barosinusitis or sinus infection while on orbit could not only render an SFP's spaceflight experience unenjoyable but symptoms may be severe enough to interfere with mission critical procedures. The results of his surgery, follow-up imaging and consultations, and medical certification pathway decision-making will be discussed during the presentation.

Learning Objectives
1. Understand some of the risks associated with pre-existing medical conditions in the spaceflight environment.
2. Become familiar with the process of medical certification for commercial spaceflight.

[474] MEDICAL EVALUATION AND CLEARANCE OF A PRIVATE SPACEFLIGHT PARTICIPANT WITH UNIQUE OCULAR CONSIDERATIONS

William Fernandez; Brian Hanshaw
UTMB, Galveston, TX, USA

(Education - Case Study)

INTRODUCTION: This case report describes the complex medical clearance of a 45-year-old male spaceflight participant (SFP) seeking a short-duration commercial spaceflight. **BACKGROUND:** NASA's astronaut selection is a rigorous process which includes extensive medical screening. When a NASA astronaut is later assigned to a mission, the medical clearance process is relatively straightforward, due to the initial selection process. Private SFPs, however, have not undergone such medical scrutiny and therefore may have a variety of medical conditions that need to be addressed prior to flight to mitigate medical risk to crew and mission. **CASE PRESENTATION:** The SFP candidate underwent a rigorous medical evaluation for a potential commercial spaceflight mission. The candidate's past medical history was significant for multiple ocular conditions novel to spaceflight, including an intraocular contact lens and central serous chorioretinopathy. **DISCUSSION:** The SFP's medical history presented a multifaceted challenge when considering the physiologic effects associated with microgravity and increased G forces during launch and reentry. The ocular conditions were of particular concern given the risks involved with an expected cephalad fluid shift during spaceflight. These shifts can be significant, which highlights the importance of appreciating the underlying anatomy. Other visual changes can create distracting symptoms which may interfere with mission duties. Furthermore, the development of acute angle closure in this environment could cause incapacitating pain and risk permanent loss of vision. Such complications could endanger crewmembers and the

mission; given their potential severity, these risks must be ameliorated prior to flight.

Learning Objectives

1. The audience will gain an appreciation for the effects of spaceflight on ocular conditions and the potential consequences when considering spaceflight medical clearance.
2. The audience will gain an appreciation for the potentially complicated medical clearance needs private spaceflight participants have when compared to professional astronauts.

[475] WHEN BIGGER IS NOT ALWAYS BETTER

Bashir El-Khoury
UTMB, Galveston, TX, USA

(Education - Case Study)

INTRODUCTION: This case report describes a 47-year-old female U.S. Air Force flight nurse who was found to have autosomal-dominant polycystic kidney disease during record review for her annual routine physical health assessment. **BACKGROUND:** Autosomal-dominant polycystic kidney disease (ADPKD) is a relatively common type of kidney disease, typically occurring in between 1 in 400 to 1000 live births. Diagnosis is usually made based on imaging in the presence of known family history; however, genetic testing can be done but is not necessary for diagnosis. Autosomal-dominant polycystic kidney disease is often asymptomatic at presentation, but it can also present with hypertension, hematuria, proteinuria, and renal insufficiency. Extrarenal manifestations of ADPKD include cerebral aneurysm, hepatic cysts, pancreatic cysts, and cardiac disease. **CASE PRESENTATION:** This flight nurse was seen for her routine flight physical without new complaints, but admitted to having a renal sonogram done over 15 years prior to her visit with cysts in both kidneys. She endorsed a family history of ADPKD in her mother, but had never been diagnosed with the disease or been seen by a nephrologist in the past. Record review identified a renal sonogram from 2002 that demonstrated numerous cysts in both kidneys, so the patient was referred to myself in nephrology clinic and MRI Kidney was ordered which demonstrated hepatomegaly, innumerable liver cysts and numerous bilateral renal cysts consistent with ADPKD. Flying duties were suspended and aeromedical waiver was submitted and approved. **DISCUSSION:** This case report describes a relatively common, but often underrecognized condition that affects both men and women in the aviation community. Although typically asymptomatic early in its course, autosomal-dominant kidney disease is the leading hereditary cause of end stage renal disease in the United States. Early recognition and specialty referral can reduce the rate of renal decline, potentially delaying the onset of end stage renal disease. Clinicians should be aware of how to diagnose polycystic kidney disease and refer for specialty consultation as, in most cases, aviators can be considered for aeromedical waiver and returned to flying duties. Complications including hemorrhagic cysts, infected cysts, or renal calculi can occur leading to mission degradation; however, risk to mission accomplishment is reasonably low for both aviation duties and for spaceflight.

Learning Objectives

1. Understand the presentation, diagnosis, treatment and complications of autosomal-dominant polycystic kidney disease in the aviator or spaceflight participant.
2. Understand the aeromedical considerations for waiver for autosomal-dominant polycystic kidney disease and potential implications of the condition on spaceflight.

[476] DECOMPRESSION SICKNESS VERSUS HYPERVENTILATION IN HYPOBARIC PHYSIOLOGICAL HYPOXIA TRAINING

Kristi Ray[1]; Karen Ong[1]; Kris Lehnhardt[2]; L. Deutsch[2]
[1]*UTMB, Galveston, TX, USA;* [2]*NASA, Houston, TX, USA*

(Education - Case Study)

INTRODUCTION: This case describes the possible development of decompression sickness (DCS) in a subject undergoing hypobaric physiological hypoxia training at the Sonny Carter Training Facility , NASA Johnson Space Center in Houston, TX, USA. **BACKGROUND:** Symptoms of patients with hypobaric DCS include joint pain, neurologic symptoms, pulmonary symptoms, and skin symptoms. These symptoms can mimic other conditions such as anxiety-induced hyperventilation and therefore, can be difficult to distinguish from DCS. **CASE:** A 30-year-old male aerospace engineer presented for initial hypobaric physiological hypoxia training. The patient began experiencing bilateral upper extremity neuropathy and paresthesias traveling to 25,000 feet while on 100% oxygen (before the hypoxia exposure). On presentation of symptoms the training was terminated. He remained on 100% oxygen during the descent and symptoms resolved once back at ground level. He was evaluated by the onsite flight surgeon and diagnosed with possible DCS. Patient was treated with a U.S. Navy Treatment Table 5 in the onsite hyperbaric chamber. The patient remained asymptomatic during treatment with an unremarkable clinical exam both during treatment and post-treatment. **DISCUSSION:** In those who undergo pressure changes and altitude exposures, DCS is a differential diagnosis for neurological symptoms. During NASA's hypobaric physiological hypoxia training, subjects undergo a 45 minute pre-breathe with 100% oxygen to decrease the risk of developing DCS by denitrogenating the body. In spite of the pre-breathe protocol, there is a 1 in 10,000 overall risk of developing DCS during this training activity. In this case, the patient's mask was examined to ensure there were no leaks. Additional diagnoses to consider include anxiety, hyperventilation, hypercarbia, breathing gas contamination, and arterial gas embolism. These can mimic neurological DCS, and most resolve once at ground level when the mask is removed. However, there is no clear way to distinguish between these different conditions, so clinicians cannot definitively diagnose. It is recommended to treat patients with either ground level oxygen or hyperbaric oxygen, based on clinical suspicion and severity of symptoms. As this patient continued to be asymptomatic at the 12-hour follow-up, he was returned to full duty, not including alternobaric exposures as he was unable to complete the required physiological training.

Learning Objectives

1. The participant will learn about the presentation of hypobaric decompression sickness.
2. The audience will learn about different differential diagnosis' of those who undergo pressure and altitude exposures.

TUESDAY, MAY 24, 2022

Tuesday, 05/24/2022 ***8:00 AM***

8TH REINARTZ LECTURE
"Overcoming Barriers On The Pressure Spectrum: From The Past To The Future"
A Joint UHMS And AsMA Panel

Moderator: Joseph P. Dervay
Panelists: Richard Moon
Mike Gernhardt
Jay Dean

Tuesday, 05/24/2022 ***10:30 AM***
Tuscany C,D,E

[S-18]: PANEL: BEYOND THE 1% RULE: AEROMEDICAL RISK ASSESSMENT IN THE 21ST CENTURY

Chair: Amy Hicks
Co-Chair: Ryan Mayes