Learning Objectives
1. Function of the ET, and barotrauma risk associated with its dysfunction.
2. Risks of barotrauma in NASA activities and recommendations for preventive risk assessment.

[464] EXPERIMENTAL DESIGN FOR RADIONUCLIDE X-RAY IMAGING IN SPACEFLIGHT

Tejal Gala[1], John Choi[2], Saif Azam[2], Matthew Hartman[2], Max Raynor[2], Scott Fraser[2]
[1]*Keck School of Medicine of the University of Southern California, Los Angeles, CA, United States;* [2]*University of Southern California, Los Angeles, CA, United States*

(Original Research)

INTRODUCTION: Long-term manned spaceflight, such as to Mars, will require inflight medicine, including inflight diagnostic space radiology. Currently, ultrasound is the only imaging modality available inflight, but technical factors limit evaluation through bone or gas, such as for intracranial, pulmonary, or gastrointestinal pathologies. For this reason, X-ray based imaging is necessary, but it has not been utilized due to limited onboard spacecraft resources, such as power. We propose a radionuclide X-ray source to reduce the power requirement, coupled with a digital camera in contrast to prior demonstrations using X-ray film, as an ideal experimental platform for a flight demonstration. **METHODS:** Commercially available exempt quantity radionuclides were coupled with a digital camera using a phosphor screen to convert X-rays to visible photons. The experimental apparatus was built using commercially available lens tube parts connected to the camera via the lens mount. Image subjects included tungsten foil and a tissue sample (cooked meat). Different sources and imaging conditions were examined. **RESULTS:** Three radionuclides were evaluated: Barium-133, Cadmium-109, and Cesium-137. Different amounts of contrast were demonstrated and correlated with the emission spectrum of each radionuclide. Imaging parameters were adjusted to optimize exposure. Optimal exposure time for the tungsten sample was approximately 15 minutes for all three sources but varied for the tissue sample: 15 minutes for Cesium, 10 minutes for Cadmium, and 5 minutes for Barium. **DISCUSSION:** The study demonstrated that it is possible to create a compact, lightweight, low-power, radionuclide-based X-ray imaging system that could be used in a flight demonstration. Further work is required to optimize the images, such as uniformity correction due to the low photon flux levels and short distance from source to sample. While the images obtained are far from clinical diagnostic quality, they are radiographs and demonstrate a feasible path to a flight instrument. In addition to diagnostic space radiology, inflight X-ray imaging is expected to enable minimally invasive interventional procedures, as well as cross-sectional imaging of humans in space for scientific purposes.

Learning Objectives
1. Understand the components of an X-ray imaging system and how to utilize a phosphor screen and radionuclide to create a compact, low-power experimental platform for a flight experiment.
2. Understand the criteria used to evaluate a radionuclide for X-ray imaging.

[465] USING A HUMAN SYSTEM FAILURE MODEL AS AN ALTERNATIVE APPROACH TO MEDICAL PLANNING FOR HUMAN SPACE EXPLORATION MEDICAL SYSTEMS

Muska Miller[1], Veronika Puisa[1], Thomas G. Smith[1], Peter Hodkinson[1], Sergi Vaquer[2]
[1]*King's College London, London, United Kingdom;* [2]*ESA, Cologne, Germany*

(Education - Tutorial/Review)

INTRODUCTION: Human exploration missions e.g. the Lunar Gateway require capabilities necessary to sustain crew life for up to 60 days. Identification of medical risks to inform development of appropriate medical kits has traditionally been an important activity for mission planners and spacecraft design engineers because resources and space are so limited and naturally require prioritization. Traditional medical planning approaches have been based on specific knowledge of environmental hazards e.g. microgravity, radiation, isolation and confinement, and anticipated medical risks. These probabilistic approaches take input on the likelihood of occurrence of medical issues based on e.g. past spaceflight experience and terrestrial analogues to generate medical kits able to respond to predicted medical issues. Alongside these well founded and proven approaches, the European Space Agency (ESA) is keen to explore alternatives that will complement these methodologies by providing a parallel way of thinking. ESA is specifically exploring an approach based on human system failures. **TOPIC:** This alternative approach to medical planning will be presented that explores the common pathways of human system failures (e.g. cardiovascular, respiratory, neurological etc), and the application to spaceflight. This includes how these might occur, the threat they may pose to life or mission, and, the associated diagnostic and treatment commonalities, to generate the medical kit list. These medical kits can then be compared with and tested against those generated from the probabilistic models. By merging the approaches along with expert input, the aim is to provide an opportunity to continue the evolution and improvement in medical planning and kits for exploration missions. **APPLICATION:** Using this human system failure model, life-threatening and non-life-threatening failure modes were identified, along with specific diagnostic tools and management therapies. This information was used to identify common elements to inform the development of a medical emergency kit equipped to treat the diversity of human failure modes, which is irrespective of the underlying diagnosis. The proposed medical kit has been evaluated by healthcare professionals across a range of specialties, including those with pre-hospital experience. Follow up work will include assessment in an analogue environment to test its efficacy and help identify areas for improvement.

Learning Objectives
1. Traditional medical planning approaches are probabilistic and use past spaceflight experience and terrestrial analogues to generate medical kits to respond to predicted medical issues.
2. Human system failures, how these might occur and the threat posed to life or mission, may be used as a complementary method when generating medical kits for spaceflight.

Thursday, 05/09/2024 ***1:30 PM***
Grand Ballroom A

[S-79]: PANEL: WHERE ARE WE WITH WHITE MATTER AND HYPOBARIA? LATEST RESEARCH AND OUTCOME OF NATO COLLABORATION

Chair: Desmond Connolly
Co-Chairs: Joan Saary, Paul Sherman

PANEL OVERVIEW: *An association between excess subcortical white matter hyperintensities (WMH) and non-hypoxic hypobaria was first reported over a decade ago. NATO Research Technology Group 274 (RTG 274) convened in 2016 to provide a focus for research collaboration and information exchange regarding risks of hypobaric exposure, with emphasis on pathophysiology of WMH. The panel will summarise the latest international research and conclusions of RTG 274 in its recent final report. First, the US research over the last decade will be reviewed, with emphasis on U-2 pilot white matter health, tract integrity (fractional anisotropy) and cognitive performance, and WMH burden in aerospace operational physiologists. A miniature swine model suggests arrest of myelination but possible neuroprotective (anti-oxidant/anti-inflammatory) benefit of atorvastatin. Next, two UK presentations will detail acute human pathophysiological responses to*