editing of one image from a patient's image set to be automatically applied to the entire image series. This new approach would allow a new level of access to untapped medical imaging data relating to VIIP that can be utilized by researchers while protecting the privacy of the astronauts. In the next step toward finalizing this technique, NASA clinical radiology consultants will test the images to verify removal of all metadata and PII.

Learning Objectives:

1. To understand the risk of attribution associated with neuro-imaging, and to define a standard/method to keep this risk to a minimum.

[015] A SYSTEMATIC REVIEW OF MEDICAL EARLY WARNING SYSTEMS IN TERRESTRIAL AND MARS ANALOG ENVIRONMENTS TO IMPROVE THE M_2ARS MODEL

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INTRODUCTION: Medical Early Warning Systems (EWS) may increase astronaut medical autonomy for short and long duration missions. EWS rely on an aggregate score derived from a range of physiological parameters captured using biotelemetry. The final score is used to 'track' the physiological trend and 'trigger' the appropriate response according to pre-defined thresholds. EWS are utilized by terrestrial medical personnel to remotely assess the clinical status of patients; thus minimizing serious adverse events. The Medical Mars Analog astronaut aleRt System (M_2ARS) is a modified EWS developed by the Austrian Space Forum (OeWF), using biotelemetry information collected by the AOUDA.X suit during Mars analog missions. This study aimed to systematically review EWS models and improve the M_2ARS for the AMADEE-2015 Mars analog mission. **METHODS:** A systematic review of terrestrial and aeromedical EWS was conducted using six online electronic databases. The Critical Appraisal Skills Programme checklist was used to evaluate identified studies in terms of validity, relevance and results. **RESULTS:** The search identified 136 papers, of which 55 were relevant. Of these, 3 papers met the methodological standards. None of the studies were conducted in the Mars analog environment. Two cluster randomized controlled trials (RCTs) from Australia and the UK evaluated the benefit of a EWS that triggered a remote hospital response team. The Australian RCT found no statistical significance between control and intervention arms (p = 0.640; adjusted OR 0.98; 95% CI 0.83 to 1.16). However, the UK RCT found that EWS reduced in-hospital patient mortality (adjusted OR 0.52; 95% CI 0.32 to 0.85). These RCTs were also evaluated by a Cochrane meta-analysis, which discussed the findings from a terrestrial perspective. **DISCUSSION:** It is challenging to derive specific improvements for the M_2ARS model from terrestrial EWS models due to their heterogeneity. The Mars analog astronaut also has additional environmental limitations, such as the suit CO_2 levels, which need to be incorporated into the final EWS. Further research is required in the terrestrial and Mars analog environments to implement effective evidence based medical EWS for future space missions, including long-duration missions to Mars.

Learning Objectives:

1. Terrestrial and Mars analog medical Early Warning Systems (EWS) use a cumulative score from a range of physiological parameters captured using non-invasive biotelemetry.
2. Early Warning Systems (EWS) may provide an astronaut with autonomy over their health; vital for long duration Mars mission.
3. The M_2 ARS EWS model may contribute to improving terrestial EWS systems and improving patient care, and vice versa.

[016] FEASIBILITY OF SURGICAL PERCUTANEOUS DRAIN USE IN THE MICROGRAVITY ENVIRONMENT

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INTRODUCTION: Percutaneous drains (PDs) have been described as the most important intervention available for stabilizing patients with intra-abdominal abscesses occurring during long-duration spaceflight. Percutaneous aspiration of intra-peritoneal fluid has been successfully performed in porcine experiments in microgravity. However, ongoing drainage of abscesses within the microgravity environment, beyond the initial aspiration, has not yet been investigated. With the advent of commercial spaceflight, transport of patients with PDs in-situ could occur. It is therefore important to understand within the microgravity environment the mechanism of fluid flow from an abscess by a PD in order to maximize drainage efficiency. The aim of this study was to analyze flow of fluid through a PD in a simulated microgravity environment. **METHODS:** A closed drainage system was set outside and within a water tank to simulate low gravity. The system had a cavity simulating intra-abdominal pressure, with a multipurpose PD (10.2Fr) inserted into the cavity and a collecting chamber measuring volume output over time. Water was used as standard fluid. Three suction levels were used from -334 to -517 Torr. Ansys fluid dynamics software was used to corroborate the experimental results and test simulated blood flow though the drain. **RESULTS:** Flow of fluid through a 10.2Fr PD in normogravity without suction was 42ml/min whereas in microgravity this was significantly reduced by 80% to 8ml/min. At -517 Torr it was 412ml/min reducing 40% to 270mls/min in the microgravity setting. Fluid flow velocity and volume output was reduced with increased viscosity of fluid (blood). The significantly reduced drainage under microgravity was predicted by computational modelling and this closely confirmed the findings from the experimental testing. **DISCUSSION:** The maintenance of abscess cavity drainage in a microgravity environment will require a constant suction vacuum to sustain adequate drainage rates. There is room for significant advancement in design concept of PD in microgravity.

Learning Objectives:

1. The use of percutaneous drains to maintain abscess drainage in a low gravity environment requires continuous suction.
2. The fluid flow of bodily fluids through a percutaneous drain in a low gravity environment is dramatically reduced compared with that at normogravity.

[017] CHALLENGES ENCOUNTERED USING OPHTHALMIC ANESTHETICS IN SPACE MEDICINE

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INTRODUCTION: On orbit, ophthalmic anesthetics are used for tonometry and off-nominal corneal examinations. Proparacaine has been flown traditionally. However, the manufacturers recently changed the storage requirements from room temperature storage to refrigerated storage to preserve stability and prolong the shelf-life. Since refrigeration on orbit is not readily available and there were stability concerns about flying proparacaine unrefrigerated, tetracaine was selected as an alternative ophthalmic anesthetic in 2013. We will discuss the challenges encountered flying and using these anesthetics on the International Space Station. **METHODS:** The NASA Johnson Space Center Pharmacy Team researched the stability of the proparacaine under room temperature conditions. A comparison between proparacaine and tetracaine was provided to the operational flight surgeons, who approved tetracaine for use in microgravity. **RESULTS:** Tetracaine began flying in crewmembers' individual medical accessory kits before it was permanently incorporated into the standard medical kit. Tetracaine was used on five crewmembers as a topical anesthetic for tonometry testing during this timeframe. Two of the five crewmembers experienced corneal flushing and scleral injection, which interfered with interpretation of on-orbit surveillance testing results. Corneal flushing and scleral injection have not been noted with use of proparacaine. These findings required a switch back to proparacaine, necessitating a new process to be developed to supply the medication refrigerated. **DISCUSSION:** Storage requirements of medications in spaceflight are important factors to consider. In the absence of stability data, performance of the medication and/or the diagnostic testing may be affected. Selection of medications for future exploration missions will need