

SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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DIAGNOSTIC AND INTERVENTIONAL ULTRASONOGRAPHY FOR HUMAN SPACE MISSIONS

Abstract

The principal concern of manned space missions is human safety. One of the principal challenges to accomplish this objective is to provide appropriate diagnostic and therapeutic means in order to identify and to treat possible side effects of the reduced gravity, as well as possible unforeseen events like injuries, diseases or accidents. Currently, the ISS has ultrasonography (US) as diagnostic imaging alternative and potential guidance for basic procedures. Short and long duration manned space exploration missions to the ISS, Moon and Mars would include this imaging technique and would use teleradiology to analyze its images. However, there is no previous experience using US in space for detection of some of the principal concerns in which this technique can be useful; therefore, it would be necessary to use our knowledge and experience acquired on Earth or reduced gravity simulators.

We identify medical conditions that might occur while astronauts are on space according to the literature and previous studies, in which ultrasound would be an essential medical diagnostic tool. Furthermore, we illustrate identified conditions using US-imaging from real diseases and procedures on Earth. Imaging of traumatic and non-traumatic conditions are shown by body systems. Principal injuries include: pneumothorax, pleural effusion, organ injuries, hematomas, vascular injury, ocular trauma, fractures, tendinous or muscle sprains or ruptures. Considering non traumatic conditions we illustrate soft tissue infections, muscle atrophy, organ infections, stones, neoplastic lesions, genitourinary emergencies and others. In addition, we discuss advances in medical ultrasound and possible US-guided interventional alternatives to some of the entities, for instance US contrast agents, elastography, high intensity focused ultrasound, and virtual navigation.

In conclusion, ultrasonography is the primary diagnostic imaging technique of medical care support for current and future manned space missions; however there is no experience using US in space for most of the health risks that astronauts face. The use of teleradiology to send images to an expert who can assess medical conditions and guide interventional procedures will be one of the principal parts of the diagnostic and therapeutic medical support, but there are limitations due to communications delay. Therefore, astronauts and people involved in health care support could be familiarized with US utilization and imaging interpretation. It is necessary to optimize current radiological techniques and to search for breakthrough technologies or processes that allow us to provide better medical prevention, diagnostic and therapeutic strategies for astronauts, but also for patients on Earth.