VIRTUAL GUIDANCE ULTRASOUND: A Tool to Obtain Diagnostic Ultrasound for Remote Environments

Timothy L. Caine[1], David S. Martin[1], Timothy Matz[2], Stuart M. C. Lee[1], Michael B. Stenger[1], Steven H. Platts[3]

[1]Wyle Science, Technology & Engineering Group, Houston, TX; [2]MEI Technologies, Houston, TX; [3]NASA Johnson Space Center, Human Adaptations and Countermeasures Division, Houston, TX

ABSTRACT

INTRODUCTION: Astronauts currently acquire ultrasound images on the International Space Station with the assistance of real-time remote guidance from an ultrasound expert in Mission Control. Remote guidance will not be feasible when significant communication delays exist during exploration missions beyond low-Earth orbit. For example, there may be as much as a 20-minute delay in communications between the Earth and Mars. Virtual-guidance, a pre-recorded audio-visual tutorial viewed in real-time, is a viable modality for minimally trained scanners to obtain diagnostically-adequate images of clinically relevant anatomical structures in an autonomous manner. **METHODS**: Inexperienced ultrasound operators were recruited to perform carotid artery (n = 10) and ophthalmic (n = 9) ultrasound examinations using virtual guidance as their only instructional tool. In the carotid group, each untrained operator acquired two-dimensional, pulsed, and color Doppler of the carotid artery. In the ophthalmic group, operators acquired representative images of the anterior chamber of the eye, retina, optic nerve, and nerve sheath. Ultrasound image quality was evaluated by independent imaging experts. **RESULTS**: Eight of the 10 carotid studies were judged to be diagnostically adequate. With one exception the quality of all the ophthalmic images were adequate to excellent. **CONCLUSION**: Diagnostically-adequate carotid and ophthalmic ultrasound examinations can be obtained by untrained operators with instruction only from an audio/video tutorial viewed in real time while

scanning. This form of quick-response-guidance, can be developed for other ultrasound examinations, represents an opportunity to acquire important medical and scientific information for NASA flight surgeons and researchers when trained medical personnel are not present. Further, virtual guidance will allow untrained personnel to autonomously obtain important medical information in remote locations on Earth where communication is difficult or absent.