BRASLET INVESTIGATION GRANT

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BACKGROUND
The Braslet device is a set of specially designed elastic thigh cuffs available to each International Space Station (ISS) crewmember for use in the early phases of flight to reduce the effects of headward fluid shift by sequestering fluid in the legs. Crewmembers that have used Braslet have been reported to experience improvement in mental concentration, reduction of headaches, and aborted symptoms of space sickness. The manufacturer of Braslet (Kentavr- Nauka Ltd.) requires preflight calibration in a 30° head-down tilt (HDT) test with incremental tightening; the therapeutic setting is determined by subjective relief of “head fullness” supported by cerebral impedance rheographic waveforms returning to supine values. Actual local and extremity effects of the cuffs remain largely assumed, and little is known about the cuff pressure required to safely produce a predictable reduction in blood flow. Physiological effects of Braslet are also not fully understood; this countermeasure could have an effect on intracranial pressure hence could be considered as a potential countermeasure in spaceflight-induced intracranial hypertension and commensurate ocular/vision changes.

METHODS
Ten healthy subjects with standardized fluid intake participated in the main portion of the study. Femoral (FV) and internal jugular (IJV) vein images, pulsed Doppler spectra of neck and upper thigh vessels and middle cerebral artery (MCA), optic nerve images, and echocardiographic data were collected. Braslet-M cuff pressure was monitored at the skin interface using pre-calibrated pressure sensors. During the first session, the therapeutic setting was determined in 30° head down tilt (HDT) while incrementally tightening the cuffs (similar to the manufacturer’s calibration procedure); however, FV size and flow pattern were used instead of cranial rheography. The second session included testing at 6° HDT at the therapeutic setting and at the settings above and below. Throughout the two portions of the study, blood pressure was measured at intervals, and direct cuff pressure was continuously monitored.

A second set of subjects (n=5) were tested using a similar protocol, which was divided into three sessions with added seated baseline. Session 1 included a rapid assessment of therapeutic setting at 30° HDT. Sessions 2 and 3 included monitoring of all parameters, including intraocular pressure (IOP) in 20-minute intervals during Braslet treatment at the therapeutic setting, at 6° and 30° HDT respectively.

RESULTS
In the first set of subjects, therapeutic pressures were approximately 20 mmHg and correlated well with several physiological parameters. Cardiac tissue Doppler values, notably left ventricular E’ and septal E’ and A’ trend downward with increasing pressure, indicating reduced cardiac preload. Optic nerve sheath diameter (ONSD) increased from supine to tilted positions (6° and 30° HDT). With acute application, the Braslet device did not reverse this increase in ONSD. Femoral vein changes during tilt and Braslet treatments indicated reduced filling of the vein during tilt, and the sequestration of blood in the leg veins upon Braslet application.

Preliminary results of the second set of subjects demonstrate dramatic differences in many parameters in the seated position as compared to supine or tilted. Tonometry reflects rapid changes in IOP in response to posture changes. Final analysis of data from both sets of subjects is in progress.

CONCLUSIONS
Braslet-M exerts a physical effect that can be measured and correlated with changes in central and peripheral hemodynamics. Trends such as the decrease in the early diastolic relaxation rate (E’) with Braslet application appear to be similar to those observed during previous spaceflight experiments using Braslet, with cardiac septal data exhibiting less dispersion. HDT was validated as an acute model for increased intracranial hypertension based on ONSD measurements. Acute application of Braslet may slow the progression of ONSD and IOP increases but does not reverse it. The second set of subjects employ longer application times to observe time dependent trends in interstitial fluid sequestration, as well as the safe levels for longer duration compression.