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

Author: Dr. Kyohei Marume
Aichi Medical University, Japan

Prof. Satoshi Iwase
Aichi Medical University, Japan
Dr. Naoki Nishimura
Aichi Medical University, Japan
Dr. Yoshinori Wakita
Aichi Medical University, Japan
Dr. Kunihiko Tanaka
Gifu University, Japan
Prof. tadaaki mano
Gifu University of Medical Sciences, Japan

IMPACT OF SIMULATED MOON AND MARS GRAVITIES WITH HEAD-UP TILT ON CARDIAC FUNCTION

Abstract

[Background] Exploration of Moon and Mars will require astronauts to remain healthy in space for longer than previously achieved. However, astronauts must be able to perform adequately on Moon, where the gravity is a sixth of that on Earth, and Mars, where the gravity is a third of that on Earth. Despite exploration of Moon and Mars is planning in near coming future, impact of Moon and Mars gravities on human health is not well understood. Herein, we are conducting this study to evaluate cardiac function on simulated Moon and Mars gravities, using head-up tilt (HUT).

[Methods and Results] We are studying approximately 8 volunteers who will be recruited after multiple screening and psychological tests. We will select subjects who have no history of cardiovascular disease and are not taking any medications. The HUT table activities consisted of tilting the subject to one of the required angles (HUT-6for Space/weightlessness, HUT10for Moon gravity, HUT20for Mars gravity and HUT80for passive response to Earth gravity). HUT10and HUT20produces approximately 0.17 Gz [sin(10)] and 0.34 Gz [sin (20)], respectively. A single expert operator is planning to perform all the transthoracic two-dimensional echocardiographic studies using an ultrasound equipment. All participants are planning to undergo standard 2D (apical 2-, 3-, and 4-camber views, parasternal short and long axis views), pulsed and continuous wave and tissue Doppler echocardiography. Following current guidelines, the following parameters will be measured from the mitral inflow pulsed Doppler tracings: peak early (E) and late (A) diastolic velocities, E/A ratio, E and A wave integrals, time-to-peak E, and E deceleration time. From the pulmonic vein Doppler, the systolic (S) and diastolic (D) peak flow velocities, as well as their ratio (S/D) were measured. From the continuous wave Doppler images of the LV outflow, the following parameters were measured: maximum (Vmax) and mean (Vmean) velocity, velocity time integral (VTI), time-to-Vmax, and ejection time. For the computation of cardiac output (CO), systolic volume (SV) was determined as the product of the aortic valve cross-sectional area, wherein the diameter of the aortic annulus was measured from the 2D parasternal. We will compare cardiac function of the subjects at each simulated gravity.

[Clinical implication] Our results contribute to considering the validity of the HUT to simulate Moon and Mars gravities. In order to study the influence of Moon and Mars gravities on human health, it is

necessary to standardize the simulated gravity of the Moon and Mars.