Paper ID: 68326
student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medicine in Space and Extreme Environments (4)

Author: Mr. Acatzin Benítez Salgado
Universidad Autónoma del Estado de México (UAEMéx), Mexico, acatbim@gmail.com

Dr. José Javier Reyes-Lagos
Universidad Autónoma del Estado de México (UAEMéx), Mexico, jjreyesl@uaemex.mx
Mr. Aaron Garduño Rodríguez
Moscow Aviation Institute (National Research Institute, MAI), Russian Federation,
alfredashford@hotmail.com

ANALYSIS OF SHORT-TERM HEART RATE VARIABILITY DURING TRAINING ADAPTATION TO MARS-ANALOG ENVIRONMENT

Abstract

Continuous health monitoring during a long-duration spaceflight is necessary to understand the psychophysiological effects that occur in individuals exposed to exceptional conditions such as microgravity, hostile environments, circadian cycle disturbance, danger, isolation, and confinement. Heart rate variability (HRV) has provided indirect insight into autonomic nervous system activity under stressful and extreme conditions. This preliminary study aims to assess the autonomic cardiac systemic by HRV in healthy humans during a training adaptation to Mars-Analog Environment. We tested the hypothesis that the cardiac autonomic activity of analog astronauts differs among days of exposure to hostile environmental factors.

By using a bioelectric sensor (OpenBCI Ganglion Board 4-channel, OpenBCI, Brooklyn, NY, USA), we collected 5 minutes of electrocardiogram (ECG) recordings for 4 days at morning (7:00 to 9:00 am) from five analog astronauts (3 men and 2 woman) during an analog space mission at Mojave Desert, California, USA. RR interval time series were computed for each ECG segment separately by the Pan Tompkins algorithm. Subsequently, temporal, and spectral indices of HRV such as mean RR interval (AvRR), high frequency (HF), low frequency (LF), the peak of the low-frequency (LFpeak), and the peak of the high-frequency (HFpeak) were calculated from the short-term RR interval time series.

We found statistical differences ($p<0.05$) in AvRR between the first day (sol 1) and the second day (sol 2) [$853\pm99ms$ vs. $1032\pm132ms$, respectively] and between the sol 1 and sol 3 ($853\pm99ms$ vs.$1005\pm76ms$, respectively). In addition, LFpeak showed statistical differences between sol 3 and sol 4 ($0.10 \pm 0.03Hz$ vs.$0.05 \pm 0.01Hz$, respectively).

Our findings showed that during the four days of the analog space mission, the neural mechanisms of heart rate regulation in analog astronauts may be disrupted. Changes in LFpeak during the last two days of the mission suggest the possible manifestation of sympathetic and parasympathetic activity alterations including baroreflex responses.

High values of HRV (indicated by AvRR) promote behavioral adaptations and cognitive flexibility during stress, while low values result in poor or inadequate adaptive responses to stress and perceived threats. These observations represented a new insight into the short-term cardiac autonomic regulation in astronauts, which could be useful for monitoring the health status of astronauts in long-term space flights.