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Medicine in Space and Extreme Environments (4)

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STRESS-RELATED EFFECTS, BIOLOGICAL AGING AND HUMAN PERFORMANCE DURING ANALOG ASTRONAUT MISSION.

Abstract

Background

Space exploration and human life in space are pushing the boundaries of human physiology and pathology. The research on possible health involvements of subjects exposed to long periods in space relies mainly on simulations and experimental settings on earth for reliable data. Hypoxia, dysbarism, thermal support, moderate acceleration levels, microgravity, and high radiation levels represent significant threats to the crew's health. Moreover, psychophysical stress, sleep disruption, isolation, multiculturality and physical deconditioning are to be considered. These factors induce a progressive loss of functional capacity that rapidly brings to a severe decline in physical and cognitive performance. Such a decline largely overlaps with the normal aging process. From a molecular point of view, Oxidative stress, Inflammation, Neuroplasticity, Metabolic stress, and insulin resistance can all directly affect the acceleration of various pathological processes. Their cumulative effects could be evaluated on DNA through biological aging detection.

Methods

The experiment involved eleven analog astronauts (age 21,55 1,69) who spent seven days in a simulated lunar module. Inside the habitat, they had no contact with the outer world, no natural light, poor ventilation, high CO2 levels, sleep quantity and quality reduction, tight working schedule, multiculturality, lack of privacy, and limited space. The subjects were constantly monitored by a Medical Doctor who conducted the experiment and was part of the crew. Each subject wore an armband that collected physical activity, sleep, and heart rate data. Urine and saliva samples have been obtained throughout the week; blood was collected at the beginning and end. Molecular analysis will determine oxidative stress, neuroplasticity, inflammation, hormonal change and biological aging from those samples.

Results and Conclusions

The molecular analysis is still ongoing, but preliminary data suggest that the crew must be constantly monitored, and the reassuring presence of a medical officer implied an optimal control and a perception of safety. Even though all of the subjects reported to have suffered from really high-stress levels, the rapid instauration of good habits, such as regular physical activity and adequate nutrition and hydration, hampered the loss of physical and cognitive performance throughout the stay in the habitat. All of this permitted all subjects to complete their tasks and overall have an optimal performance compared with other crews.