

SPACE LIFE SCIENCES SYMPOSIUM (A1)
Human Physiology in Space (2)

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ADAPTATION RISKS IN SPACE MEDICINE

Abstract

Introduction. The process of adaptation to space flight proceeds stepwise, and at some stages the risk of adverse states which are borderline between normality and pathology may increase. These functional states were called prenosological and premorbid and differ by level of adaptation to environmental conditions. Being in the long-term space flight, the human body as a dynamic system realizes a continuous adaptation to microgravity conditions and the risk of disadaptation may increase. Our purpose was to verify the concept of so-called "adaptation risk" or probability characteristics of adaptation and functional status of cosmonauts at different stages of flight.

Methods. We present the results of heart rate variability (HRV) analysis when performing scientific experiments "Pulse" and "Pneumocard" in 26 Russian crew members of the International Space Station (ISS) at rest and during the deep breathing test (DBT10, 6 breaths per min). A new methodological approach to assessing the risk of disease, developed in space medicine, been applied in evaluating the results of HRV analysis. The degree of human adaptation to conditions of life activity is measured by the parameters of functional reserves (FR) and the degree of stress (SD). Probability (in %) of each of the 4 possible functional states (physiological normal, prenosological, premorbid and pathological states) is determined and is a quantitative measure of the possible risk.

Results. The group means of functional states during flight do not go beyond normal (probability of physiological normal state varies from 63 to 74%). The probability of prenosological state, which determines the risk of disadaptation, did not exceed 36%. This "adaptation risk" is a quantitative characteristic of individual adaptation at each stage of flight. It is illustrated by few examples that adaptation reactions depend on individual characteristics, workloads and work - rest schedule. Comparison of probabilistic risk ratings at rest with DBT10 results showed high correlations. Correlation coefficients of normal state and prenosological state probabilities with amplitude of fluctuations in heart rate during DBT10 were +0.48 and -0.43 respectively.

Conclusion. Adaptation risk characterizes the reserve of adaptation abilities ("health reserve") unlike the concept of clinical risks, where a set of signs (symptoms and syndromes), sufficient (or insufficient) for production of clinical diagnosis is considered. Adaptation risk as a new concept of prenosological diagnostics can be applied in various fields of physiology and medicine, especially when assessing the health of people (non-patients), living and working under unusual conditions.