Challenges of Life Support/Medical Support for Human Missions (8)
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THE IMPACT OF MICROCLIMATE PARAMETERS OF LONG-TERM SPACE FLIGHTS AND COMMENSURABLE SIMULATING CONFINEMENTS ON THE HUMAN PSYCHOPHYSIOLOGICAL STATE AND BODY COMPOSITION

Abstract

The estimation of an impact of the microclimate of space manned objects on crewmembers is an actual problem of the modern space medicine as it differs with normal terrestrial habitation by hypercapnia and lowered humidity. Therefore, the main goal of the present research was comparative analysis of various relationships between parameters of microclimate on ISS and in closed hermetic chambers for simulation of prolonged space flights (SF) by long-term confinement (LTC, 105-520 days) with psychophysiological states and body compositions of cosmonauts and volunteers-participants of LTC. Via methods of multivariate statistical analysis the positive relationships of atmospheric pCO2 within LTC with comfort level, indices of lipid exchange, growth hormone in blood, index of insulin resistance, dynamics of hematocrit and body cell mass, and negative – with specific resting energy expenditure, glucocorticoids/androgens ratio, triiodothyronine in blood, and dynamics of a dry lean body mass (DLBM) were revealed. We found close connections of variations in pCO2, pO2, humidity and temperature with DLBM, increments in lean body mass, body cell mass, body fat, anxiety, and generalized actual psychic state and mood in the Russian cosmonauts of 41/42 - 56/57 missions on ISS. The presence of compensated acidosis, obviously, having a respiratory genesis due to a moderate hypercapnia in hermetic chambers (CO2=0,17-0,39%), was revealed by measured high pCO2, HCO3-, buffer bases (BB), bases excess (BE) and low anion gap (AG) in blood of 3 test-subjects in 520-day LTC. The high HCO3-, BE and low AG were found in blood of the Russian cosmonauts of 4 missions on ISS (2003-2005 yrs), also evidencing of respiratory acidosis compensated by metabolic alkalosis. The compensation of acidosis in both groups (volunteers and cosmonauts) evidently was implemented via the accumulation of bicarbonate ions in blood (increased biosynthesis and reabsorption by kidneys) and by formation of reserve of anions with a shift to the right in a balance of bicarbonate and the total buffering systems of blood. It should be noted that the mean atmospheric CO2 concentration within latest years of our observations (0,17-0,38%, 27-335 days of SF within 2014-2018 yrs) is lower compared with early ISS missions (CO2 content was up to 0,5-0,6%) that, certainly, has a positive impact on crewmembers' health, but the diversified influence of microclimate on human psychophysiological state and body composition is necessary to be monitored via scheduled and periodic acid-base balance evaluation.