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DYNAMICS OF AQUAPORIN-3 CONTENT IN ERYTHROCYTES OF THE RUSSIAN COSMONAUTS DURING LONG-TERM SPACE FLIGHTS ON THE RUSSIAN SEGMENT OF THE INTERNATIONAL SPACE STATION

Abstract

Mechanisms of water and electrolyte homeostasis (WEH) and its regulation during long-term space flight (SF) are very important and only partially studied problems of space biology and medicine. One of unknown – the participation in WEH adaptation to SF of the water/glycerol-transporting protein aquaporin-3 (aquaglyceroporin-3, 31.4 kDa, AQP3) - a water and glycerol channel present on human erythrocytes and at the basolateral membranes of cells in various tissues, which main function is the passive transport of water into and out of cells according to the osmotic gradient across the membrane and, in a smaller degree, the transport of nonionic small solutes such as glycerol (Mobasheri A, Wray S, Marples D, 2005; Verkman AS, Anderson MO, Papadopoulos MC, 2014). Therefore, the main goal of the present research was a study of dynamics of AQP3 content in erythrocytes of the Russian cosmonauts during long-term SF (4-6 months) on the Russian segment of the International Space Station. Blood smears were prepared in laboratory before and after SF on the Earth, in the middle and at the end of SF onboard ISS by cosmonauts. After the delivery of onboard blood smears in the lab, the localization of AQP3 on membranes of erythrocytes was performed in all samples by immunocytochemistry with reagents of Sigma-Aldrich and Vector laboratories (USA). The microscopy of stained smears have shown the increased accumulation of AQP3 on membranes of erythrocytes in microgravity, especially in 2-3 months of SF, which was expressed in rise of color intensity and high contouring. Probably, the increased AQP3 in erythrocytes is one of reactions involved in decrease of their osmotic resistance during SF, which regularly observed in our studies and was reported earlier (Leon HA, Serova LV, Landaw SA, 1978, 1980). Obviously, the received results partially confirm the important role of AQP3 as major participant of WEH in the human body within SF, and, undoubtedly, these studies need to be continued for confirmation (or, worse, rejection) the following global scientific hypothesis - does the increase of AQP3 at the basolateral membranes of cells is a general reaction inducing by microgravity – if so, it will be highly important and useful in our understanding the actual problems of space biology and medicine like decrease of kidney sensitivity to vasopressin, skin resistance and wound healing, choroid plexus, intestine, distal colon and pancreatic ducts permeability, subchondral osteoblasts function, etc.