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Human blood proteins after long duration space flights

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Motivation and Aim: The conditions of space flight have a significant effect on the physiological processes in the human body, yet the molecular mechanisms driving physiological changes remain unknown.

Methods and Algorithms: Blood samples of 18 Russian cosmonauts who had conducted long-duration missions to the International Space Station were collected 30 days before launch (L-30), on the first (R+1) and seventh (R+7) days after landing. A panel of 125 proteins in the blood plasma was quantitated by a well-established and highly-regarded targeted mass spectrometry approach involving multiple reaction monitoring (MRM) in conjunction with stable isotope-labeled standards at the University of Victoria - Genome BC Proteomics Centre.

Results: In our data set, 125 plasma proteins were detected and quantitated in fmol/µl. Concentrations of most proteins were reduced at R+1 with a gradual return of their concentrations to the background level by R+7, except apolipoprotein A-II and serotransferrin whose concentrations remained reduced. This concentration dynamics partly reflected the dilution of the plasma during the restoration of the plasma circulation volume at R+1 and the gradual return of the plasma composition to the background values by R+7. Therefore, proteins whose concentration although insignificantly, but increased on the first day after the landing were of interest. It was determined 30 such proteins, including complement system proteins, acute phase proteins, proteases and their inhibitors. The only one protein whose concentration significantly increased at R+1 was S100A9 protein, that broadly regulates vascular inflammation and contributes to the biological response to vascular injury. This protein could serve as a marker of activation of proinflammatory reactions or damage of endothelial cells due to landing stress.

Conclusion: A decrease in the level of certain blood' proteins, without these levels being restored to their pre-flight levels 7 days after the flight, could clearly be interpreted as the impact of space flight on the human body. The increase in proteins involved in the regulation of inflammatory reactions and the immune response may adversely affect the functioning of the endothelium.

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