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Human Physiology in Space (2)

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BODY CORE TEMPERATURE CHANGES DURING SUBMAXIMAL BICYCLE EXERCISE UNDER LONGTERM MICRO-G IN ASTRONAUTS ON INTERNATIONAL SPACE STATION

Abstract

Introduction: Studies on thermoregulatory adaptations in Astronauts during long-term Spaceflight have been very limited to date or are even missing. First measurements have been done nearly 40 years ago (Spacelab); moreover only in animals up to date. But those studies could not answer questions to body core temperature (BCT) due to methodological constraints. Nevertheless, this elementary parameter influences several physiological and biochemical key pathways and could badly influence human performance. We hypothesized that heat balance and thermoregulation are altered in Astronauts in micro-g (weightlessness). Methods: Funded by the DLR (50WBXXX) the new developed non-invasive, heat flux DoubleSensor technology let research becomes possible for BCT in humans and therefore in Astronauts. Changes in BCT in conjunction with a submaximal bicycle exercise VO2max test were obtained pre-, in- and post-flight in 11 Astronauts during September 2008 and December 2012. The thermo-sensors were placed on the head and sternum. Results: Out of 12 we have collected full data sets from 11 Astronauts in total. During up to three time pre-flight exercise, BCT amplitude increased about 2.0C compared to baseline by a peak temperature of about 38.28 +/- 0.93C; similar to a control group on Earth. On flight day (FD) 15 and 45 we obtained a decrease in temperature amplitude of BCT (1.57C) due to a lower reached power during bicycle test and a peak temperature of about 38.88 +/- 0.82C. But on day FD135 and FD165 BCT the reached temperature was 39.19 +/- 0.73C, amplitude increased to 2.16C. In all FD measurements we recorded a prolonged elevation of BCT during the test and in cool down phase. Post-flight BCT amplitude and elevation was not re-adapted and did not reach pre-flight levels. Conclusions: The new sensor technique was able to monitor BCT in humans during micro-g and was well accepted. However, thermoregulation seems to be attenuated due to changes in heat transfer adaptations. We conclude a higher load in BCT in Astronauts during long-term Spaceflights which might have an impact on human basic physiological key pathways.