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

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HEMODYNAMIC MONITORING DURING LONG TERM SPACE FLIGHT – COMPARISON BETWEEN LATERAL (4 ELECTRODES) AND LONGITUDINAL (8 ELECTRODES) IMPEDANCE CARDIOGRAPHY TECHNIQUES

Abstract

Impedance plethysmography was widely used in space medicine to monitor fluid shifts and regional hemodynamic changes. Transthoracic impedance cardiography (ICG) detects blood volume changes of great vessels oriented along the current lines produced by the impedance device. We compared changes in basal impedance, signal amplitude and time intervals during long term space flight using lateral (four electrodes, between upper arms) and longitudinal ICG (eight spot electrodes, between the neck and the diaphragm) assuming that the lateral ICG detects mainly the right ventricle and the pulmonary arteries, whereas the longitudinal ICG detects mainly blood volume changes in the aorta. We analyzed the lateral ICG in 5 cosmonauts (age: 43+/-3 years, height: 175+/-3 cm, weight: 86+/-3 kg) and the longitudinal ICG in another 5 cosmonauts (age: 41+/-2 years, height: 180+/-2 cm, weight: 81+/-2 kg) during 6 months in space. The electrocardiogram (ECG), seismocardiogram (SCG), finger photoplethysmogram (PPG), and respiration were recorded (sample rate 1 kHz) using the "Pneumocard" device. Resting measurements of 5 minutes were made while supine prior to the flight, every month in space and during the first week after landing. Basal impedance (Z0, Ohm), the maximum of ICG (dZmax, Ohm/s), and systolic time intervals (preejection period, PEP; time to dZmax, left ventricular ejection time, LVET) were analyzed. The parameter changes during space flight showed comparable patterns for both techniques. Basal impedance increased early in flight (lateral ICG: 16+/-8 Ohm or 26+/-14%, longitudinal ICG: 8+/-2 Ohm or 267%) and remained above supine pre-flight levels during flight. The lateral technique showed unacceptable high intra- and inter-individual variability. The amplitude of the ICG increased profoundly early in flight and decreased stepwise towards the end of the flight reaching pre flight levels for both techniques. PEP and LVET were found slightly shorter during space flight. None of the parameters differed significantly between techniques except basal impedance. Our data suggest that both techniques are reliable for hemodynamic monitoring in space. The 8 electrode technique provided more stable recordings. Our findings are in accordance with earlier reported reduced body fluid during space flight. Cardiac output is increased early during flight and comparable to preflight supine values later in flight.