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REDUCED PULSE ARRIVAL TIME (PAT) AND STABLE PRE-EJECTION PERIOD (PEP) ARE ASSOCIATED WITH REDUCED DIASTOLIC BLOOD PRESSURE DURING LONG TERM SPACE FLIGHT

Abstract

Background: Pulse arrival time (PAT) measured between the ECG R-wave and the finger pulse is simple to measure and may potentially permit cuff-less blood pressure (BP) monitoring. PAT is equal to the sum of pulse transit time (PTT) and the pre-ejection period (PEP). Recent studies have shown that PAT is unreliable compared to PTT as a marker of BP because, PEP is a highly variable proportion of PAT. The Russian flight experiment "Pulse" showed significantly reduced PAT in 8 cosmonauts after 6 months in space compared to preflight supine values. The reduction in PAT was associated with decrease in diastolic BP. The aim of this study was to evaluate the hypothesis that changes in PEP during space flight not detected by simple ECG and photopulse measurements make the simple PAT measurements unreliable. Methods: We analyzed the recordings from 25 cosmonauts obtained twice before flight, every month during flight and first weeks after landing. PAT and PEP were computed from the simultaneous measurement of electrocardiogram, finger photoplethysmographic pulse waveform and transthoracic impedance cardiogram. PAT was measured as the time between the R-peak in the ECG and the upslope of the PPG. PEP was defined as the time interval between the R-peak of the ECG and the aortic valve opening detected as the B-point in the ICG. The ECG, PPG, and ICG were recorded using the "Pneumocard" device. Pre- and post-flight measurements were made supine as well as in sitting and standing positions. Results: Heart rate was similar to pre-flight supine values early in flight (pre-flight: 592 bpm vs. 1-2 months: 622 bpm) and increased slightly later in flight (632 bpm). The highest values were measured after landing (672 bpm). Diastolic BP was lower late in flight (5-6 months: 712 mmHg) compared to preflight supine values (792 mmHg). Pulse arrival time was 2084 ms before flight while supine and decreased during flight (1-2 months: 1933; 3-4 months: 1943 ms; 5-6 months: 1922 ms). The pre-ejection period did not change significantly during space flight. Conclusion: Our data repeat the earlier findings during the flight experiment "Pulse". Despite the fact that PEP is a variable proportion of the pulse arrival time, the shortening of the pulse arrival time accompanied by decrease in diastolic BP is a robust finding during long term weightlessness. Our data may suggest a mismatch between functional and structural changes of the heart and the large vessels compared to peripheral vasculature.