Orthostatic Hypotension after Long-Duration Space Flight: NASA's Experiences from the International Space Station

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Our laboratory previously reported that the incidence of orthostatic hypotension (OH) was greater after long- than short-duration spaceflight in astronauts who participated in Mir Space Station and Space Shuttle missions. To confirm and extend these findings, we retrospectively examined tilt test data from International Space Station (ISS) and Shuttle astronauts. We anticipated that the proportion of ISS astronauts experiencing OH would be high on landing day and the number of days to recover greater after long- than short-duration missions. **Methods**: Twenty ISS and 66 Shuttle astronauts participated in 10-min 80° head-up tilt tests 10 d before launch (L-10), on landing day (R+0) or 1 d after landing (R+1). Data from 5 ISS astronauts tested on R+0 or R+1 who used non-standard countermeasures were excluded. Many astronauts repeated the test 3 d (R+3) after landing. Fisher's Exact Test was used to compare the ability of ISS and Shuttle astronauts to complete the tilt test on R+0. Cox regression was used to identify cardiovascular parameters that were associated with test completion across all tests, and mixed model analysis was used to compare the change and recovery rates between ISS and Shuttle astronauts. In these analyses, ISS data from R+0 and R+1 were pooled to provide sufficient statistical power. **Results**: The proportion of astronauts who completed the tilt test on R+0 without OH was less in ISS than in Shuttle astronauts ($p=0.03$). On R+0, only 2 of 6 ISS astronauts completed the test compared to 53 of 66 (80%) Shuttle astronauts. However, 8 of 9 ISS astronauts completed the test on R+1. On R+3, 13 of 15 (87%) of the ISS and 19 of 19 (100%) of the Shuttle astronauts completed the 10-min test. An index comprised of stroke volume and diastolic blood pressure provided a very good prediction of overall tilt survival. This index was altered by spaceflight similarly for both groups soon after landing (pooled R+0 and R+ 1), but ISS astronauts did not recover at the same rate as Shuttle astronauts ($p=0.007$). **Conclusions**: The proportion of ISS astronauts who could not complete the tilt test on R+0 due to OH (4 of 6) is similar to that reported in astronauts who flew on Mir (5 of 6). Further, cardiovascular parameters most closely associated with OH recover more slowly after long- compared to short-duration spaceflight.