

PILOT FIELD TEST: USE OF A COMPRESSION GARMENT DURING A STAND TEST AFTER LONG-DURATION SPACE FLIGHT

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BACKGROUND

Orthostatic intolerance (OI) is a concern for astronauts returning from long-duration space flight. One countermeasure that has been used to protect against OI after short-duration bed rest and space flight is the use of lower body and abdominal compression garments. However, since the end of the Space Shuttle era we have not been able to test crewmembers during the first 24 hours after landing on Earth. NASA's Pilot Field Test provided us the opportunity to test cardiovascular responses of crewmembers wearing the Russian Kentavr compression garment during a stand test at multiple time points throughout the first 24 hours after landing.

HYPOTHESIS

We hypothesized that the Kentavr compression garment would prevent an increase in heart rate (HR) >15 bpm during a 3.5-min stand test.

METHODS

The Pilot Field Test was conducted up to 3 times during the first 24 hours after crewmembers returned to Earth: (1) either in a tent adjacent to the Soyuz landing site in Kazakhstan (~1 hr) or after transportation to the Karaganda airport (~4 hr); (2) during a refueling stop in Scotland (~12 hr); and (3) upon return to NASA Johnson Space Center (JSC) (~24 hr). We measured HR and arterial pressure (finger photoplethysmography) for 2 min while the crewmember was prone and throughout 3.5 min of quiet standing. Eleven crewmembers consented to participate; however, 2 felt too ill to start the test and 1 stopped 30 sec into the stand portion of the test. Of the remaining 8 crewmembers, 2 did not wear the Russian Kentavr compression garment. Because of inclement weather at the landing site, 5 crewmembers were flown by helicopter to the Karaganda airport before initial testing and received intravenous saline before completing the stand test. One of these crewmembers wore only the portion of the Russian Kentavr compression garment that covered the lower leg and thus lacked thigh and abdominal compression. All crewmembers continued wearing the Russian Kentavr compression garment during the second testing session in Scotland, but none wore it during testing at JSC.

RESULTS

The mean Δ HR from the supine to standing position in the 8 crewmembers measured pre-flight or 60 days after return from long-duration space flight was 9.8 bpm. During the first few hours after landing from long-duration space flight, the mean Δ HR of the 6 crewmembers who wore the Russian Kentavr compression garment in Kazakhstan or Karaganda was +14 bpm and the change in mean arterial pressure (Δ MAP) was +0.8 mmHg, while the 2 crewmembers who did not wear the Russian Kentavr compression garment had a Δ HR of +38 bpm and a Δ MAP of +1.1 mmHg. In Scotland, 4 crewmembers wore the Russian Kentavr compression garment and had a Δ HR of +7.4 bpm while the 3 crewmembers who did not wear it had a Δ HR of +25.0 bpm. Seven crewmembers were tested upon return to JSC ~24 hr after landing, but none wore the Russian Kentavr compression garment and their Δ HR was 16.0 bpm.

CONCLUSIONS

These are the first stand-test data to be collected from long-duration crewmembers during the first 24 hr of re-adaptation to gravity on Earth. The Δ HR measured in crewmembers who completed the stand-test while wearing Kentavr within the first ~4 hours after returning to Earth was only slightly elevated from pre-flight Δ HR, while the few subjects who did not wear the Russian Kentavr compression garment had a much larger increase in HR in order to maintain arterial pressure throughout 3.5-min of standing. These data demonstrate the effectiveness of a compression garment in preventing large increases in HR during a 3.5 min stand test after long-duration space flight. However, the fact that three crewmembers were too ill to complete the test or was not able to complete 3.5 min of standing despite wearing the Russian Kentavr compression garment indicates that wearing a compression garment does not resolve all problems crewmembers face during the period of re-adaptation immediately after return to Earth's gravity.