

AORTIC VESSEL WALL PROPERTIES DURING 60 DAYS STRICT HEAD DOWN TILT BEDREST - PRELIMINARY RESULTS OF AGBRESA

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Background. Changes in large artery properties including increased arterial compliance and increased carotid artery stiffness have been described after space flight. Altered vascular structure, which heralds cardiovascular risk, and reversible changes in vascular function could contribute to the response. Compared with previous studies, which did not reproduce these findings, AGBRESA applied strict -6° head-down bedrest (HDT) mimicking chronic cephalad fluid shifts in space. In this study, we assessed aortic vessel wall properties using state-of-the-art imaging methods and pulse wave analysis and tested for possible protective effects of artificial gravity training.

Material and Methods. We present preliminary data from 12 healthy subjects (8 men, 4 women) obtained during baseline data collection 9-6 days before bedrest (BDC, supine position) and towards the end of two months head down tilt bedrest (MRI on day 56 and echocardiography on day 60 of HDT). Subjects were assigned to 30 minutes per day continuous short arm centrifugation (cAG), 6 times for 5 minutes interval short arm centrifugation, iAG), or a control group (ctr). We assessed aortic pulse wave velocity using oscillometric upper arm and thigh cuffs (PWV-2C, CardioCube, AIT, Vienna, Austria) and 4D-flow cardiac velocity encoded phase contrast magnetic resonance imaging (PWV-4D-MRI). We also measured area, area changes, and distensibility (AoD) of the ascending aorta by 2D-phase contrast cardiac MRI and arterial compliance (Ca) using transthoracic echocardiography.

Results. Mean aortic area increased in all subjects after 60 days head down tilt bedrest (5.3 ± 0.7 vs. 5.8 ± 0.7 cm², $p < 0.05$). Stroke volume decreased from 94 ± 13 to 84 ± 10 ml ($p < 0.05$) and pulse pressure from 56 ± 11 to 46 ± 9 mmHg ($p < 0.05$) in part through reductions in stroke volume. The figure illustrates individual data on aortic properties (red diamonds = women). In contrast to the more consistent changes in aortic area, stroke volume, and pulse pressure, aortic distensibility, compliance, and pulse wave velocity responses show substantial inter-individual variability.

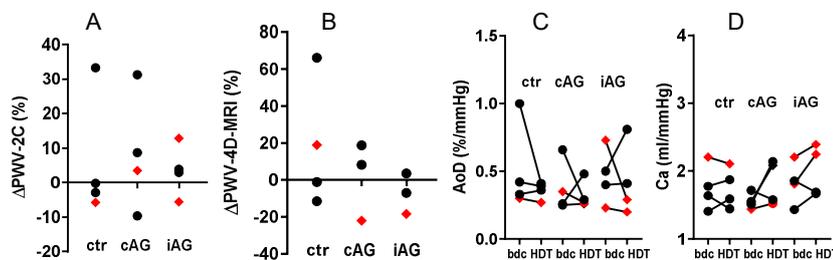


Figure: Individual data (A) of changes in pulse wave velocity measured with 2 cuffs, (B) changes in pulse wave velocity measured by 4D-Flow MRI, (C) of aortic distensibility (AoD), and (D) for arterial compliance (Ca) at baseline (BDC) and after 2 month of -6° head-down bedrest (HDT). Ctr=control group, cAG=continuous artificial gravity training, iAG= interval artificial gravity training, red diamonds = women.

Conclusion. The important finding of our study is that 60 days strict head down bedrest elicit consistent changes in ascending aortic area, pulse pressure, and stroke volume. The resulting changes in vascular loading conditions likely confound vascular function measurements, both, in head down bedrest studies and in space.