Individualized Centrifugation Training for Improving Microgravity Induced Orthostatic Tolerance

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Orthostasis: “Standing up”

Hemodynamic

↓ Venous return
↓ Blood pressure

↓↓↓
↑ NERVOUS ACTIVITY

↓↓↓
↑ Heart rate
↑ Vascular resistance
↑ Blood pressure

Hormonal

• Stress hormones
• Other hormones
Orthostasis: PROBLEM?
Combining HUT + LBNP
Artificial Gravity (AG)

- Artificial Gravity (AG) improves orthostatic tolerance
  (Iwase et al. 2002 *Environmental Medicine* 64: 29 -33)

- AG maintains orthostatic tolerance in bed rested men

- Effects across gender not clear

- Effects of *individualized* AG training not known
Aims & Objectives

• Effects of **individualized** centrifugation on orthostatic tolerance

• Is artificial gravity training protocol effective in both sexes?

*Centrifugation during spaceflight may prevent orthostatic intolerance upon return to Earth*
Hypothesis

45 min of AG increases orthostatic tolerance of men & women
Methodology

- 7 males and 5 females

**Protocol 1**
- 60 min HDT
- AG training
- HUT + graded LBNP (presyncope)

**Protocol 2**
- 60 min HDT
- no AG training
- HUT + graded LBNP (presyncope)

28 day separation
Artificial Gravity Protocol

Example of DLR Centrifuge Protocol for a Woman
Ramp up/ Ramp down 5°/sec/sec

Women start at 0.6 Gz
Men start at 0.8 Gz

*Single Heel Raise at Presyncope

HSTI meeting, San Jose, Costa Rica 2016
AG improved orthostatic tolerance (11 min vs 14 min, $p < 0.0019$) and this improvement was seen in both sexes ($p < 0.0352$)
Conclusions

- Artificial Gravity improves orthostatic tolerance
- Orthostatic tolerance improved in males and females
- Individualized AG training program is important
Scientific Team

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