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UMC St Radboud

Increased Physical Fitness After 4-week Hybrid Training in Persons With Spinal Cord Injury

Petra Heesterbeek[1], Dick Thijssen[2], Dirk van Kuppevelt[1], Rik Berkelmans, Maria Hopman[2], Jacques Duysens[1,3]

[1]Sint Maartenskliniek Research, Nijmegen

[2]Department of Physiology, University Medical Center Nijmegen

[3]Department of Biophysics, University Medical Center Nijmegen

Exercise in SCI

- SCI → ↓ Cardiovascular condition
  Changes in muscles
  ↓ Peripheral circulation
  → Secondary complications
- Aerobic capacity is limited
  - Small active muscle mass
  - Absent muscle pump
- FES (functional electrical stimulation)

Hybrid cycling

- FES as accepted method to train the cardio-vascular system of SCI-individuals

- Hybrid training
  - More effect than FES-LCE or armcranking alone (Raymond et al 1999, Stein et al 2001)
  - Larger active muscle mass
  - Laboratory settings

New hybrid outdoor FES cycle

- FES
- Voluntary arm-cranking
- Outdoors cycling
- Independent use
- Coupling to wheelchair

Purpose

- To determine the effect of a 4-week hybrid training program on physical fitness of Spinal Cord-Injured individuals

Subjects

- 10 persons with paraplegia (Th2-Th12, ASIA A-B)
- 9 male, 1 female
- Age: 23-53 years
- Experienced hand bikers

Training

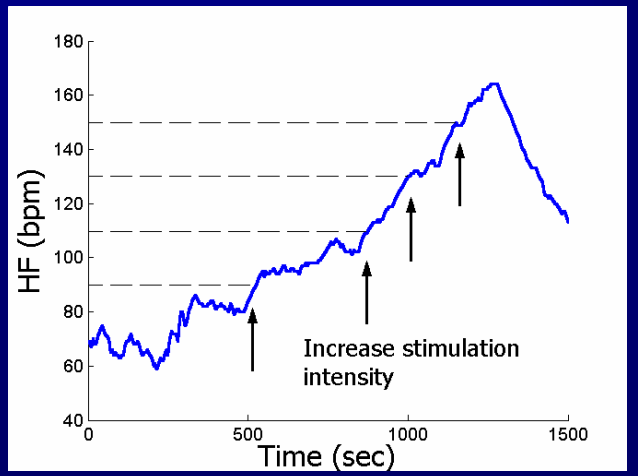
- Training
  - 8-12 sessions within 4 weeks
  - 30 minutes
  - Assisted training
  - Indoors in laboratory setting

Measurement PRE training

Measurement POST training

Measurements

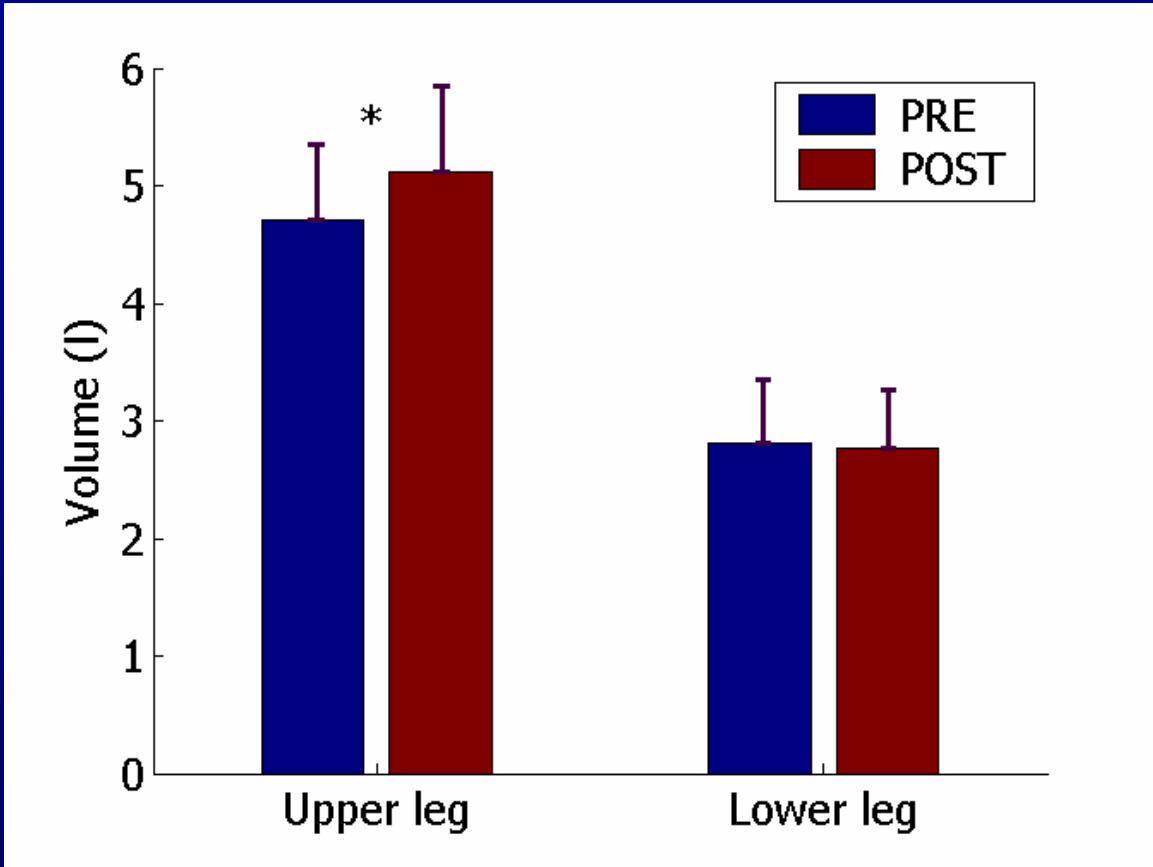
- Graded hybrid exercise test
  - FES cycle in laboratory setting
  - Protocol:
    - A: 5 min rest
    - B: 3 min 30 RPM (10 Watt)
    - C: 3 min 50 RPM (20 Watt)
    - D: graded, 1 min +10 Watt, 50 RPM
  - FES controlled by heart frequency
- Leg volume



Physical fitness

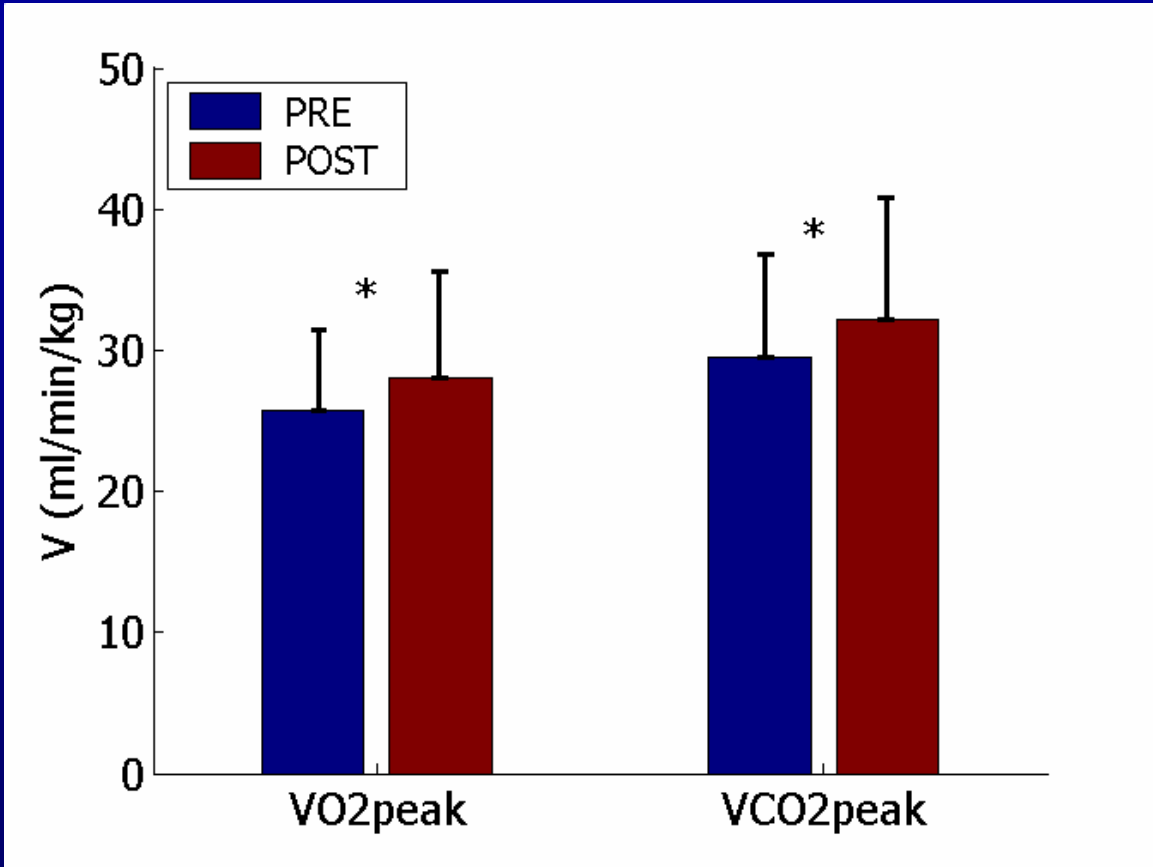
- Measurements of physical fitness
  - Peak oxygen uptake (VO2peak)
  - Peak carbon dioxide production (VCO2peak)
  - Peak expired ventilation (VEpeak)
  - Peak power output (POpeak)
- Leg volume (upper and lower leg)

Leg volume



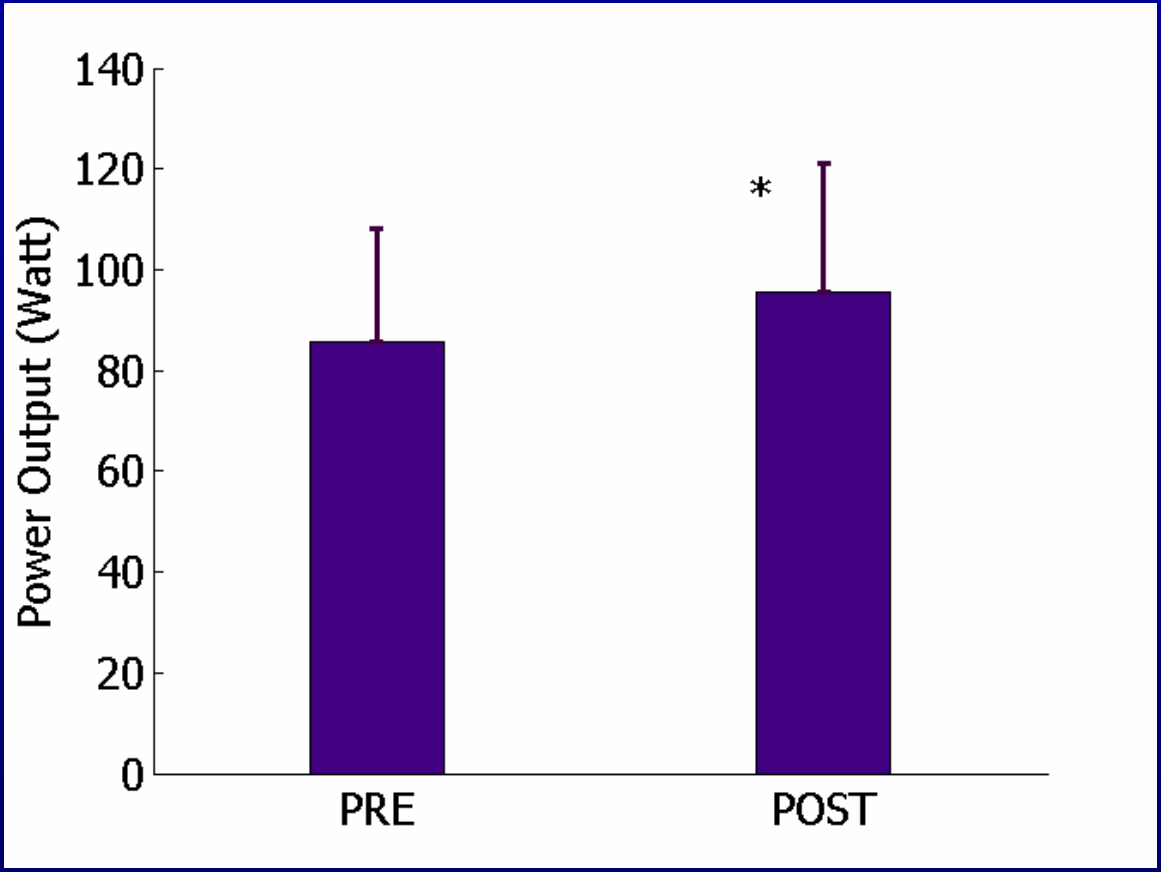
* p=0.04

VO2peak and VCO2peak



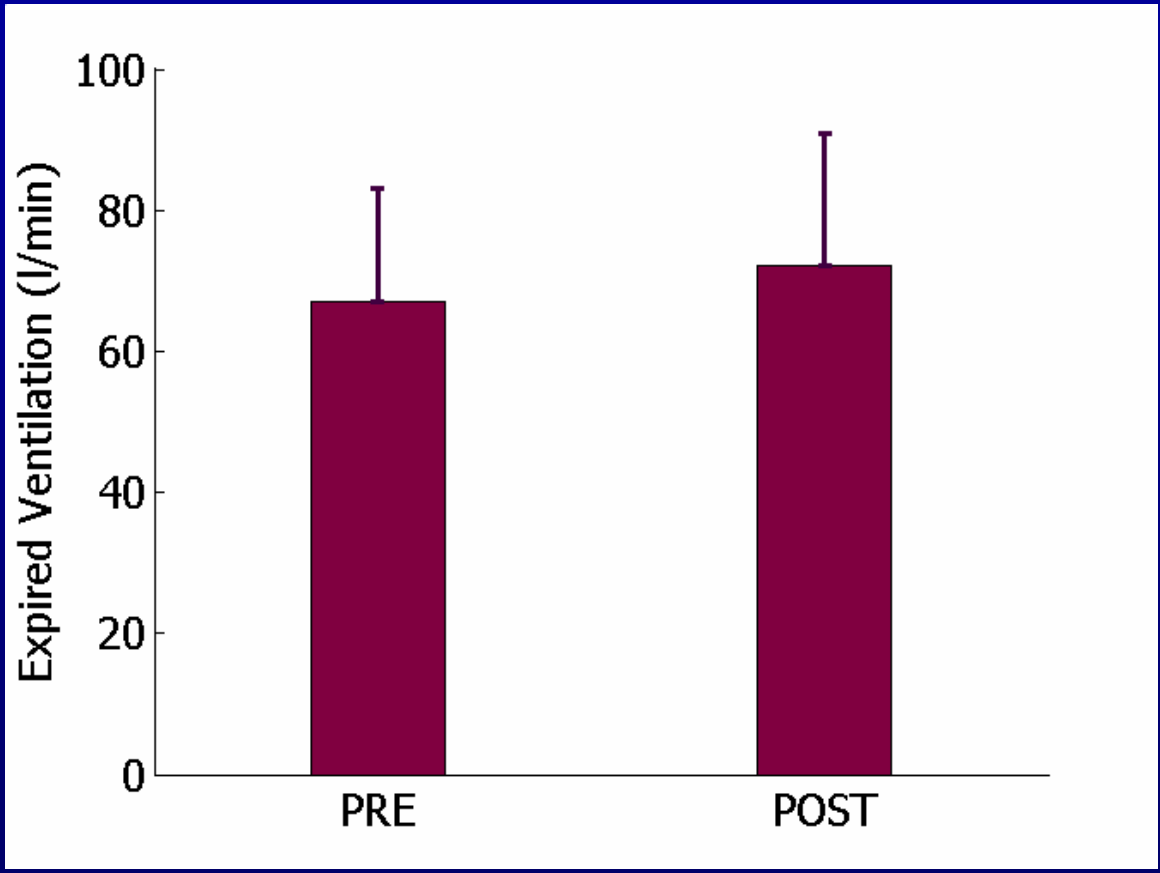
* VO2; p=0.022 * VCO2; p=0.012

Peak power output



* p=0.028

Peak VE



Conclusion

- A 4 week hybrid training on the new hybrid outdoor FES cycle leads to a significant increase in upper leg volume and to improvement of physical fitness in SCI individuals

Thanks for your attention

Stimulation Intensity