Autonomic cardiovascular control and deconditioning in astronauts "Cardio astronautes' - BL/01/C38

(Geographic) study area (country/region) : Beijing taikonauts
OSTC testsite (if applicable) **: /**
Data used: Sept 2004

Context and objectives

Microgravity is a unique environment that challenges human adaptive responses, especially with respect to the cardiovascular system. In microgravity conditions, body fluid hydrostatic pressure gradients will change and as a result blood will pool in the thorax and blood volume will decrease. This will influence venous return and as a result changes in autonomic modulation of the cardiovascular system can be expected. All these symptoms result in cardiovascular deconditioning. One of its manifestations is post-flight orthostatic intolerance and is a current operational problem for all astronauts.
The project aims to evaluate the relative role of the autonomic nervous system in cardiovascular deconditioning during astronaut training and after weightlessness. The goal is to better understand the detailed mechanism leading to cardiovascular deconditioning and especially to orthostatic intolerance, and to evaluate the potential role of autonomic alterations.
Recent evidence implicates post-flight autonomic dysfunction as a contributor to orthostatic intolerance. The autonomic nervous system is studied during specific tests (tilt test, breathing at fixed rate, head flexion) using heart rate variability (HRV) tools, with linear and non-linear methods.
The project should contribute to a better understanding of the cardiovascular impairment in a selected group and induced by weightlessness and study the influence of race and further help to develop new countermeasures.

Methodology

Respiration (an important modulator of HRV) is monitored continuously.
ECG electrodes are applied to the chest wall.
Continuous blood pressure is determined (Portapres) with a non-invasive pulse method at the finger and conversed to brachial blood pressure Modelflow® is be used to derive blood flow from the continuous arterial blood pressure curves. Although this method might not give accurate absolute values of blood flow, it is well-suited for providing relative changes. All analysis will be performed off-line. After peak detection, the RR interval file (tachogram) and a systogram are created that can be processed. Analysis of HRV, BPV and baroreflex will be performed to determine cardiac vagal and sympathetic and vasomotor sympathetic modulation..

Results

Results obtained in 2 Chinese astronauts from Shenzou6 flight, are quite different from similar measurements (according to the above mentioned protocol) from ESA and Russian cosmonauts.
In the Chinese group there was no difference in pre- and post-flight HRV parameters {(Xpre-Xpost)/Xpre*100%} in the standing position for: HR, LF%, HF%, LF/HF and BRS: difference between 5% and 24%. Similar differences after 10 day flights of ESA and Russian cosmonauts were between 13% and 54%. Moreover there was no evolution until R+9. Similar behavior was observed for BPV parameters.
Results from the Chinese astronauts compared to previous results in other cosmonaut groups after short space flight showed: 1. no significant differences were found between pre and post flight in the Chinese group in contrast to the ESA/Russian group; 2. no evolution post-flight until R+9 in the Chinese group. It is suggested that this different behavior could be due to specific training methods and/or nutrition methods.
Results have been presented at the:
16th IAA Humans in Space Symposium, May Beijing, China
See Appendix 2: Abstract at the Beijing Meeting
Appendix 3: presentation of results

Products and services

Web-link: : http://www.kuleuven.be/neurocardiology/china.html (for annexes)

At the16th IAA Humans in Space Symposium, May Beijing, China
5 abstracts have been presented.
A full paper is being planned

Two meetings have been attended organized by Belgian Foreign Affairs for China-Belgium scientific cooperation in 2005/2007
The Chinese Ambassador is invited by the Rector of K.U.L to be informed about space related KUL

An ESA-study is ordered on ESA-China space cooperation in the next decade (App 4: Executive Summary)

Execution

Period: 2005-2007

Laboratory/network:

- Prof. A. Aubert KUL, P rof.M. Dumont UMH
- Chinese Astronaut Training and Research Center, Bejing

Discipline

Space science
Medecine