Modifications of immunological and neuroendocrine responses in humans induced by simulated microgravity using head-down bed rest (HDBR), and the effect of the countermeasure of artificial gravity coupled with exercise.

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Introduction: Head-down bed rest of -6º (HDBR) was used as a model for studying the physiological changes during microgravity in spaceflight. Exposure of animals and humans to the space flight condition results in numerous immunological and hormonal changes similar to those observed during HDBR, but the mechanisms are not clear.

The aim of the study: The aim of the present study was to investigate whether exposure to such an environment led to alterations in the synthesis of some acute-phase proteins and cytokines, and if countermeasures (artificial gravity with ergometric exercise) would prevent these changes.

Methods: Twelve male volunteers were subjected to HDBR of -6° for 20 days; six were chosen to form the countermeasure group and were exposed to artificial gravity with ergometric exercise for 30 min per day, and the other 6 were used as controls. Plasma noradrenaline (NA), adrenaline (Ad), dopamine (DA), leukocyte count (WBC), interleukin 6 (IL-6), total serum protein (TP), C-reactive protein (CRP) and α-1antichimotrypsin (ACT) were determined before and after HDBR, to assess the effects of HDBR and the countermeasure.

Results: In all subjects, Ad and NA concentrations increased significantly, and the concentration of CRP decreased, (ANOVA $p<0.05$) after HDBR. The concentration of CRP was significantly higher, and that of Ad was significantly lower, in the control group (ANOVA $p<0.05$).

Conclusions: The results indicate that several neuroendocrine and immunological parameters are modulated by prolonged HDBR of -6º, and that psychological stress and/or the increased sympathetic nervous system might play a role in inducing these changes and this alterations might be counteracted at least in a part by the artificial gravity with exercise.

Figure 1a, b. Changes of the catecholamine values in the mean (±SE) before and after the HBDR for each of the countermeasure and control groups.

Figure 1a.

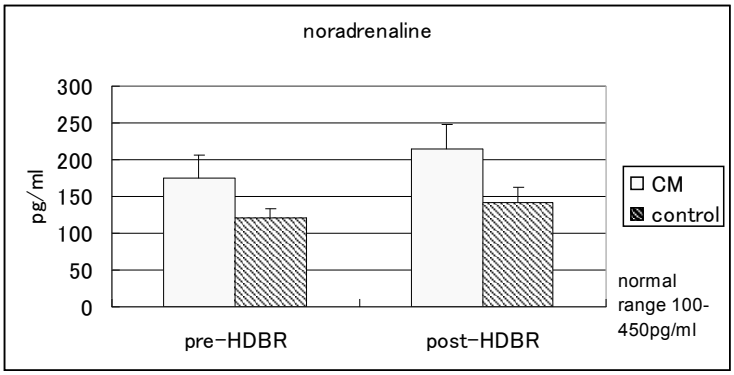


Figure 1b.

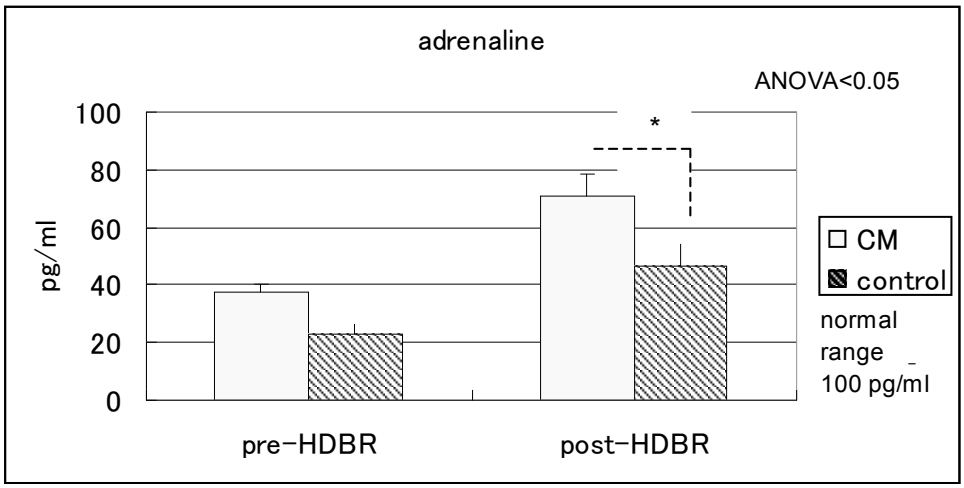


Figure 2. Changes with the day of the HBDR in the mean (±SE) values of CRP for each of the countermeasure and control groups

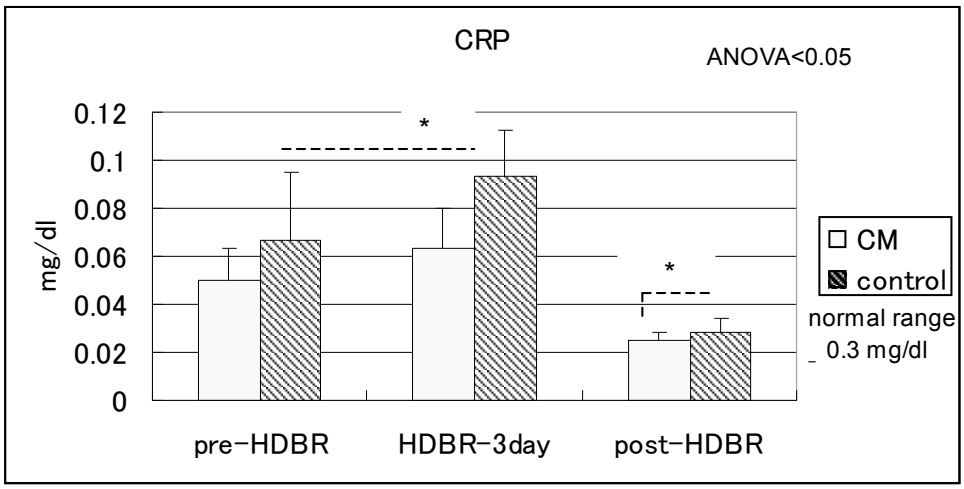
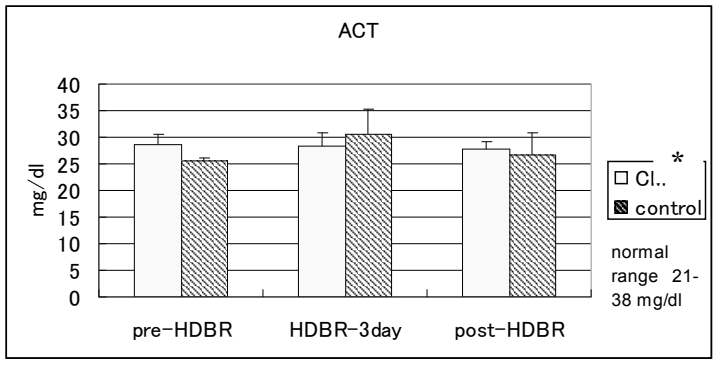


Figure 3. Changes with the day of the HBDR in the mean (±SE) values of the ACT for each of the countermeasure and control groups.



ANOVA p< 0.05