

CORRELATION OF PSYCHO-PHYSIOLOGICAL RESPONSES DURING PARABOLIC FLIGHTS AND POSSIBLE IMPACTS ON MOTOR CONTROL

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Introduction

Numerous studies have shown significant effects of weightlessness on adaptational processes of the CNS. Most of these studies have been carried out during parabolic flights, using the recurring 20s periods of weightlessness during each parabola. The continuous change in gravity between 1.8G, 1G and 0G can contribute to a potentially stressful situation for subjects during parabolic flights. While some authors have attempted to explore the influence of this stress, so far there seems to be only limited information about objective parameters of stress, evoked by parabolic flights. In this study we correlated physiological and psychological data to determine the subjects' state during the course of a 1.5 hrs parabolic flight and its impact on motor control.

Method

During three parabolic flight campaigns from Sept 05 to Dec 06, 21 subjects performed a sensorimotor adaptation task (mirror inversion tracking) either during the weightlessness (0G) or the normal gravity (1G) phase of the flight. EEG activity, blood hormone concentration and perceived physical, emotional and psychological state were assessed several times before, during and after the flight. EEG was subdivided by FFT into alpha and beta frequency ranges. From the blood samples, cortisol, ACTH, prolactin, epinephrine and norepinephrine were determined. A second group of subjects performed the same procedure within the same time frame under stress free conditions in our laboratory.

Results

A reduction in performance and adaptation was observed for the groups learning under 0G and 1G conditions in flight compared to the laboratory group. While this impairment did not reach significance in the 1G group ($p = .16$), it did so in the 0G group ($p < .01$). An increase in the concentrations of prolactin, cortisol, ACTH and epinephrine during the course of the 120 minute flight were observed. Increases in the beta EEG frequency range, which traditionally is regarded as an increase in arousal and stress, were observed. During the post flight period there was an increase in alpha EEG activity. Psychological data showed a decrease in perceived physical state. Correlating these data revealed a high correlation (r^2 from .63 to .15; $p < .01$) between psychological data and blood values whereas no correlations could be observed between EEG data and both the blood values and psychological data.

Discussion

These results confirm that parabolic flight is related to an increase in stress. This is characterised by changes in ob-

jective stress parameters (EEG, stress hormone concentrations) as well as perceived physical state. While some of these parameters seem to be connected, increased beta-EEG activity is more likely to show an overall increase of arousal in flight. These data suggest that psychophysiological effects have to be considered as a relevant factor for previously reported and further studies performed under so called weightlessness conditions during parabolic flights.

Keywords: Psychology, Hormones, Stress