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Author: Prof. Hasan Birol Cotuk
Turkey, hbcotuk@marmara.edu.tr

Mrs. Canan Elif Ozcan-Cakir
Turkey, cananelifozcan@hotmail.com
Dr. Adil Deniz Duru
Turkey, deniz.duru@marmara.edu.tr

NEURAL ELECTRICAL DYNAMICS DURING HEAD DOWN TILT AND MENTAL LOAD

Abstract

Head down tilt (HDT) has been used as ground based analogue for simulation of acute circulatory effects of microgravity on the central nervous system. Changes in cerebral hemodynamics elicited by HDT may impact neural activity and related cognitive processing. The aim of this study was to investigate the effect of HDT on neural electrical activity during i) the resting and ii) the increased mental workload state.

The electroencephalogram (EEG) was recorded from 10 volunteers using 16 electrodes in two postural conditions (supine and HDT at -20^o in random order) and during three tasks: Resting with eyes opened, resting with eyes closed, and then during mental load (backward serial subtraction with eyes closed). Each task lasted for two minutes. Power spectrum of the EEG was computed in the conventional frequency bands for frontal, occipital, parietal, midline, left and right electrode groupings. Separate Anova analysis were performed for each frequency band for electrode group x task x condition (the significance level was adjusted by Bonferroni correction).

During HDT delta band power was found to be greater than during the supine condition ($p<0.05$). Frontal delta band power increased during the eyes opened task when compared with the eyes closed and the serial subtraction task ($p<0.05$). The theta band power of the supine condition was found to be higher than its corresponding value of HDT ($p<0.01$). Topographical changes of alpha band power were observed in the occipital and parietal exerting increments during the eyes closed task when compared to eyes opened and mental workload task ($p<0.01$). Frontal beta and gamma band power were found to increase during the mental workload task only for the supine condition ($p<0.05$).

The mental workload task was not able to increase spectral power of the beta and gamma bands during HDT. This decrement in neural synchronization in the frontal lobe may be related to the decrease in cerebral blood flow which has been reported as an acute response to HDT (Marshall-Goebel et al. 2016).

Marshall-Goebel, Karina, et al. "Effects of short-term exposure to head-down tilt on cerebral hemodynamics: a prospective evaluation of a spaceflight analog using phase-contrast MRI." Journal of Applied Physiology 120.12 (2016): 1466-1473.