SEROTONIN RELEASE OF FRONTAL CORTEX IN HUMAN BRAIN AFTER HIGH INTENSITY EXERCISE.

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INTRODUCTION: We know empirically that acute fatigue and emotional changes are induced after high intensity exercise. Serotonin (5-hydroxytryptamine, 5-HT) in the brain is one of the neurotransmitter related to changes in emotion, cognition, memory and fatigue. Gomez-Merino et al. (2001) has shown that intensive exercise in rats increases brain 5-HT release in the frontal cortex using microdialysis. In the present study, to investigate the effect of high intensity exercise on 5-HT release of the frontal cortex in humans, we used positron-emission tomography (PET) with [11C]N-methylspiperone (NMSP). NMSP has a high affinity for serotonin 5-HT2 receptors in the frontal cortex (Wong et al. 1984). Thus, we hypothesized that intensive exercise would bring out the reductions in [11C]NMSP binding, which show increases of 5-HT release by competitive inhibition of ligand binding in human brain.

METHODS: Eight healthy male (20.6 ± 0.26 yr.) volunteers participated in the present study. The mean maximal oxygen consumption (VO2max) was 46.8 ± 2.16 ml kg-1min-1. Two brain PET scans were performed on the same day to each subject. First PET scan (baseline scan) was performed in the morning. About 2.5 hours later from lunch, Subjects pedaled the cycle ergometer at the workload of VO2max 70% for 30 min. After exercise, second PET scan (exercise scan) in the afternoon was performed as same as first PET scan. [11C]NMSP (562 ± 82 MBq) with a specific activity of 27 ± 14 MBq/nmol was administered intravenously. The subject marked the magnitude of systemic fatigue, pain and mood in separate 10 cm, horizontal visual analog scales (VAS) without marks before first PET scan and after exercise.

RESULTS: Binding potential (BP) of anterior cingulate cortex (ACC) was a significant reduction by exercise (from 1.45 ± 0.11 to 1.23 ± 0.07; P < 0.05). On the analysis of summed image for 90 min using SPM2, there were significant decreases by exercise in ACC (P < 0.01, uncorrected). There was a significant increase of systemic fatigue by exercise (from 2.36 ± 0.58 to 7.20 ± 0.67; P < 0.001). Similarly, there was a significant increase of systemic pain by exercise (from 1.35 ± 0.52 to 4.59 ± 1.00; P < 0.05). No change was observed in the VAS of mood by exercise.

DISCUSSION: The decreases in [11C]NMSP binding simply show increases of 5-HT release by competitive inhibition of ligand binding. Furthermore, the region of ACC and its 5-HT2 receptors seem to be associated with emotions. Taken together, the present study suggests that 5-HT release in ACC by intense exercise may be involved in changes of emotions relation to exercise, in particular fatigue.

REFERENCES:

Keywords: Fatigue, Brain Activity, Exercise