CHANGES OF ACTIVATION PATTERNS WITHIN THE HUMAN SENSORIMOTOR CORTEX BEFORE AND AFTER DRY WATER IMMERSION

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Dry water immersion (DWI) offers an excellent opportunity to simulate some of the effects of microgravity in ground-based laboratories. By deprivating the brain from proprioceptive input sensorimotor co-ordination is seriously disrupted and motor patterns are changed. To proof the influence of DWI on cortical activation within the sensorimotor cortex central activation patterns during finger-tapping before and after 48 hours DWI and 7 days after sensory deprivation were compared using fMRI.

The experimental set-up consisted of a baseline fMRI examination (test motor task) before the 48 hours of sensory deprivation, a conditioned fMRI examination immediately after the sensory deprivation (conditioned motor task) and a third fMRI examination one week after the second one. The experiments were performed with four healthy male volunteers (age range 24-30 years). All experiments were performed on a 1.5 Tesla whole body scanner with a conventional circular polarised head coil (FoV=250mm). T2* weighted images were acquired with a single shot echo planar imaging (EPI) sequence allowing the simultaneous acquisition of 15 slices within 2 sec (TR/TE/α=4sec/64ms/90°). To avoid artifacts due to involuntary head motions, a dedicated self-developed device was used to provide a rigid head fixation within the head coil. The 15 images were positioned to cover the entire sensorimotor cortex parallel to a line crossing the anterior and the posterior commissure. The on/off motor paradigm was a monitored finger-to-thumb tapping with the left hand with a tapping rate of about 2 Hz. Series of 10 images at rest (condition A) and 10 images performing finger tapping (condition B) were alternatively acquired up to a total amount of 60 images (time series: ABABAB). The temporal resolution was 4 sec.

The base-line fMRI examinations revealed bilateral activation within the primary motor (MI) and the primary sensory cortex (SI). After DWI three out of four healthy volunteers showed extensive changes of the cortical brain activity of the primary motor, primary sensory cortex and the premotor area. The supplementary motor area was activated more than 100% after sensory deprivation in all four subjects. Additionally new activation within the ipsilateral Globus Pallidus was observed. Thus, after sensory deprivation we found a significant increase in activity in higher motor control areas compared to the pretest baseline. One week after, these changes could not be found anymore.

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