

FEATURES OF HEART RATE REGULATION AND BRAIN ACTIVITY DURING CHOICE REACTION IN MILITARY MEN WITH TRAUMATIC BRAIN INJURY AND POSTTRAUMATIC STRESS DISORDER

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Traumatic brain injury (TBI) is the most common brain injury among military personnel who took part in armed conflicts [1] (War in Afganistan, Iraq conflict, Israel-Palestinian conflict, War in eastern Ukraine and etc.). Also military personnel suffers from post-traumatic stress disorder (PTSD) [2]. As far as TBI disrupts brain structure and its functions [3], consequences of TBI are long-term and have a huge impact on cognitive processes and control of behavior [4]. PTSD affects normal execution of cognitive processes as well [5]. Decision making implies execution of basic cognitive processes which are based on choice reaction. Disrupting of information processes during execution of choice reaction can result in inadequate outcome. Development of efficient rehabilitation methods for patients with TBI and PTSD requires additional information about features of brain activity of these people.

The study involved 33 male volunteers, right-handed, 18-28 y.o., without health complaints – students of Taras Shevchenko National University of Kyiv (control group); 14 male volunteers, right-handed, 22-52 y.o., military men of Armed Forces of Ukraine with mild TBI (mTBI), who took part in armed conflict in the East of Ukraine, later – military men with mTBI – the patients of Kundiiiev Institute of Occupational Health of the NAMS of Ukraine, Kyiv; and 31 volunteers, right-handed, 20-54 y.o.: 18 military men of Armed Forces of Ukraine with mTBI and 13 with PTSD, both groups also took part in armed conflict in the East of Ukraine, – patients of Center for Medical Rehabilitation and Health Centre of the Ministry of Defence of Ukraine "Pushcha Voditsa".

In the study simple reaction time (SRT) and choice reaction time (CRT) of responses made by right and left hand were measured. EEG and ECG were recorded before patients got tested and during simple reaction and choice reaction tasks. Brain structures engaged in choice reaction and corresponding dipoles of brain activity were indentified with analyzing of EEG records in low resolution electromagnetic tomography LORETA. Activation levels of parasympathetic and sympathetic divisions of autonomic nervous system (ANS) were rated due to the mode of R-R intervals and the mode amplitude of R-R intervals.

CRT of responses made by right and left hand for the military men with mTBI was significantly longer compared to control group (454 [436; 552] ms vs. 402 [392; 435] ms ($p=0,002$) for right hand and 486 [460; 576] ms vs. 414 [390; 430] ms ($p=0,002$) for left hand), while there was no statistically significant difference between the response time made by right and left hand between the military men with PTSD and control group (447 [394; 486] ms vs. 402 [392; 435] ms ($p=0,116$) for right hand and 430 [416; 477] ms vs. 414 [390; 430] ms ($p=0,06$) for left hand). Increased activity of the parasympathetic division of ANS was revealed only in the military men with mTBI, comparing the mode of R-R intervals during simple reaction task and choice reaction task (0,710 [0,658; 0,909] s vs. 0,740 [0,664; 0,940] s ($p=0,002$)), while there were no changes in mode amplitude value (54,75 [48,8; 71,4] % vs. 53,5 [46,4; 62,8] % ($p=0,584$)). EEG analysis by LORETA showed that control group executed choice reaction primarily engaging fronto-parieto-occipital regions. The group with mTBI showed more activity of fronto-temporo-occipital regions. The group with PTSD had mostly right lateralized brain activity with activation of fronto-temporal regions and insula. Furthermore, there was revealed that mTBI had statistically significantly greater activation of parahippocampal gyrus, temporal and occipital lobes regions, insula and posterior cingulate gyrus during choice reaction task compared to control group ($p=0,018$).

In conclusion, obtained results require further researches for eventual establishment of association between features of parasympathetic nervous system activation and brain activity in the military men with mTBI during choice reaction task. Also additional approach is needed to clarify the difference between engaged in choice reaction brain regions of the military personnel with mTBI and PTSD.

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