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The impact of combat traumatic brain injury on the early development of cognitive dysfunction in young people.

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Abstract

Due to the recent increase in the number of military conflicts in the world, physicians are increasingly faced with the combat traumatic brain injury (TBI). The paper deals with the question of development of cognitive and emotional disorders in persons of young age in different periods of the combat traumatic brain injury received during military operations. The development of vegetative and higher nervous activity disorders was especially noted. Medical histories were reviewed and patients who underwent combat operations during the war in Ukraine in the period from 2014 to 2022 were examined. Scales of mental functions assessment - MMSE (Mini-Mental State Examination), Montreal Cognitive Functions Scale (MoCA), Spielberg-Hanin anxiety scale, Beck Depression Scale, Study of memory, attention activity and work capacity "10 words" technique (A.R. Luria) and Schulte tables (Schulte's methodology) were also used. Particular attention was paid to the degree of development of the disorders and the patients of different groups which were divided according to the factor of the age of injury. A detailed analysis of the development of nervous disorders in each group was given, allowing us to evaluate the most sensitive brain structures. It was revealed that the medial stem structures of the brain are especially susceptible. This paper is of special interest for the medical personnel and medical establishments which supervise the persons suffered from combat TBI during the military operations.

Keywords: *traumatic brain injury - cognitive impairment - cognitive dysfunction - emotional-volitional disorders*

Introduction

One of the current problems of modern society is traumatic brain injury (TBI), and its consequences and rehabilitation is one of the leading tasks of medicine around the world [1,2,5]. According to WHO, in the last few years, more than 10-12 million victims of TBI are diagnosed annually in the world, of which 350 thousand cases end lethally [9,11].

Among the priority and socially significant problems of modern medicine, the so-called 'combat traumatic brain injury', a brain injury that constitutes the main part of cerebral trauma and is sustained during combat operations, has recently attracted attention. The increase in local military conflicts in recent decades has led to an increase in the number of combat-related traumatic brain injuries. High prevalence and steady increase of craniocerebral traumas, high percentage of complications, and disablement of large group of population stipulate the urgency of studying this medical and social problem, which is one of the key concepts of modern medicine and enables to analyze the components of human life activity in accordance with the WHO criteria. In these conditions, it is also important to study the possible long-term consequences of brain injuries both for the patients themselves and for their families and society.

In addition to traumatic brain injury, the problem of cognitive impairment (CI) or cognitive dysfunction (CD) has become an important topic and is being investigated worldwide. Interest in the problem of disorders of higher brain functions is extremely high and is explained by the gradual "ageing" of the population and the increasing number of patients with such disorders. According to European studies, dementia occurs in 6-7% of people over the age of 65 [6,9]. But so-called non-demential CI is even more common. In young people, for example, neurotrauma and intoxication are significant causes of cognitive dysfunction. According to different authors, cognitive dysfunction is found in 70-100% of TBI victims, depending on the degree of injury, and is often the leading cause of permanent incapacity and disability. Thus, there is no

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doubt about the relevance of further study of the impact of TBI on the cognitive sphere and approaches to treatment and rehabilitation of this patient population.

The severity and qualitative characteristics of CI following a traumatic event depend on the severity and mechanism of injury. After mild traumatic brain injury, neurodynamic disturbances predominantly develop [11,14,18] in the form of distracted attention, mild mnemonic disturbances, and a slight slowing of mental activity [11,17,18,21]. In moderate and severe traumatic brain injury, higher brain function abnormalities correspond to the localization of focal brain injury combined with neurodynamic disorders of varying severity [4,5,13,17].

Some authors have noted that cognitive and emotional-behavioral disorders characteristic for frontal lobe dysfunction are often found in survivors of severe trauma. Such symptoms are found both in the cortical localization of the lesion in the frontal lobes and in damage to subcortical structures that are functionally related to the frontal cortex [5,7,8,19]. After severe trauma, there is often a decrease in the speed of mental processes, attention, memory, and cognitive flexibility [9]. Disorders of categorization and generalization, abstract thinking, planning, regulation, and control of activity, i.e., the so-called control (or regulatory) functions, may develop [20]. In a study of the structure of posttraumatic psychotic disorders, American researchers found that 31% of the patients had psychiatric disorders of varying degrees, of which 22% had severe psychiatric disorders. The most common were depression (8.5%), generalised anxiety disorder (GAD) (9%), post-traumatic stress disorder (PTSD) (6%), agoraphobia (6%). Patients were more prone to develop post-traumatic psychotic disorders due to mild traumatic brain injury.

Aim

Despite the large number of studies of the problem of CI in persons with traumatic brain injury, there are still many questions to be answered. Our attention was attracted to study the features of CI and emotional-volitional disorders (EVD) in young adults in the acute period and in the long-term period (more than 5 years) of combat traumatic brain injury.

Materials and methods.

On the basis of the neurological department of the "Regional Hospital of War Veterans" and the State Institution "Institute of Neurology, Psychiatry and Narcology of NAMS of Ukraine" we examined 250 male patients aged 25 to 45 years who suffered a combat trauma during war in Ukraine from 2014 to 2022. The study is not subject to approval by the ethics committee; patients have signed an agreement with the diagnostic and treatment process. The medical history of the patients was not burdened by chronic and severe somatic diseases. The diagnosis of combat traumatic brain injury was made on the basis of generally accepted criteria.

All patients were divided into two groups. The first group consisted of 110 patients in the acute period of combat traumatic brain injury (24 hours to 10 days). The second group, 140 patients were in the long-term period of combat trauma (more than 5 years after the injury). Each group was divided into subgroups depending on the severity of their neurotrauma. We used clinical and neurological examination by conventional methods, psychodiagnostic, neuroimaging, and other methods.

The MMSE and MoCA were used to quantify the severity of cognitive impairment (CI).

EVD was assessed with the Spielberg-Hanin Anxiety Scale and the Beck Depression Scale. The results of the study of memory, attention activity, and work capacity in patients were assessed using the "10 words" technique (A. R. Luria), and Schulte tables (Schulte methodology) were also used.

The examination of patients with a combat traumatic injury revealed subjective and objective neurological symptoms. Patients in all groups at different periods of the combat traumatic injury complained of headache of varying intensity, dizziness when turning the head to the sides and changing body position, fear of death, anxiety, palpitations, head shaking, sweating, unstable blood pressure, "tingling and creeping" in the extremities, etc.

Results

In the acute period of combat trauma, patients in both groups predominantly complained of acute general weakness (92.6%); headache (97.5%); dizziness (88.5%); unsteadiness while walking (73.3%); dyssomnia (77.1%); impaired attention and memory of current events (around 50%); attacks of sudden anxiety with tremors in the limbs (43.85%); palpitations (up to 35%), impaired vision (38.75%), impaired hearing (34.3%); nausea with vomiting (30%). In the long term after the injury, the following complaints predominated: memory loss on current events (up to 48%), attention deficit (45,5%), headache (41,88%). The most frequent and persistent symptoms in the acute period were marked vegetative disorders (85.5 %), oculomotor group insufficiency (80 %), pyramidal insufficiency (32 %), vestibule-ataxic disturbances (52.6 %) and 78.4 % dyssomnic disturbances in those examined. Autonomic, vestibular disorders persisted in the distant period of the combat traumatic event. It should be remembered that the stress factor in the acute period contributed to a flattening of subjective and objective neurological symptoms, which made it difficult to diagnose cerebral dysfunction. At a later stage of the traumatic event, objective neurological symptoms gradually smoothed out, and the focus turned to vegetovascular and emotional-personal disorders. They were observed in the majority of patients as a symptom complex: increased fatigability, dissomnic disorders, decreased memory on current events, impaired concentration of attention. On this basis, we can say that vegetative disorders during all periods of trauma are one of the main causes of social maladaptation. We analysed the results of subjective, objective signs of nervous system damage. In the acute period of trauma, the main syndromes were: vegetovascular dystonia syndrome (81.5%), asthenic syndrome of varying severity (84%), cerebral hypertension

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(53%), vestibulo-ataxic (30.7%), and dissomnic syndrome (in almost 72%).

Asthenic syndrome was the most frequent manifestation of impaired nervous system function in all periods of a combat traumatic event, which makes it difficult for patients to adapt later in communication with relatives and in society. Symptoms are worsen when aggravated by bad habits (smoking, use of drugs, alcohol, etc.), exposure to minor stressors, meteorological dependence. Asthenic syndrome is often combined with vegetative and disomic disorders. Asthenic syndrome is manifested by decreased capacity for work, general weakness, fatigue, irritability, mood swings. Patients complained about absent-mindedness, forgetfulness, inability to concentrate on a particular action. In the acute period of the traumatic event, a low mood is expressed, patients are more indifferent to what is going on, feel drowsy during the day, and have reduced physical and mental activity. In later periods of combat trauma, patients were more concerned about impatience, lack of restraint, fatigue, headaches, dizziness, and sleep disturbances. Patients are more emotionally labile, which is manifested by sentimentalism, irritability, and excessive sensitivity to common external stimuli (noise and bright light). The study of the emotional-volitional sphere using diagnostic scales confirmed asthenic disorders. Emotional-volitional disturbances were manifested in the form of decreased positive modality and increased value of negative emotions, primarily anxiety, both reactive and personal. They were especially high in the acute period of the trauma, with a gradual tendency to decrease at the expense of reactive anxiety, while personal anxiety was similar in all periods of trauma. Thus, in the acute period of a combat traumatic injury, about 35.8% of patients had depressive disorders, more often mild, while anxiety was moderately elevated in almost 60.5%. The depressed state of the patients was noteworthy. In the remote period, the severity of anxiety did not reach the level of normal values, and the indicators of depression even slightly increased. According to the authors [19, 20], depression associated with TBI occurs in different periods: in the acute period, and with the phenomena of traumatic encephalopathy in the later stages. In our study, there was a predominance of anxiety over depression in all periods of combat traumatic brain injury, especially in the acute period. In the distant period of the TBI, anxiety-depressive disorders predominated, while astheno-neurotic disorders markedly decreased. From these results, we can say that a "mixed" variant (48.5 %) prevailed in the asthenic syndrome structure during the acute period of combat trauma, while anxiety-asthenic manifestations decreased and anxiety-depressive manifestations predominated (37.4 %) in the distant period of neurotrauma.

In all patients, a study of vegetative nervous system function revealed signs of vegetative dystonia. These manifestations were characterized by variability and inconstancy in different periods of the trauma. Disturbances in the form of headaches of various localization, unsystematic dizziness, labile blood pressure, sinus arrhythmia, general or local hyperhidrosis, skin marbling. Impaired vegetative regulation was manifested by insufficient vegetative reactivity and inadequate vegetative support of activity; vegetative reactions were characterized by lability and their intensity quickly decreased. In the acute period of the combat traumatic brain injury in 76 % of patients there were marked the disturbances of vegetative nervous system function, syncopal states, dyssomnia, the signs of predominating sympathetic effects of vegetative nervous system. The autonomic disturbances were mostly of a permanent nature. At other periods of EMF, prevalence of parasympathetic effects of vegetative nervous system was registered in 66,75 % of patients, and paroxysms manifested only at increased physical and emotional load. Vegetative disorders (48.5 %) were the most persistent neurological disorders in the long-term period of combat traumatic brain injury. For example, in the acute period of a mild combat traumatic injury, changes in autonomic regulation due to dysfunction of suprasegmental centers of the autonomic nervous system, due to frequent involvement of various parts of the limbic system, including suprasegmental autonomic structures, were noted. It is an undisputed fact that the basis of cognitive dysfunction is dysfunction of nonspecific systems of the brain, including the hippocampus, which contributes to the failure of unstable compensation during different periods of traumatic brain injury. Cognitive dysfunction in traumatic brain injury patients often affects areas of mental functioning such as memory, attention, speed of processing incoming information, and the controlling functions (planning, organization, decision-making) provided by the prefrontal areas of the large hemispheres of the brain.

Sometimes patients have no subjective cognitive complaints, and there may be no cognitive impairment on classical neurological examination. But the results of psychodiagnostic tests did not correspond to the age norm in more than 85% of the patients we examined. In the acute period of a combat traumatic event, they were diagnosed in 94.7% of the examined patients, and in the period of delayed sequelae of neurotrauma up to 35.4 %. This fact argues in favor of the persistence of cognitive deficits. In assessing cognitive functions, it was immediately noticeable that the patients themselves, especially in the acute phase of the combat traumatic event, did not actively complain in this area. However, objective neuropsychological tests diagnosed mild cognitive impairment in 50% of patients and moderate in 35 percent. None of the patients were found to have severe cognitive impairment, namely dementia. In 62.7% of patients, the MoCA score indicated cognitive decline. The overall score on the MMSE did not differ significantly between the two groups, with a score of 26.8 ± 0.6 in the acute period of the traumatic event and 23.9 ± 0.9 in the long-term period, which speaks in favor of the presence of the light form of CI and moderate CD in all periods of injury. Thus, in the acute period of the traumatic injury, the cumulative score was 22.5 ± 0.3, and in the long-term period, the cumulative score was 25.8 ± 0.2.

Changes in the cognitive functions of the brain of the examined patients in all the groups were confirmed by the

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results of the Schulte table. They consisted in a decrease in the level of active attention, which was combined with an increased attentional exhaustion and a worsening of the ability to switch attention. Attention exhaustion in the acute period was observed in all subjects (up to 99.4%). In the attention span test, the rate at which the task was completed was the most reduced (65.7%). At the same time, a decrease in attention concentration was observed in 43.13% of patients. It is likely that difficulty in concentrating caused a significant decrease in performance in patients in the acute period. In the distant period of the traumatic brain injury, a low rate of task performance was detected in only 13% of patients, while a low level of concentration was noted in 7.53% of patients. The average time to complete a task on Schulte tables (performance) was 50.45 ± 20.4 seconds. This indicates that patients had an increase in the time required to complete the Schulte tables task as compared to the normative values. The rate of task completion on the worksheets was uneven: "The performance curve" was characterised by a low baseline (41.43 ± 19.87 s - time spent on the first table) with gradual and steady deterioration, with no marked fluctuations towards improvement (44.28 ± 21.14 s. - time spent on the second table; 47.96 ± 19.68 s. - time spent on the third table; 49.62 ± 21.76 s. - time spent on the fourth table; 48.14 ± 0.73 s. - time spent on the fifth table). An increase in the number of errors in working with each successive table is evidence of increased attention exhaustion in this contingent. Memory disorders in all periods of CHT were dynamic. There was a decrease in performance and an increase in the number of errors at the end of the 10-word memory test using the method of A.R. Luria [6].

There was a significant deterioration in visual and auditory memory, especially in the reproduction of learned material, while there were no disturbances in memory mechanisms. There was a high degree of distractibility and a low level of attention. In the acute period of mild traumatic brain injury, immediate verbal memory was 5.02 ± 0.38 words, long-term memory 6.75 ± 0.5 words; and in the long-term, immediate average memory was 5.97 ± 0.6 words. This nature of CD indicates impaired neurodynamics of cognitive processes as the leading mechanism of the identified abnormalities of higher brain functions.

Conclusions

On the basis of the results of our study, we can say that medial stem structures of the brain are particularly susceptible to traumatic brain injury, as their leading role is to ensure the adaptive processes of the organism. Clinically, the dysfunction of nonspecific brain systems is manifested by a disintegrating psycho-vegeto-somatic syndrome. In the distant period of a combat traumatic event, the organic neurological symptoms gradually flatten out and the vegetative-psychopathological disorders prevail, which is one of the main reasons for clinical and socio-occupational maladaptation. And we should remember that traumatic dysfunction of the limbic-reticular complex alters emotional reactivity, which contributes to the increased susceptibility of patients with the consequences of combat traumatic injury to the influence of stressors.

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Statement of conflict of interests

The author state no conflict of interest.

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