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Diagnostic Approaches to Verification of the Mild Traumatic Brain Injury in Patients with Posttraumatic Stress Disorder

Диагностические подходы к верификации легкой черепно-мозговой травмы у пациентов с посттравматическим стрессовым расстройством

Abstract

Introduction. Many studies indicate the increase of mild traumatic brain injury (mTBI) among other military injuries that are not diagnosed in time, have a negative psychosocial effect, reduce the possibility of successful adaptation and re-socialization, especially in combination with post-traumatic stress disorder (PTSD).

Materials and methods. We examined 93 post-deployment men, who participated in the military conflict in eastern Ukraine. In order to verify mTBI, the Boston Assessment of TBI-Lifetime (BAT-L) was used. The scale for clinical diagnosis of PTSD (CAPS-5) was used for PTSD verification.

Results. MTBI is one of the most common injuries among veterans, but individual symptoms may be inaccurately associated with another disease. It may adversely affect the diagnosis, treatment planning, and recovery expectations. The accuracy of verification is complicated by lack/false information about mTBI; the initial assessment delay; overlap of PTSD and mTBI symptoms; comorbidity of mental disorders and mTBI.

In our study, it was found that according to BAT-L, 63% of patients had at least one mTBI throughout their lives. In 41.9% of cases, there was at least one military mTBI, but only 19.2% of people had documentary evidence of mTBI, and 17.2% of persons did not seek medical assistance at all. Among military injuries, 38.5% were blast-related, 43.6% – due to other military reasons, 17.9% had a combined injury mechanism. According to the CAPS-5 scale, 54.4% of patients with mTBI had PTSD, and 45% of persons had adjustment disorders. Violations of attention were observed in 86.8% of all patients, executive dysfunction – in 75.0%.

Conclusions. Boston assessment of traumatic brain injury during life (BAT-L), PTSD clinical diagnostic scale (CAPS-5), and cognitive tests are useful for mTBI + PTSD diagnostics.

Keywords: mild traumatic brain injury, posttraumatic stress disorder, diagnostics.

Резюме

Введение. Множество исследований указывают на рост среди военных повреждений удельного веса легких черепно-мозговых травм (ЛЧМТ), которые не диагностируются своевременно

и оказывают негативное психосоциальное влияние, снижая возможность к успешной адаптации и ресоциализации, особенно в совокупности с посттравматическим стрессовым расстройством (ПТСР).

Материалы и методы. Для верификации ЛЧМТ выбрана методика Бостонской оценки травматического поражения мозга на протяжении жизни (BAT-L), для определения ПТСР – Шкала для клинической диагностики ПТСР (CAPS-5). Было обследовано 93 мужчины – участника АТО на востоке Украины.

Результаты. ЛЧМТ является одной из наиболее распространенных травм среди ветеранов, но отдельные симптомы могут быть неточным образом связаны разными патологическими состояниями, что может негативно влиять на диагностику, планирование лечения и ожидание восстановления. Усложняют точность верификации отсутствие/ложность информации о ЧМТ у пациента и медицинских работников; отсрочка первичной оценки клинической картины пациента; клиническое перекрывание симптомов ПТСР и ЧМТ; сопутствующие психические заболевания, коморбидные с ЛЧМТ.

Проведенное нами исследование выявило, что среди 93 исследуемых при помощи Бостонской оценки травматического повреждения мозга на протяжении жизни (BAT-L) 63,2% имели по крайней мере одну ЛЧМТ на протяжении всей жизни. У 41,9% пациентов была по крайней мере одна военная ЛЧМТ, но только 19,2% лиц имели документальные подтверждения ЛЧМТ и 17,2% не обращались за медицинской помощью. Среди военных травм: 38,5% были вызваны взрывом, 43,6% – другими причинами, у 17,9% пациентов имел место совмещенный механизм травмы. По шкале CAPS-5: у 54,4% лиц с ЛЧМТ в анамнезе было ПТСР, у 45% – расстройства адаптации. Нарушения внимания имели место у 86,8% исследуемых, исполнительная дисфункция – у 75,0%.

Выводы. Целесообразным является использование Бостонской оценки травматического поражения мозга на протяжении жизни (BAT-L), Шкалы для клинической диагностики ПТСР (CAPS-5) и когнитивных тестов для диагностики ЛЧМТ+ПТСР.

Ключевые слова: легкая черепно-мозговая травма, посттравматическое стрессовое расстройство, диагностика.

■ ACTUALITY

In practical medicine, there are still uncertain diagnostic algorithms and established therapeutic programs for comorbid disorders, in which the traumatic brain damage and mental disorder, in particular post-traumatic stress disorder, are in the aggregate. This uncertainty generates a request for scientific research on such comorbid sickly conditions, especially in view of significant and varied disorders of physical, mental and social adaptation of such patients.

Problems in the diagnosis and treatment of traumatic brain injuries, their remote effects in the form of disorders of cognitive and social functioning were studied in samples of patients with sports and other civilian injuries, as well as military injuries, which, unfortunately, have become the most urgent in recent decades, considering the number of armed conflicts in the modern world and the features of the striking effect of modern weapons.

Numerous studies indicate a significant increase among other military injuries mild traumatic brain injuries (mTBI) that are not always diagnosed in a timely manner, but have a negative psychosocial impact, reducing the ability for successfully adaptation and re-socialization, especially in

combination with mental disorders, in particular post-traumatic stress disorder (PTSD) [3, 8, 14, 22, 25].

■ MATERIALS AND METHODS

In order to select methods of diagnosing multiple mTBI, remote effects of mTBI and comorbid states of mTBI + PTSD, we made a search in CrossRef, PubMed, Google Scholar, the Directory of Open Access Scholarly Resources (ROAD), the Bielefeld Academic Search Engine (BASE), Directory of Open Access Journals (DOAJ) databases for the period of 2008–2018 for keywords: post-traumatic stress disorder, mild traumatic brain injury, diagnosis, method, test, comorbidity, overlapping symptoms. According to the selected methods, 93 men were studied who participated in the ATO in the east of Ukraine within 3–40 months prior to the survey, of which 68 people had mTBI during their life, as well as post-stress mental disorders within the PTSD (F43.1 – 37 people) or adjustment disorders (F43.2 – 31 people) at the time of the survey. The verification of clinical manifestations of an injury was carried out anamnestically according to the criteria of ICD-10, taking into account the criteria of mTBI and post-contusion syndrome as well as the clinical scales for DSM-5. Clinical peculiarities of mTBI and PTSD were evaluated separately according to the criteria we determined [7, 8].

■ RESULTS AND DISCUSSION

Psychosomatic (organic and psychogenic) disorders among servicemen participating in contemporary local armed conflicts, as well as among American veterans of Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Star (OEF/OIF/OND) are difficult for their nosological verification, primarily due to overlapping symptoms of psychogenic and organic genesis disorders.

On the one hand, one of the most common injuries among these veterans is a mild traumatic brain injury (mTBI), which is even referred to as the "injury – calling card" of wars in Afghanistan and Iraq [3, 22]. It is known that about 90% of all confirmed (documented) military and civilian TBI are classified as mild [3], but data on their prevalence are significantly divergent. So, in the study of B.C. Taylor and coauthors, among 327,388 veterans (OEF/OIF) 6.7% of them were diagnosed with TBI [22]. At the same time, according to J. Wasserberg, from 9% to 23% of OEF/OIF veterans received at least one mTBI during service [25], and C.B. Fortier and co-authors have recently shown the prevalence of MTBI to 35% in a research sample of veterans who participated in OEF/OIF conflicts [7, 8].

On the other hand, the so-called "triad of polytrauma", which combines mTBI, chronic pain and PTSD, is a significant part of the most common health problems among veterans of OEF/OIF/OND [18]. The study of the factors influencing the course of mTBI among 50 OEF/OIF veterans showed that 80% of them reported the signs of mTBI, 96% of the pain, and 44% of the symptoms of PTSD [1]. In the above-mentioned study of veterans by B.C. Taylor and co-authors PTSD and pain were combined with TBI in 54% of the examined and only in 11% of cases - in people without traumatic brain damage [22].

Consequently, individual symptoms may be inaccurately associated with one or another sickly condition, which may adversely affect diagnosis, treatment planning and recovery expectations [19].

According to L.A. Brenner and co-authors [4], there are several factors that complicate the accuracy of the verification of the disease states for PTSD and TBI in veterans of combat operations. They include the following:

- the absence/false information about the TBI in patient and health care workers;
- delay in the initial assessment of the patient's clinical picture, which may be a further barrier in diagnosis;
- unpredictable impact of many potentially harmful events;
- overlapping symptoms of PTSD and TBI, as well as symptoms associated only with stress disorders;
- concomitant mental illnesses, comorbid with mTBI.

The current classification of TBI related disease states only approximately corresponds to real conditions and long-term prognosis of the disease. Moreover, the symptoms related to acute TBI are described in great detail and are especially evident during the first 24 hours after TBI, but their clinical significance in the postponed period of TBI (especially mTBI) and the prognosis is not sufficiently substantiated from the standpoint of evidence-based medicine. Thus, the following codes may be used in ICD-10 for TBI: F06.8: Other specified mental disorders due to damage and dysfunction of the brain and other physical illnesses; F07.2: Post contusion syndrome; F50-F59: Behavioral syndromes associated with physiological disorders and physical factors; G90-G99: Other disorders of the nervous system; S06.0: Brain concussion [13]. It is clear that this classification does not cover the complex problems that often arise as a result of TBI, especially if it is comorbid with mental and behavioral disorders.

Despite the fact that mental and behavioral disorders, especially post-traumatic stress disorders, often caused by combat operations, the detection of such disorders in people with head injuries can go unnoticed, even with the use of modern diagnostic criteria and neuropsychological tools. With a multidimensional approach (such as a biopsychosocial model) applied to each cluster of symptoms, their nosological affiliation can be verified, and psychological, occupational and social dysfunctions can be delimited and managed [14].

The diagnostic criteria for TBI, depending on severity (mild, moderate, severe), have been elaborated by the American Congress of Rehabilitation Medicine (ACRM) and set out in the relevant clinical guidelines [6, 11, 16, 17].

In addition, the first, second and third degrees of severity were additionally allocated within the mTBI (Table). This gradation is also recognized by the American Academy of Neurology (AAN). At the first degree of mTBI there may be a temporary confusion without any signs of memory changes, and with a second degree of mTBI after a short period of disorientation there is anterograde amnesia <5 min. With the III degree of mTBI, as with TBI of moderate and severe degree, there are both anterograde and retrograde amnesia [6]. The degrees of MTBI in combat conditions are differentiated according to the duration of loss of consciousness and post-traumatic amnesia. However, in those conditions of mTBI, recommended terms on the duration of loss of consciousness (1, 5 or 10 minutes) and post-traumatic amnesia (up to 5 minutes, 5–10 minutes, up to 10 minutes) have limited reliability. It should be noted that the above gradation of acute TBI probably reflects the degree of damage of the brain stem and medial temporal lobe [11].

Gradation of acute TBI

Criteria	Mild			Moderate	Severe
	1st degree	2nd degree	3rd degree		
Loss of consciousness	no	< 5 min	>5 min and <30 min	>30 min and <24 h	>24 h
Changes in mental condition	0–15 min	>15 min and <24 h	> 24 h.	>24 h, severity caused by other criteria	
Post-traumatic amnesia	0–15 min	>15 min and <24 h	>24 h.	>24 hour period and <7 days	>7 days
Glasgow Coma Scale	13–15			9–12	>9

The ACRM clinical guideline also lists a number of other physical, cognitive and behavioral symptoms as additional evidence of mTBI including nausea, dizziness, vomiting, headache, visual impairment, decreased concentration, fatigue, lethargy, memory loss, irritability, and emotional lability. However, these signs and symptoms are not specific enough and may be due to the effect of a psychological trauma, representing in these cases a clinical picture of stress-associated psychiatric disorders [6, 16, 17].

People who have received TBI, even of mild severity, subsequently suffer from a large number of symptoms that can be grouped into separate clusters [11], namely:

- cognitive dysfunction, usually associated with damage to the neocortex: impairment of memory, attention, speech, visual-spatial orientation, sensorimotor integration, recognition and executive function;
- emotional and behavioral symptoms that can be caused by damage to the cerebral cortex, limbic system and/or monoaminergic brain projection systems: mood disorders, affect, anxiety, agitation, insomnia, libido loss, and post-traumatic and psychotic symptoms;
- somatosensory symptoms, often caused by sensory injuries and/or the leading ways and/or specific analyzers of cerebral cortex areas: impairment of smell, vision, hearing, balance, taste and somatosensory perception;
- somatic symptoms: headache and other chronic pain of different localization;
- addictive cluster: dependence on psychoactive substances, in particular alcohol, etc.

Additionally diagnostic verification of disease states (mTBI and PTSD) of soldiers after the demobilization is complicated by the fact that the symptoms typical for PTSD are not specific, they can occur in patients suffering TBI. In turn, organic symptomatology, even in the absence of MTBI, begins to dominate on the background of functional-psychogenic manifestations in cases of chronic PTSD.

A prospective biopsychosocial study of persistent residual symptomatology after mTBI compared with healthy individuals indicates that the possibility of retrospective assessment of mTBI is very difficult [10]. The authors noted that the degree of damage to the structure of the brain, which contributes to the preservation of the residual symptoms after mTBI, remains uncertain. According to this study using neuroimaging techniques (computed tomography, magnetic resonance imaging, diffusion tensor imaging) and cognitive tests in one month (n=126) and one year (n=103)

after the injury, according to ICD-10, 59% of the patients with mTBI met the criteria for the disease in a month and 38% fulfilled the criteria for one year. At the same time, 31% of the control sample of healthy individuals also showed symptoms of mTBI, that illustrated the high level of mistakenly positive assessment of patients' condition.

The authors also noted that structural abnormalities on MRI and micro-structural changes of white substance were not significantly associated with reports about the presence of residual symptoms of mTBI. Thus, the number of complaints and even symptoms after mTBI is individualized, representing the cumulative effect of many variables such as genetics, mental health history, current life stress, health problems, chronic pain, depression, personality traits, and other psychosocial and environmental factors [10].

That is why studies [2, 12, 15, 20, 21, 23, 24, 26], which prove that the detection of TBI, in particular, mTBI, in demobilized servicemen is primarily dependent on self-reported (anamnestically) injuries, which often occurs in the context of a military injury. The data from these studies suggest that from 9 to 23% of OEF/OIF veterans had at least one mTBI during service. Also, special attention among other military TBI deserves notification of injuries caused by the effects of explosions, considering the hypothesis of additional axonal brain damage with this type of injury [15].

According to research, many OEF/OIF veterans reported having traumatic brain injuries before the military service, as well as returning home. In addition, soldiers who reported military TBI, had TBI in anamnesis more often [24]. Consequently, in view of the the high prevalence of several TBI among OEF/OIF veterans, the relevant TBI assessment also had to take into account head injuries throughout life. Moreover, repeated brain concussion, especially in a short period of time, can lead to more severe neurological and mental disorders and complicate reconvalescence [2, 9].

A recognized standard for the diagnosis of remote effect of MTBI is semi-structured interviews according to the criteria of ICD-10, but they are largely designed for the civilian population and may be less useful for the characterization of TBI among veterans. On the other hand, existing evaluation tools developed for the assessment of the military TBI usually do not take into account possible civilian injuries in the same patient, focusing on the absence or presence of military TBI, rather than on the specific determination of the severity of mTBI, which are much more common in this cohort. In addition, they often do not evaluate the duration of key symptoms: loss of consciousness, changes in mental condition and post-traumatic amnesia.

The above-mentioned diagnostic problems served as the basis for the development of the Boston Assessment of Traumatic Brain Injury-Lifetime (BAT-L), which was tested at the department of neuropsychology and polytrauma at the military hospital in Boston [5]. Unlike previous TBI diagnostic interviews, the BAT-L includes a detailed assessment of the impact of the explosion and the mTBI – related explosion, evaluates the person's life-time injury, bases on the duration of the key symptoms, which contributes to the assessment of the disorder in the context of the joint traumatic events.

A study of 131 OEF/OIF veterans on the BAT-L scale according to TBI criteria (change of mental condition, post-traumatic amnesia and loss

of consciousness) showed that up to 67% of veterans had undergone TBI throughout their lives. Almost 35% of veterans have experienced at least one military TBI; all injuries were mild degree of severity, 40% of which were caused by the explosion, 50% – due to some other (ie blunt) mechanism, and 10% – because of both types of trauma. 45% of veterans had TBI during the lifetime before military service. The internal reliability of BAT-L was strong ($\kappa_s > 0.80$). The authors concluded that BAT-L is an effective tool which helps to assess TBI lifelong and evaluates the diverse and complex nature of brain damage in the life cycle of OEF/OIF veterans [5].

Comparing the clinical features of mTBI and PTSD, it should be noted that there are common types of disorders: emotional, personal and cognitive [14]. Moreover, differential diagnostics of cognitive impairments can help in the verification of mTBI, PTSD and mTBI + PTSD.

One of the recent study of mTBI and PTSD is a work by H.L. Combs and co-authors about the mental health of 251 veterans of wars in Iraq and Afghanistan [5] to compare the cognitive and psychopathological manifestations in patients with PTSD and mTBI separately and in combination mTBI + PTSD compared to healthy veterans. According to the results of the study, cognitive deficits in the mTBI + PTSD group were higher compared to healthy veterans and mTBI and PTSD groups separately. The mTBI group showed a slight decrease in the speed of information processing and visual attention, while the PTSD group showed a slight decrease in verbal memory. At the same time, in the mTBI + PTSD group there was a moderate decrease in all the listed indicators. The results of this study indicate the need for complex diagnostics of patients with comorbid states of mTBI + PTSD.

During the period of March 2016 – January 2018 at the Ternopil regional municipal clinical neuropsychiatric hospital, we have examined 93 servicemen of ATO in eastern Ukraine for 3–40 months before the survey and were directed / came to a psychiatrist because of mental disorder related with stress. The verification of clinical manifestations was carried out by applying clinical anamnestic, clinical psychopathological and pathopsychological methods. An evaluation of anamnesis data obtained in oral and documented form was performed. Diagnostic criteria for mTBI and post-stress disorders were evaluated according to ICD-10. All patients were screened for BAT-L, CAPS-5 and a cognitive test battery.

It was found that according to the Boston Assessment of Traumatic Brain Injury-Lifetime (BAT-L), 68 people (63.2%) of all surveyed noted the presence of at least one mTBI throughout life, and civil mTBI have been confirmed by medical documentation only in 2 people (2.2%). 39 people (41.9%) testified the presence of at least one military mTBI, only 18 people (19.2%) of which had documented mTBI, and 16 (17.2%) patients did not seek medical assistance after receiving mTBI (in 100% was recognized the 1st degree of mTBI by criteria anamnestic). Among war injuries mentioned in a BAT-L scale (for each person to 0 - 3 the hardest episodes of explosives and other (non-explosive) injuries) in 15 individuals (38.5%) they were caused by the explosion, in 17 people (43.6%) they were caused by other reasons (injuries, falls, etc.), in 7 people (17.9%) the mechanism of injury was combined. It should be noted that compared with the analysis of trauma mechanisms of the US veterans [5], it is observed almost double number of war injuries combined with complicated mechanism of brain damage.

According to CAPS-5 scale, in 37 surveyed with mTBI in anamnesis (54.4%) fulfilled all the criteria for PTSD (F43.1), and the remaining 31 people (45%) had some symptoms of PTSD, but together they did not reach the level of PTSD. Consequently, 31 patients were diagnosed with adaptation disorders¹⁰ (F43.2). Such a nosological distribution, obtained in our sample, corresponds to the data of scientific medical literature on the ease of PTSD formation in patients with mTBI.

Assessing the mental status of the patients we have identified disorders of cognitive functioning: 59 people (86.8%) had difficulty in switching, maintaining and the amount of attention and 51 people (75.0%) had difficulty in planning, doing the scheduled tasks and solving multistage projects. Quantitative and qualitative analysis of cognitive deficit (parameters of attention and executive functions) in people with mTBI and PTSD features is planned for the next stage of research.

■ CONCLUSIONS

In the diagnostic algorithm of the verification of a disease state mTBI + PTSD is appropriate to use the Boston Assessment of Traumatic Brain Injury-Lifetime (BAT-L), Clinician-Administered PTSD Scale for DSM-5 (CAPS-5) and a series of cognitive tests primarily aimed at study of attention and executive function.

Authors declare no conflict of interest.

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