Traumatic Brain Injury and Adjustment Disorders

Jovan MILATOVIĆ

Summary

Introduction. Traumatic brain injury and reactive psychiatric disorders are universal health problems, both individually and in comorbidity. Traffic accidents are the most common cause of traumatic head injury, followed by falls, violence, and sports injuries. Due to the fact that they are associated with rapid, stressful events, they clearly trigger or generate reactive psychiatric disorders. What makes them special in this area is their organic substrate. Almost all patients with severe head injuries, more than half with moderate, and one tenth with mild head injuries suffer neuropsychiatric sequelae. Discussion and Conclusion. Among the published papers on this topic, prospective epidemiological analytical studies are dominant. Most articles deal with injured soldiers, injured children or adolescents. Recent papers emphasize the need for a timely, multidisciplinary care for the affected people and the primary community. It is very important to initiate early rehabilitation and psychotherapy. Due to non-specific and limited pharmacotherapeutic options, especially evident in organ damage and pediatric population, special attention is given to occupational, psychological rehabilitation, and cognitive-behavioral psychotherapy, as well as psycho-pharmacological drugs in case of clear clinical indications. As potentially the most important for further research, are the results on the genetic predisposition of individuals for clinical outcomes of associated conditions, structural and functional visualization of brain regions associated with specific psychological symptoms, and psycho-protective role of morphine and amnesia. Involvement of the wider community in a range of activities that contribute to poor outcomes is of utmost importance.

Key words: Brain Injuries, Traumatic; Cranioencebral Trauma; Adjustment Disorders; Stress, Psychological; Stress Disorders, Post-Traumatic; Memory Disorders; Risk Factors

Sažetak


Ključne reči: traumatske povrede mozga; kranioencebralne traume; poremećaji prilagođavanja; psihološki stres; posttraumatski stresni poremećaji; poremećaji memoriije; faktori rizika

Corresponding Author: Dr Jovan Milatović, Klinički centar Vojvodine, Klinika za psihijatriju, 21000 Novi Sad, Hajduk Veljkova 1-7, E-mail: jovan.milatovic@mf.uns.ac.rs
TBIs can roughly be divided into open (penetrating) and closed (blunt) injuries, whereas in regard to the severity of clinical manifestations into: mild, moderate, and severe injuries. Blunt traumas are more common than penetrating traumas [2].

Head injuries are frequent clinical conditions. It is estimated that about two million incidents are associated with head injuries annually. The most commonly affected are people aged 15 to 25 years, with triple predominance of males. Traffic accidents are responsible for more than half of all incidents that lead to blunt head injury. Falls, violence and sports injuries are responsible for most of the remaining cases. Almost all patients with severe injuries, more than half with moderate, and about one tenth with mild head injuries have neuropsychiatric sequelae resulting from head injury [2].

Memory disorders occurring after head injuries usually appear after retrograde amnesia, up to the moment of injury, sometimes including amnesia for the traumatic event itself. Injury severity may somewhat correlate with the duration and severity of amnesic syndrome, and the best predictive indicator of recovery is the memory recovery during the first week after regaining consciousness [3]. After a period of post traumatic amnesia, the recovery usually takes 6 to 12 months, and its symptoms are likely to remain permanent [2].

The most common cognitive problems after a head injury include slow processing of information, increased distractibility and consequent attention disorders, difficulty solving problems and a reduced ability to endure faith in oneself, problems with memory and learning new information, and diverse speech disorders [2]. Dementia can also be caused by head injury. Specifically, the so-called “punch-drunk” syndrome, or “dementia pugilistica”, which occurs in boxers receiving repeated blows to the head for years, and is characterized by emotional instability, dysarthria and impulsivity [4].

Behavioral sequelae of traumatic head injuries primarily include depressive syndromes, increased impulsivity and irritability, and personality changes. The symptoms can be intensified by the use of alcohol, which may lead to traumatic incidents [2]. A recently published study of patients with TBI in the Swedish population, particularly distinguishes alcoholism, drug addiction and depression among psychiatric disorders that occur before and after the injury. Particularly important are the findings that show that comorbidity of psychiatric disorders and TBIs are significantly associated with an increased suicide rate and mortality in general, affirming that the premorbid psychiatric diagnosis seems to have a greater impact than the one made after the injury [5]. As a direct result of abrupt and sudden severe stress events or chronic stress, the following reactive psychiatric disorders may arise: acute stress reaction, post-traumatic stress disorder (PTSD), and adjustment disorders: short and prolonged depressive reaction, anxious-depressive and behavioral disorders [6]. Since traumatic head injury is certainly an abrupt and sudden stressful event, it is a trigger, or the generator of reactive mental disorders which is clearly visible. What is certainly special in this domain is their organic substrate.

The aim of this paper is to review the current literature on TBIs and adjustment disorders. Articles published in the last five years were analyzed using the PubMed database.

Discussion

Among the papers dealing with the problems of adjustment after TBI, prospective epidemiological analytical studies are most predominant. In regard to the number of the examined population, most articles studied soldiers who participated in the war zones of Afghanistan and Iraq, as well as children and adolescents.

The above mentioned Swedish study accurately provides data on psychiatric comorbidity in patients with TBIs leading to a significant increase in the mortality rate - 7.6 times higher than in patients without psychiatric disorders, if the six month period or more after the injury is considered [5]. Even worse, the mortality rate among psychiatric patients is more than 10 times higher in those diagnosed with substance abuse. Regarding the suicide rate, comorbidity of depression or substance abuse with TBIs leads to a statistically significant increase [5]. There is a strong association reported between premature deaths and both psychiatric disorder and substance abuse, with 61% of premature deaths in TBI patients having a lifetime psychiatric or substance abuse diagnosis. Among those with moderate to severe TBI and psychiatric or substance abuse comorbidity, 1 in 12 died prematurely. Another two important implications of this study show that the suicide rates and death are greater six months or more after the injury in patients with focal head injuries, but the assumption of a higher suicide rate among people with lower incomes and psychosocial deprivation has not been supported [5].

These findings are connected with the results of other studies dealing with social, demographic and psychiatric aspects of head injuries. Thus, a study conducted in Taiwan showed that people with mental disorders had almost twice the risk of such injuries, with predominance of male gender, older age, living in urban areas, and lower incomes as risk factors. The intensity of psychiatric treatment and pharmaco-therapy is positively correlated with the risk of injury and mortality, which rises proportionally with the frequency of outpatient treatment, hospitaliza-
tion, and emergency psychiatric intervention [7]. The examination of the work-related psychiatric disorders in Korea showed that the main compensated occupational problems are as follows: 1) personality and behavior disorders caused by disease, injury or brain dysfunction, 2) other mental diseases due to cerebral injury/dysfunction and somatic diseases, 3) reaction to severe stress and adjustment disorders, and 4) depressive episodes [8]. The assumption that the incidence of stressful life events is a strong predictor of poor outcome after head trauma, is supported by the results of the study published in 2011, which reported that several potentially life-changing-stressful events experienced before the accident are present in at least 25% of the tested participants [9]. One group of studies examined the impact of psychological symptoms early after injury in the further course of the recovery and broader life-social consequences. Thus, a pilot study which included 142 patients with mild to moderate traumatic head injury found that the intensity of acute pain, post-traumatic adjustment, depression and acute trauma symptoms, as well as the use of alcohol, were significant predictors of the severity of pain, depression, post traumatic stress symptoms, as well as physical mobility 6 months after the injury [10]. Early multidisciplinary treatment, which involves pain therapists, physical medicine specialists, psychotherapists, occupational therapists, and clinical psychologists in the first and third months after injury, leads to a significant relief of pain symptoms 6 months later. This model of a therapeutic approach appears protective against the development of PTSD symptoms. Namely, in contrast to the 24% of patients undergoing conventional health care after the injury presenting with PTSD symptoms, none of the patients assigned to a multidisciplinary model had the characteristic symptoms following exposure to trauma 6 months after the injury [10]. Another research indicates that the poor outcome associated with memory, executive functions, attention and information processing speed, are connected with self-reported depression and anxiety after TBI, and adaptive coping strategies have greater influence on the level of depression in individuals with a lower information processing speed [11]. One-year follow-up of patients after traumatic axonal injury has shown that fatigued patients had subjective experience of significantly higher cognitive dysfunction and a lower quality of life than shown on the application scales [12]. The presence of alexithymia, in persons with TBIs, turned out to be a significant factor affecting the quality of relationships and satisfaction in relationships, especially from the point of view of the partners of injured patients, showing much lower estimates of the overall relationship quality, customization, consensus and cohesion [13].

In some studies, in addition to psychological tests, patients were subjected to radiological "neuroimaging" procedures, in order to achieve the visualization of the possible organic and functional changes that correlate with psychiatric symptoms. A five-year trial showed that scores of the peritraumatic dissociation levels are positively correlated with the activation of the right occipital lobe - lingual, fusiform and parahippocampal gyri, regions responsible for vivid autobiographical memory of highly emotional events. The results suggest that peritraumatic dissociation directly leads to the formation and intrusive memories. The peritraumatic dissociation represents a valuable predictor of PTSD development from the fifth week until the third month after the injury [14]. By comparing the findings of behavioral measurements with magnetic resonance imaging (MRI), there are three significant results: 1) impulsivity is associated with an elevated coefficient of diffusivity present bilaterally into the orbitofrontal gyrus, the insula and the caudate nucleus; 2) an abnormal adjustment risk correlates with an increased coefficient of diffusion shown in the right thalamus, the dorsal striatum and the left caudate nuclei; 3) damage of performing rational choices corresponds to displayed high diffusion coefficient in the bilateral dorsolateral prefrontal cortical areas of the frontal and top gyri, right ventrolateral prefrontal cortex, the striatum dorsal and ventral hippocampus and the left hippocampus. These findings support the theory that disruption of key monoaminergic neurotransmitter systems, such as dopamine, may play a key role in a widespread cognitive dysfunction seen after traumatic axonal injury [15]. Abnormalities of the proton magnetic resonance spectroscopy (H MRS) in the limbic system, with a reduced ratio of N-acetyl aspartyl-glutamate (NAAG) - creatinine in the left hippocampus, together with the neuronal loss and/or dysfunction, correlated significantly with psychosocial adjustment. The change appears independent from the age of the patient and cortical atrophy. Also, the reduction of this ratio in the left frontal part of the cingulate cortex is present in patients with TBI and clinical diagnosis of mood disorders, independently of the age and severity of injury. This technique (H-MRS), may give valuable information about traumatic injuries of the brain which are not shown best in structural MRI [16]. The studies that compared psychometric scales with the findings obtained by neuro-radiological diagnostic procedures suggest that in vivo detection of brain damage could have important implications for the organization of the patient's medical care, research choice, and help understanding complex neurocognitive pathways [15].

Apart from the psychiatric, other comorbidities stand out as very important in the context of TBI. A thirteen-year monitoring of United States patients discharged with TBI has concluded that the worst outcomes of injured are found in patients with epilepsy and convulsive disorders, due to potentially more often repeated and therefore severe injuries [17]. The finding that seizure control is of utmost importance in the prevention of TBI and comorbid
conditions gets important if we take into account the results of the study indicating that the neurological and psychiatric conditions (substance abuse, psychosis, bipolar affective disorder, schizophrenia and depression) represent significant predictors of new onset epilepsy in older adults of both genders [18].

Since the treatment of cognitive and behavioral disorders in patients with head injuries are similar to the approaches in other patients with these symptoms, a difference in the fact that such patients may be particularly susceptible to side effects of psychotropic medications [2], most of the papers dealing with the treatment of these conditions are focused on the psychotherapeutic and rehabilitation approaches. Changes in the structural and functional connections after cognitive rehabilitation suggest that the pace of adjustment in the activities on the tasks and the rest in regions related to the site of injury, most likely is the mechanism responsible for the recovery of function. Behavioral interventions that target these processes emphasize the need for metacognitive and emotional regulation, as well as a very welcome role of subjective experience and beliefs as central in the process of rehabilitation [19]. Post-acute rehabilitation interventions improve integration into society, with special emphasis on the role of occupational therapy [20]. The need for a convenient, cost-effective and accessible education and training after injury is very important, but plenty of large barriers are present (problems finding a job, coexisting diagnosis, and limited self-representation). Opportunities for inter-agency cross-training and education, particularly in terms of symptoms of psychological adjustment risk assessment, can reduce the resulting disconnection, improve guardians’ security and ease the crisis. Developing multi-professional teams to maximize the availability of services, either face to face or virtual, is essentially important. These perspectives highlight opportunities to improve access to services and strengthen the relationship between the guardian and agencies [21]. A new semiological approach to meet the best possible integration of people with severe TBI is needed, not only limited to medical care, including social-psychological care that is tailored to the needs of each person and family that lives in its environment, which is currently minimal even in developed countries [22].

As already mentioned, the most numerous among the analyzed papers are those dealing with soldiers who participated in war zones in this century and pediatric patients.

**Children and adolescents**

The most common causes of head injuries in children and adolescents, causing developmental disorders, including seizures, are traffic accidents. However, there are head injuries caused by home accidents: falls off the table, open windows and stairs, as well as traumas due to child abuse [23].

Epidemiological studies of pediatric population in the United States have shown TBI as the leading cause of morbidity, mortality and deficits in cognitive, behavioral and social functioning, as well as in quality of life related to health [24]. A Taiwanese study, which included over eight thousand pediatric patients, showed a significantly increased risk of TBI in socioeconomically disadvantaged children, especially among children with mental disorders, epilepsy, or both. It emphasized that children from low income families should be monitored with special care to reduce the risk of head injury and the subsequent morbidity [25].

Some studies examined the impact of age at the time of injury on the outcome of head injury. From the aspect of intellectual development, younger children are more resistant to the effects of TBI compared to the older, because of greater neuroplasticity. The view that young children have a greater capacity of cerebral reorganization may find support in early, focal vascular lesions, but not in severe diffuse white matter traumas. Permanent intellectual impairment probably arises from injury involving acceleration-deceleration of a high level, due to the resulting diffuse or multifocal severe injury of the brain tissue [26]. A research including children divided into four age categories (newborn, preschool, middle childhood, late childhood) shows the worst outcome of TBI in patients injured during the middle childhood or early school-period [27].

A cohort prospective comparative study, which compared children with TBIs and orthopedic injuries, shows that children with TBI presented with greater acquired anxiety problems compared with children with orthopedic injuries. With the passage of time, children who suffered brain injuries at an earlier age had higher levels of anxiety, attention and hyperkinetic disorders than children who were older at the time of injury [28]. Pediatric patients with mild TBI presented with more post concussion symptoms than those with orthopedic injury [29]. A 6-month follow-up of children aged 3 to 6 years suggested that children with head injury showed more sleep problems than children with orthopedic injury. Sleep problems, on the other hand, considerably increased the risk of poor psychosocial performance over time, but did not show worse neuropsychological test results [30]. An interesting study observed three groups of patients, aged 24 to 47 months, with acquired brain lesions (trauma injuries, vascular tumors and/or infectious damage). About half of the total sample showed psychological and behavioral problems, which varied depending on the etiology. Children with traumatic injuries achieved average scores on most behavioral scales for children aged 2 to 3 years, as opposed to the more distinct internalizing problems of children who have survived a brain tumor and higher scores on externalizing scales in children with vascular or infectious damage. The relevance and impact of brain lesions must necessarily be taken into account in the organization and development of psychological treatment, rehabilitation and social re-entry [31].

In addition to expected results, significantly lower values of intelligence quotient were found in chil-
dren with mild, moderate and severe TBIs sustained under the age of 3 years, compared to the control group, approximately after 40 months of injury; it is important to point out that the child’s environment affects the cognitive-behavioral functioning after the injury [32]. Good maternal care and psychological support contribute to normal deoxyribonucleic acid methylation and brain development. In this sense clinically useful psychological instruments are dialogue, symbolic play, drawing and storytelling [33].

Pediatric patients with TBI are at risk of deterioration in the social sphere. The six-month follow-up of social functioning after brain trauma and contributing injuries, cognitive and environmental impact testing has shown serious violations and consequently scarce communication skills leading to greater social problems - adjustment and participation in social life disorders, with significant influence on family functioning. Processing speed, younger age and male gender contribute to social outcomes [34]. This study builds upon the results of similar ones that examined long-term psychosocial outcomes and quality of life. Parents of adolescents aged 15 to 18 years, who have suffered TBIs under the age of five years, reported that their children’s quality of life was lower in comparison to their peers in the control group who did not experience a TBI [35]. An Icelandic cohort study of children and adolescents, who were sent questionnaires to scale clinical outcomes and issues related to socioeconomic status, sixteen years after the injury, showed that impact strength, the number and severity of injuries are predictors of poor results. Socioeconomic status of parents and demographic factors had limited effects [36]. One study registered more prominent vulnerability of children with mild TBIs in functional families, with better material and existential status, which is especially noticeable in the subsequent somatic symptoms [29].

**Armed forces**

Most of the published papers report on the development of adjustment disorders after TBI among American, British and Canadian soldiers who participated in the wars in Iraq and Afghanistan, as a major psychiatric comorbidity, namely PTSD. Although PTSD is usually a consequent psychiatric condition after head injury in military personnel of both genders, it was noted that females have fewer prospects for its development, but on the other hand, are twice as likely to develop depression, and increased risk for developing other anxiety disorders and PTSD with depression [37]. While less severe brain traumas reported by soldiers typically have neuropsychological consequences of limited duration, post traumatic stress and depression are associated with a more permanent cognitive loss [38].

Returnees from the battlefields with TBI associated with psychiatric comorbidity (PTSD, depression, alcohol abuse) represent major challenges: persisten-
er prevalence of PTSD (6.3%) and mood disorders (15.6%) compared with patients who received only fentanyl (PTSD prevalence of 41.2%, the prevalence of mood disorders, 47.1%). The GCS scores and therapy using morphine or fentanyl were not significantly associated with adjustment disorders, anxiety and substance abuse disorders [49].

Finally, worthy of note is that the research suggests that both the genotype of the serotonin transporter-linked polymorphic region (5-HTTLPR) status and TBI, independently, in almost identical but opposite ways affect the resilience and the perceived limitations of social participation. Among those who have suffered brain injury resistance, perceived constraints are higher among carriers of SO SO genotype, with respect to the holders of LO genotype. While the existence of TBI seems to increase the sensitivity, the veterans with occupational injuries, carriers of LO allele genotype fared the worst, with a lower resilience and a much lower community reintegration, compared to the carriers of LO allele genotype without TBI or veterans with SO SO genotype, regardless of the cerebral trauma status [50].

**Conclusion**

Traumatic brain injury and reactive psychiatric conditions are highly frequent and widespread health problems, both individually and in comorbidity. Bearing in mind the polymorphism of psychological, somatic and neurological symptoms connected with their associated occurrence, the main conclusion of the current scientific paper reviews imposes the need for timely, multidisciplinary approach, directed primarily to the affected individuals, as well as to the primary community. In the earliest stage, besides stabilizing somatic and neurological conditions, it is very important to start with the early rehabilitation and psychotherapy involving, if necessary, different specialists, psychologists, social workers and therapists.

With regard to the non-specific and somewhat limited psychopharmacological possibilities, especially in patients with a pronounced organic damage and pediatric population, the current state of the art therapy gives priority to psychotherapy (occupational, psychological and rehabilitation, cognitive-behavioral), with the adjuvant use of psychopharmaceuticals in the case of clear clinical indications. Potentially most important for further analysis are the results on the genetic predispositions with regard to the clinical outcomes associated conditions (genotype of the serotonin transporter-linked polymorphic region), the structural and functional visualization of brain regions, which are specifically associated with certain psychological symptoms, as well as protecting role of morphine and amnesia in the development of post-traumatic stress disorder. Prevention is still the best way to reduce morbidity, comorbidity and mortality associated with traumatic brain injuries. It is of particular significance to engage wider community to cut risky behavior and fight against activities that are associated with poor outcome. In this regard, I would personally comment on the papers dealing with brain trauma and associated reactive psychiatric conditions in recent wars. It appears that a selective choice of patients (no study was performed on the problems of the local population and civilians exposed to military aggression) leads to a pseudo-humanistic approach. If the papers fail to condemn aggressive military campaigns, their devastating effects on the health of people and the community, we are far away from ethics and good medical and research practice.

**References**


Rad je primljen 22. VIII 2015.
Recenziran 25. XII 2015.
Prihvaćen za štampu 27. III 2017.