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The Features of the Course of Traumatic Brain Disease in Persons with Combat Traumatic Brain Injury

Chernenko Inna

Department of Neurology, Psychiatry, Narcology and Medical Psychology, Kharkiv National University by V. Karasin, Kharkov, Ukraine

Email address:
cher.innushta@gmail.com

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Abstract: This article is devoted to the problem of survival and prognosis of treatment outcomes of patients with traumatic brain injury who have sustained craniocerebral trauma according to changes in neurospecific protein (S100β) levels during the acute period of trauma. The material includes data from the examination of 250 combatants and invalids who sustained craniocerebral trauma in the ATO-JFO zone at the neurological department of the Regional Hospital for War Veterans. An analysis of the course and results of treatment of patients who had sustained severe craniocerebral trauma was carried out. Patients underwent routine biochemical examinations, neuroimaging studies and neurospecific protein (S100β) levels examination in the acute period of trauma. On the basis of the data obtained, it was found that the level of neurospecific protein S100β in the blood serum takes a great role in predicting the course and outcome of the disease.

Keywords: Brain Injury, Acubarotrauma, Neurospecific Protein S100β

1. Introduction

The material includes data from the examination of 250 combatants and invalids who sustained craniocerebral trauma in the ATO-JFO zone at the neurological department of the Regional Hospital for War Veterans. An analysis of the course and results of treatment of patients who had sustained severe craniocerebral trauma was carried out. Patients underwent routine biochemical examinations, neuroimaging studies and neurospecific protein (S100β) levels examination in the acute period of trauma. On the basis of the data obtained, it was found that the level of neurospecific protein S100β in the blood serum takes a great role in predicting the course and outcome of the disease.

Topicality. One of the most severe and common forms of damage to the central nervous system can be safely attributed to traumatic brain injury [1, 7]. Long-term consequences are not only a medical and social problem, but also an economically significant one. Post-traumatic brain injury is one of the most important issues of modern medicine and neurology in particular. This is due to the steady trend of increasing TBI and, consequently, its consequences: in peacetime it reaches 30-50% of all types of injuries and increases in frequency by 2-4.6% annually [2, 6, 9].

The annual cost of diagnosis, treatment and rehabilitation of victims of traumatic brain injury is growing on the one hand, this is due to improved types of neuroimaging, introduction into clinical practice of the latest methods of neuromonitoring, improving the equipment of hospitals with specialized equipment, on the other hand, with a steady increase in the total number of patients with traumatic brain injury and the number of patients with severe traumatic brain injury, diffuse axonal lesions (DAL) and polytrauma, which significantly worsens the course and outcome of brain injury [3, 8]. Mortality in patients with severe traumatic brain injury, the presence of intracerebral hematomas and foci of concussion, accompanied by dislocation syndrome, reaches 41-85%, and in extremely severe trauma reaches 90-100%.

The problem is exacerbated by the fact that neurotrauma is more common in young and middle-aged people (25-40 years), ie in the most mobile, active in the labor and social sense of the population, which is now, when the number of disabled people increases from year to year, declining birth rate, becomes especially important social and economic importance [1, 7, 9]. Extremely high prevalence and steady increase in the number of traumatic brain injuries of varying severity, a high percentage of complications leads to disability of young and middle-aged people, which

determines the relevance of the study of this medical and social problem [8, 10].

In recent decades, the number of local military conflicts has increased in different countries, which has led to an increase in traumatic brain injuries (shrapnel and gunshot wounds, mine injuries, battery injuries), which predominate in the structure of combat brain injuries. The problems facing Ukrainian society over the past few years, the extremely difficult political and economic situation, the long-lasting armed confrontation in the east of the country, the increased terrorist threat in the country outside the area of anti-terrorist operation, necessitate the provision of professional medical care to citizens, especially those involved in the anti-terrorist operation. According to rough estimates for the first half of 2021 almost 150,000 servicemen take part in the anti-terrorist operation [5, 6].

It is clear that the neurotrauma itself contributes to the violation of the adaptive functions of the body both in acute and in subsequent periods of its development and course. Transient autonomic and angiodystonic disorders of the acute period of trauma over time become permanent, structurally defined syndromes of vascular disease; as the duration of traumatic brain injury and with increasing age of patients, in the process of natural aging of the body, the likelihood of vascular disease increases even more [4, 7, 8].

Therefore, the dynamics of traumatic brain disease can be presented either as a process of complete compensation, culminating in the restoration of regulatory systems, or as a process of incomplete compensation, which is gradually depleted and leads to persistent violations of regulatory mechanisms not only in the nervous system but in the body. For example, air concussion accounted for 12.8% of all closed traumatic brain injuries [2, 4]. The number of people injured by the blast wave increased with each passing year of the war as the density of fire per unit area increased. The number of victims of the blast wave increased significantly during heavy defensive battles, as well as in the battles for control of long-term enemy fortifications, saturated with artillery.

Due to the constant improvement of the means of armed struggle, each new war or major armed conflict is not similar to the previous ones, although they have a number of similarities. The events in the area of anti-terrorist operation in the east of Ukraine are no exception in this respect [2, 10]. A distinctive feature of large-scale combat operations was the widespread use of acts of sabotage with the widespread use of both anti-personnel and anti-transport minesweepers. The use of modern explosives with different from the previously used TNT and its analogues high explosive properties, led to the fact that the concept of closed TBI has expanded to the concept of combat closed trauma with extensive multiple organ damage [1, 3].

Neurotrauma is stress (generalized adaptation reaction) for all people, and for combatants - it is a double stress, which activates the mechanisms that lead to changes in metabolism in body tissues, resulting in increased oxygen demand. The state of hypoxia of the brain is accompanied by metabolic disorders in combination with disorders of ionic and micronutrient metabolism. Markers of nerve tissue damage, neuronspecific proteins in particular S100β play an important role in the course and formation of the consequences of traumatic brain disease. This protein is produced and secreted mainly by glial cells and Schwann cells of the central nervous system. Constant concentration of this protein ensures the normal functioning of all brain systems. The increase in the level of S100β in the blood in traumatic brain injury is a consequence of structural and functional damage to glial cells of the brain and increased penetration of the blood-brain barrier. Indicator of protein level affects the course and formation of certain consequences. However, it is not always possible to see a direct correlation between the severity of brain damage, neuroimaging data, and S100β protein levels.

2. Objective

To elucidate the relationship between changes in the level of neurospecific protein (S100β) in the acute period of injury, data from neuroimaging methods (CT and / or MRI) of the study, the course and results of treatment and consequences of traumatic brain injury in combat zone Environmental protection in the East of Ukraine on the basis of the analysis of retrospective research (injury follow-up was 1 year, 3 years, 5 years).

3. Materials and Methods of Research

250 participants of hostilities and invalids, after the received craniocerebral trauma in the zone of carrying out anti-terrorist operation, on the basis of neurological department of Regional hospital of war veterans were observed. Patients were divided into groups depending on the severity of the injury (mild, moderate and severe), treatment in the acute period, the course and outcome of the disease. Observations have been conducted since 2015. by 2021, the follow-up was 1 year, 3 years, 5 years.

4. Research Results and Discussion

4.1. Research Results

Based on the study, we conducted a retrospective analysis of the course and results of treatment of patients included in the third group of observations who received severe traumatic brain injury. The statistical sample included 36 male patients with a mean age of 34.2 years. Patients were further divided into groups depending on the mechanism of injury.

Groups of patients by the mechanism of injury:

1) 1 group: 11 people who received a mine injury with damage to the skull bones, meninges, the presence of intracerebral hematomas.
2) 2 group: 14 people who received severe air concussion, acubarotrauma with damage and / or rupture of the

eardrum, damage to facial bones.

3) 3 group: 11 people who received severe combined trauma (acubarotrauma, catatrauma) with damage to other organs and systems.

Follow-up: All injuries were urgently hospitalized in the surgical or neurosurgical department from 5 hours to 36 hours after injury. In the admission department, patients were 100% examined by a surgeon and / or neurosurgeon, neurologist, therapist, the general condition was assessed on the Glasgow Coma Scale (GCG). All patients underwent laboratory tests (clinical blood test, blood chemistry, coagulogram, blood sugar test) and instrumental (ECG, ultrasound of internal organs, ultrasound of the heart if necessary, radiography of OGK and / or CT). To address the issue of urgent surgical treatment (presence of bone fragments, intracerebral hematomas, damage to the meninges) computed tomography was performed in 26 patients out of 36 (72.2%) in the first hours after hospitalization.

On the first day after trauma, 17 out of 36 patients (47.23%) underwent surgery, including: surgical treatment of the wound with removal of bone and metal fragments 8 out of 17, which amounted to 47.05%, resection craniotomy with removal of intraosseous and epidural hematomas 6 out of 17 (35.29%), thoracentesis after combined trauma (open traumatic brain injury, closed trauma to the chest and abdomen) - 3 out of 17 (17.65%), the other 19 out of 36 patients (52.77 %) performed primary surgical treatment of wounds of the face, head, extremities without massive surgery.

In addition to CT scans, patients underwent a number of instrumental (ECG, EEG and ultrasound of internal organs) and laboratory tests (general clinical tests, biochemical parameters of blood).

The most severe patients 21 of 36 (58.3%), whose condition on GC was from 7-10 points in addition to the analysis of the content of neuronspecific protein S100β in the serum. The analysis was taken on the first day and on the fifth day after the neurotrauma. The level of protein in the first day ranged from 10.64 μg/l to 12.88 μg/l, depending on the patient's condition and severity of injury (GCG 7-10 points). On the fifth day, the patient's condition improved, with a GCG of 12-13 points and S100β levels decreased from 5.62 μg/l to 2.1 μg/l, which indicated a favorable prognosis.

But there were cases (4 out of 21, which was 19.04%), when high levels of S100β did not correspond to the actual condition of patients and the data obtained by neuroimaging. For example, on CT scans of the brain of a 32-year-old soldier, after a mine injury, we saw a small intracerebral hematoma without shifting the middle structures of the brain, without fractures and bone fragments, Glasgow scale 12-13, but S100β on the first day was 11.72 μg/l. In the neurological state, the minimal neurological deficit in the form of left-sided sensory, pyramidal insufficiency attracted attention. The patient was immediately prescribed treatment: primary surgical treatment of wounds of the face, head, left upper extremity (shrapnel wound), introduced anti-tetanus serum, analgesics, detoxification, vascular and antibiotic therapy, diuretics and others, physiotherapy and gymnastics. On day 5 of treatment, the S100β level decreased to 4.82 μg/l. The patient's condition gradually improved, after a three-week course of treatment, he was discharged from the hospital, demobilized for health reasons (VLK inspection report). For the last 5 years he has been taking regular outpatient (in-place) and inpatient courses in the neurological department of the OGVV CHO.

4.2. Discussion

It is very difficult to predict the course of traumatic illness in the acute period of severe trauma for a number of reasons. The most difficult to predict the long-term consequences of the injury, the degree, level of social and labor readaptation of victims. Here are just some of the prognostically significant points:

1) Severity of injury.
2) The age of the victim at the time of injury.
3) Topics of lesions, the nature of clinical manifestations and syndromes.
4) It is important to provide qualified and timely medical care to victims in the acute period of injury.
5) Social factors: education, professional skills, working conditions, living conditions and more.

From the neurological point of view, there are three basic periods in the course of traumatic brain injury: acute - from 2 to 10 weeks (interaction of traumatic substrate, damage reactions and defense reactions); intermediate - from 2 to 6 months (resorption and organization of damage, further deployment of compensatory-adaptive processes); remote - completion or coexistence of degenerative-destructive and regenerative-reparative processes.

5. Conclusions

Based on the data we conducted on the basis of the Regional Hospital for War Veterans retrospective analysis of medical documents of the military who received severe trauma in the area of anti-terrorist operation, we can say that the level of neuronspecific protein S100β in serum plays an important role in predicting the course and outcome of the disease.

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