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CLINICONEUROLOGICAL AND NEUROPSYCHOLOGICAL ASPECTS OF ACUTE PERIOD OF MILD CRANIAL BRAIN TRAUMA CAUSED BY SHOCK WAVE

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Abstract

Purpose: to study the clinical, neurological, and psychological status of patients at acute period of mild cranial brain trauma caused by shock wave.

Material: patients participated in fighting actions in the East of Ukraine, which were treated in neurological department of Military medical clinical centre of Northern region in 2015.

Results: authors have revealed some symptoms of sensory disorders in the form of nonspecific sensomotor hemisyndrome and general analgesia.

Conclusions: Mild closed cranial brain trauma, caused by shock wave, in its acute period has more severe course than in civilian traumas. The identified symptoms are the result of complex influence of shock wave on the central nervous system and nonspecific structures of brain that subsequently can lead to the vegetative nervous system's disorders and impairment of higher cortical (mental) functions, and also to adjustment disorders and social maladjustment.

Keywords: craniocerebral injury, shock wave, combatant.

1. Introduction

In today's military conflicts the frequency of cranial traumas reaches 34.4 % from total quantity of wounded, while damage to the skull – 76–80 % from the quantity of neurological profile patients; it witnesses that in today's military conflicts traumatic brain injury (TBI) significantly influences on fighting capability of military officers [1, 2].

One of forms of closed cranial brain trauma (CCBT) in period of fighting actions is trauma caused by shock wave from shell or mine, exploded nearby.

Such traumas result in significant CSF offsets, generalized damages of vegetative and non-specific structures, located by the walls and at the bottom of IIIrd and IVth ventricles of brain, shifting of medibasal divisions of brain to skull base bones' protrusion and, that is very important, disordering of speech-hearing system, which is, to large extent, connected with mechanisms of temporal lobe [3–6].

Some authors [3] stress that powerful flow of sound impulses can be regarded as super-strong adequate irritation of hearing and functionally connected with it speech sectors of cerebral cortex. As a result, in these zones outrageous inhibition with temporary off functions take place. In some cases functional-dynamic pathogenesis of deafness is combined with anatomic damage of cerebral cortex hearing zone [7–11].

2. Material and methods

For the period from March 2014 to October 2015 we examined 58 military officers with CCBT, caused by shock wave. All these patients participated in fighting actions in the East of

Ukraine and were hospitalized in Military medical clinical center of Northern region (Kharkov). As on the moment of examination remoteness of traumas was from 2 to 5 days. Distance from shell or mine explosion was from 5 to 10–12 meters. With CCBT, 14 (24±6 %) military officers lost consciousness for period from 5 to 20 minutes. The age of the tested was 22–36 years.

All patients underwent detail clinical-neurological examination: indicators of vegetative nervous system (vegetative tonus (VT), autonomic reactivity (AR), vegetative provisioning (VP), electric-physiological and neurological-psychological indicators were analyzed that permitted to assess participation of different cortex and sub-cortical systems of brain in formation of pathological syndromes, to determine some prognostic criteria for possible complications on further stages of disease.

3. Results of the research

In **Table 1** there are presented the main subjective complaints of patients in acute period of CCBT, caused by shock wave.

Table 1

Complaints of patients in acute period of CCBT, caused by shock wave

Complaints	Number of patients	p
Headache	58 (100–2)	
– chronic;	32 (55±7)	<0.001
– periodical	27 (46±7)	
Dizziness	49 (84±5)	
– chronic;	21 (36±6)	<0.001
– periodical	37 (64±6)	
Nausea	44 (76±6)	<0.001
Pain in eyes	39 (67±6)	<0.01
Noise in head and ears	30 (52±7)	
Asthenia manifestations	52 (90±4)	<0.001
Memory disorders	44 (76±6)	<0.001
Fears	16 (28±6)	
Hyperhidrosis	29 (50±7)	<0.05–0.01
Sleepiness within daytime	43 (74±6)	<0.001
Poor sleep	51 (88±4)	<0.001
Finger tremor	18 (31±6)	

Table 2 presents the autonomic reactivity (AR) and vegetative provisioning (VP) indicators of patients in acute period of CCBT

Table 2

Autonomic reactivity (AR) and vegetative provisioning (VP) indicators of patients in acute period of CCBT

Vegetative index	Number of patients	p
	AR	
normal	4 (7±3)	>0.05
insufficient	38 (66±6)	<0.01
increased	7 (12±4)	>0.05
distorted	9 (16±5)	>0.05
	VP	
normal	2 (3±2)	>0.05
excessive	16 (28±6)	>0.05
insufficient	40 (69±6)	<0.01

4. Discussions

As we can see in **Table 1** the most frequent complaint of patients was headache ($p<0.001$), which took place in all examinations. Further, in rank sequence there go asthenia manifestations ($p<0.001$), poor sleep ($p<0.001$), defective memory, nausea, sleepiness within daytime ($p<0.001–0.01$). 24 (41±6) % of patients felt headache in frontal temporal zone; 13 (22±5) % headache – in half of head; 11 (19±5) %, – in occipital area; 10 (17±5) % of the tested felt "ache in all head".

It should be noted that the latter 10 patients endured shock wave in face and in contrast to other patients they were characterized by acute slowing of motor functions, their faces were unable for facial expression; they had anosmia, paralysis of eyeballs, mydriasis, weakening of hearing on both sides, expressed edema of face and front 2/3 part of tongue. Besides, they had total pain anesthesia, sharp reduction of tendons' reflexes, expressed ataxia with static tests, rich hyperhidrosis, cyanosis and swelling of distal parts of limbs, expressed general weakness, acute weakening of memory and disorder of sleep-wake cycle. Such clinical picture witnesses about outrageous inhibition of all important centers of central nervous system at moment of shock wave impact directly on face [12, 17].

In 51 (88±4) of the examined patients there was poor sleep. Superficial sleep and too early awakening were replaced by languor, infirmity, expressed sleepiness within daytime. Independent on disordering of sleep structure the patients complained on absence of feeling of relaxation; often they complained on headache in night and morning time. All these witness about dysfunction in non-specific systems of brain, caused by breaking of correlations between activating and synchronizing brain systems that specifically break sleep-wake cycle.

Alongside with it strongly pronounced stem symptoms, which include disorders of general sensitivity, should be noted: pain hypoesthesia on face in Zelder's zones. The variant of hypoesthesia was specific sensor-motor hemi-syndrome, which reflects deficit of extralemniscal sensor systems. This syndrome was observed in patients, who received CCBT from shock wave, directed to one of head's sides (right or left). It is characterized by reduction of pain sensitivity on the side of trauma (as per hemi-type), on oral and tongue mucosa, weakening of muscular strength in limbs on the same side. It is the so called hemi-syndrome of extralemniscal type. The theory of extralemniscal hemi-syndrome of sensitivity's disordering envisages certain significance of inhibition processes in cortex, which appear with barotraumas, but here not primary, but secondary-cortical disorders are meant; disorders generalized or regional, connected with breaking of limbic neocortical correlations, with change of cortex toning non-specific influences [26].

Medical examination showed disorders in vegetative nervous system was in 56 (96±2) % ($p<0.001$) of patients. Analysis of VT showed that it was very low: functioning of parasympathetic division of nervous system prevailed. As we can see in **Table 2** in patients with acute CCBT, in most cases (38 (66±6) %) AT was insufficient. Indicators of VP permit to speak about insufficient (40 (69±6) %) vegetative provisioning of life functioning. The mentioned vegetative changes witness about tension of sympathetic division of vegetative nervous system, which relates to organism's adaptive functions and de-adaptation under influence of shock wave.

Electric-physiological testing – electroencephalogram (EEG) showed regular modulated α-rhythm of 9–10 Hz frequency and 70 mcV amplitude with expressed frontal occipital gradient. In central front parts of the brain low amplitude θ and Δ activity was registered. When carrying out rhythmic photo stimulation adoption of light impulses in the range of low frequency (3 Hz) was found. After functional loads on EEG we determined increase of β-range bio-potentials' presentation and presence of diffuse sharp waves in structure of α-rhythm. Inter spherical asymmetry and local changes either did not manifested or they were expressed minimally.

The mentioned changes in EEG point at irritation of cortex resulted from increase of activation processes in diencephalic-stem non-specific structures.

Neurological-psychological examination permitted to find out disorders in energy provisioning of psychic functioning (asthenia manifestations) in the form of slowdown of work of different expressiveness, uneven efficiency, attention instability, exhaustion, disordering of current control when fulfilling motor, cognitive and speech programs. Reduction of selectivity of ability to think, violations of intellectual activity and behavior in the form rigidness combined with increased

impulsivity and aggressiveness are indicators of frontal basal areas' of cerebral hemispheres involvement in pathological process. Alongside with it disorders of simultaneous factor of mental activity's organization, found in some patients, can witness about presence of mild dysfunction of parietal-temporal cortex division [14–19].

5. Conclusions

It should be noted that combat CBT of light degree is characterized heavier flow in acute period, comparing with cerebral traumas, received in peace time. As per our data impact of shock wave on face is a heavy clinical form CCBT. Besides, not only influence of shock wave on brain should be considered, but also impacts of its components: strong sounds, too bright flashes. All these in complex cause damage of not only cores in sub-cortical centers, brain stem and midbrain but in all nervous system as well.

Cranial brain trauma, conditioned by shock wave, is a stress, which is processed by brain and causes tension of vegetative mechanisms, followed by vegetative disorders. Structural-functional deficit of supra-segmental patterns, which takes place in acute period of CCBT, can progress in the future of patients, when they have to tense adaptation mechanisms; further it can result in their failure and formation of steady neurological deficit. Degree of expressiveness and dynamic of clinical manifestations, structural and functional disorders (main pathogenic processes) directly depend on heaviness of trauma, character of damage and period of being in zone of fighting actions [20–28].

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