Pathomorphological Markers of the Explosive Wave Action on Human Brain

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Abstract— **Introduction**. The increased attention of researchers to an explosive trauma around the world is associated with a constant renewal of military weapons and a significant increase in terrorist activities using explosive devices. Explosive wave is a well known damaging factor of explosion. The most sensitive to the action of explosive wave in the human body are the head brain, lungs, intestines, urine bladder. The severity of damage to these organs depends on the distance from the explosion epicenter to the object, the power of the explosion, presence of barriers, parameters of the body position, and the presence of protective clothing. One of the places where a shock wave acts, in human tissues and organs, is the vascular endothelial barrier, which suffers the greatest damage in the head brain and lungs.

The objective of the study was to determine the pathomorphological changes of the head brain followed the action of explosive wave.

Materials and methods of research. To achieve the purpose of the study, there have been studied 6 male corpses delivered to the morgue of Municipal Institution "Dnipropetrovsk regional forensic bureau" during 2014-2016 years. The cause of death of those killed was a military explosive injury. After a visual external assessment of the head brain, for histological study there was conducted the 1 x 1 x 1 cm/piece sampling from different parts of the head brain, i.e. the frontal, parietal, temporal, occipital sites, and also from the cerebellum, pons, medulla oblongata, thalamus, walls of the lateral ventricles, the bottom of the 4th ventricle. Pieces of the head brain were immersed in 10% formalin solution for 24 hours. After fixing, the paraffin blocks were made from the material using the standard method. Then, using a microtome, there were made sections of 4-6 micron thickness from paraffin blocks which then were stained with hematoxylin and eosin. Microscopic analysis was performed using a light microscope with x4, x10, x40 lenses.

Results of the study. According to the results of our study, injuries of the head brain were divided into macroscopic and microscopic. Macroscopic injuries were marked according to the results of visual assessment of haemorrhages under the membranes and into the substance, their nature and localisation, areas of softening. In the microscopic study, our attention was drawn to both vascular changes and those of neurons and glial cells.

Microscopic qualitative analysis of histological sections of different parts of the head brain revealed a number of structural changes both at the cellular and tissue levels. Typical changes in most of the studied areas of the head brain included damages of the vascular system. The most characteristic microscopic sign was the separation of vascular walls from neuroglia with the formation of perivascular space. Along with this sign, wall fragmentation of these vessels, haemolysis of erythrocytes, formation of haemorrhages in the newly formed perivascular spaces were found. In addition to damages of the cerebrovascular system, destruction of the neurons, presence of oedema of the brain tissue were observed on the histological sections of the brain. On some sections, the head brain had a heterogeneous step-like or wave-like nature.

Conclusions. The pathomorphological microscopic changes in the brain, identified in the study on the died of explosive traumas, can be used for diagnostic purposes in conjunction with other characteristic signs of explosive trauma in forensic and pathological studies. The complex of microscopic signs in the head brain, i.e. separation of blood vessel walls from neuroglia with the perivascular space formation, fragmentation of walls of these blood vessels, erythrocyte haemolysis, formation of haemorrhages in the newly formed perivascular spaces are the direct indication of explosive wave action.

***Keywords*—**blast wave, neurotrauma, human, brain.

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