IMAGING - BASED MORPHOMETRIC ANALYSIS OF CEREBRAL VENTRICLES FOLLOWING TRAUMATIC BRAIN INJURY

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Abstract. *Traumatic brain injuries (TBI), including mild concussions and moderate cranial injuries, remain one of the leading causes of mortality and long-term disability worldwide. Structural and functional alterations of the brain caused by trauma are closely associated with changes in the cerebrospinal fluid system, particularly the cerebral ventricles. This study analyzes X-ray-anatomical, morphometric and neurological characteristics of cerebral ventricles in patients with various degrees of traumatic brain injury and evaluates their clinical significance.*

Introduction. *Traumatic brain injury represents a major medical and social challenge in modern healthcare. According to the World Health Organization, TBIs account for up to one third of all injuries and are associated with high mortality and disability rates. Even mild concussions can lead to persistent neurological symptoms, while moderate injuries often result in long-term cognitive and motor impairments. The cerebral ventricles play a crucial role in maintaining intracranial homeostasis through cerebrospinal fluid circulation. Any disturbance in ventricular size, symmetry or morphology may indicate pathological changes in the brain following trauma. Therefore, the assessment of ventricular morphometry using modern imaging techniques is of great diagnostic and prognostic value.*

Keywords: *traumatic brain injury, cerebral ventricles, morphometry, CT, MRI.*

Purpose of the study. The purpose of this study was to investigate morphometric, X-ray-anatomical and neurological features of cerebral ventricles in patients with different severities of traumatic brain injury and to improve diagnostic and therapeutic approaches based on the obtained findings.

Relevance of the study. Traumatic brain injuries significantly affect the quality of life and working capacity of patients. Morphometric studies have demonstrated that TBIs frequently cause ventricular dilatation and asymmetry. The severity of these changes correlates with the intensity of neurological deficits and recovery

outcomes. Understanding these relationships is essential for early diagnosis, prognosis and optimization of treatment strategies.

Materials and Methods. The study utilized imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI) and X-ray anatomical analysis to assess cerebral ventricular changes. Ventricular width, volume and symmetry were measured and analyzed. MRI was particularly valuable in detecting subtle morphological changes that were not visible on CT scans. Neurological examination included assessment of cognitive functions, motor activity, reflexes and static-locomotor status. The correlation between imaging findings and clinical manifestations was evaluated.

Results and Discussion. The analysis included patients with mild and moderate traumatic brain injury. Morphometric measurements demonstrated that patients with mild concussion showed minimal enlargement of the lateral ventricles, with an average increase in ventricular width of 3–5% compared to age-matched controls. These changes were often symmetrical and did not significantly disrupt cerebrospinal fluid circulation. In contrast, patients with moderate traumatic brain injury exhibited pronounced ventricular dilatation, with increases in ventricular volume ranging from 12% to 25%. Ventricular asymmetry was observed in more than half of these patients, indicating localized brain tissue damage and impaired CSF dynamics. Imaging findings frequently revealed associated midline shift and periventricular edema, particularly in the acute phase of injury. MRI data provided superior sensitivity in detecting subtle structural alterations, including thinning of periventricular white matter and early signs of post-traumatic hydrocephalus. CT imaging, while effective for acute assessment, was less sensitive to minor morphometric changes but remained essential for identifying hemorrhagic lesions. Neurological examination demonstrated a strong correlation between ventricular enlargement and clinical manifestations. Patients with mild injuries primarily reported headaches, dizziness, and short-term memory impairment, whereas moderate injury cases presented with motor dysfunction, coordination disorders, speech disturbances, and prolonged cognitive deficits. Statistical analysis revealed that greater ventricular dilatation was associated with slower functional recovery and increased risk of long-term disability.

These findings confirm that ventricular morphometric changes serve as reliable indicators of traumatic brain injury severity. Early identification of pathological ventricular alterations allows clinicians to adjust therapeutic strategies, including timely management of intracranial pressure and targeted neurorehabilitation programs. The integration of imaging-based morphometry with neurological assessment significantly enhances diagnostic accuracy and prognostic evaluation.

CONCLUSION

Comprehensive assessment of cerebral ventricles using morphometric, X-ray-anatomical and neurological methods is essential in patients with traumatic brain injuries. The findings confirm that ventricular changes serve as important markers of injury severity and prognosis. Implementation of individualized diagnostic and treatment strategies based on imaging data can significantly enhance patient recovery and reduce long-term complications.

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