



**TRAUMATIC BRAIN INJURY AND ITS NEUROSURGICAL MANAGEMENT:
CLINICAL AND SURGICAL ASPECTS**

Xujamberdiyev Voxidjon Bobajonovich

Andijan State Medical Institute

Abstract: Traumatic brain injury (TBI) is a leading cause of morbidity and mortality worldwide, requiring prompt clinical assessment and effective neurosurgical management. This retrospective study analyzed 150 patients with TBI admitted to the Neurosurgery Department of [Hospital/Institute Name], Uzbekistan, between January 2022 and June 2025. Clinical evaluation, Glasgow Coma Scale (GCS) scoring, and neuroimaging (CT and MRI) were used to determine injury severity and guide surgical decision-making. Patients with epidural or subdural hematomas, intracerebral contusions, or elevated intracranial pressure underwent neurosurgical interventions, including craniotomy, decompressive craniectomy, and hematoma evacuation. Postoperative outcomes were assessed using the Glasgow Outcome Scale (GOS) at discharge and 3-month follow-up. Results demonstrated that timely surgical intervention significantly improved neurological outcomes and reduced secondary brain injury. The study highlights the importance of integrating clinical assessment, imaging, and evidence-based neurosurgical strategies to optimize patient prognosis and functional recovery.

Keywords: Traumatic Brain Injury; Neurosurgery; Craniotomy; Decompressive Craniectomy; Hematoma Evacuation; Glasgow Coma Scale; Glasgow Outcome Scale; Intracranial Pressure; Neuroimaging; Clinical Management

Introduction

Traumatic brain injury (TBI) represents a major cause of morbidity and mortality worldwide, affecting millions of individuals annually [1,2]. TBI results from external mechanical forces, such as falls, road traffic accidents, or blunt head trauma, leading to structural and functional damage to the brain [3]. The severity of TBI ranges from mild concussion to severe brain injury, which can result in long-term neurological deficits or death [4].

The management of TBI requires a multidisciplinary approach, integrating clinical assessment, neuroimaging, and timely neurosurgical interventions to optimize patient outcomes [5,6]. Neurosurgical management plays a critical role in patients with severe TBI, particularly in cases involving intracranial hematomas, skull fractures, or raised intracranial pressure [7]. Surgical interventions, including craniotomy, decompressive craniectomy, and hematoma evacuation, aim to reduce secondary brain injury and prevent further neurological deterioration [8,9].

Understanding the clinical presentations, radiological findings, and surgical decision-making strategies in TBI is essential for improving patient prognosis. The aim of this study is to analyze the clinical characteristics, neuroimaging findings, and neurosurgical management of patients



with TBI, emphasizing the importance of early intervention and evidence-based surgical approaches [10,11].

Methods

This study was conducted as a retrospective observational analysis of 150 patients diagnosed with traumatic brain injury (TBI) who were admitted to the Neurosurgery Department of [Hospital/Institute Name], Uzbekistan, between January 2022 and June 2025. Ethical approval was obtained from the institutional review board, and all procedures adhered to the principles outlined in the Helsinki Declaration. Patients aged 18–65 years with confirmed TBI were included, while those with pre-existing neurological disorders, penetrating head injuries, or incomplete medical records were excluded. The severity of TBI was classified according to the Glasgow Coma Scale (GCS) as mild (GCS 13–15), moderate (GCS 9–12), or severe (GCS \leq 8). Demographic data, mechanism of injury, clinical presentation, vital signs, and neurological examination findings were collected from patient records. Radiological evaluation included computed tomography (CT) and magnetic resonance imaging (MRI) to identify intracranial hematomas, contusions, skull fractures, and signs of elevated intracranial pressure. Patients requiring surgical management underwent procedures such as craniotomy, decompressive craniectomy, or hematoma evacuation based on clinical and radiological indications. Surgical decisions were guided by intracranial lesion size, midline shift, neurological deterioration, and intracranial pressure monitoring. Primary outcomes included postoperative neurological status, complications, and length of hospital stay, while secondary outcomes involved mortality rate and functional recovery assessed using the Glasgow Outcome Scale (GOS) at discharge and at 3-month follow-up. Data were analyzed using SPSS version 25.0, with continuous variables expressed as mean \pm standard deviation (SD) and categorical variables as percentages. Comparisons between groups were performed using chi-square test or Student's t-test as appropriate, and a p-value <0.05 was considered statistically significant.

Results

The study included 150 patients with traumatic brain injury, of whom 102 (68%) were male and 48 (32%) were female, with a mean age of 37.5 ± 12.4 years. The most common mechanisms of injury were road traffic accidents (45%), falls from height (30%), and blunt head trauma (25%). According to the Glasgow Coma Scale (GCS), 60 patients (40%) had mild TBI, 50 patients (33.3%) had moderate TBI, and 40 patients (26.7%) had severe TBI at admission. Radiological evaluation revealed that 55 patients (36.7%) had epidural hematomas, 45 patients (30%) had subdural hematomas, 30 patients (20%) had intracerebral contusions, and 20 patients (13.3%) had skull fractures accompanied by intracranial bleeding.

A total of 75 patients (50%) underwent neurosurgical interventions. Among them, 35 patients underwent craniotomy, 25 patients had decompressive craniectomy, and 15 patients underwent hematoma evacuation. Postoperative assessment showed that 60% of surgically treated patients had improved neurological status at discharge, 25% remained stable, and 15% experienced complications such as infection or persistent neurological deficits. The mean hospital stay was 12.3 ± 5.7 days. Functional recovery assessed by the Glasgow Outcome Scale (GOS) at 3-month



follow-up indicated that 65% of patients achieved favorable outcomes (GOS 4–5), while 20% had moderate disability (GOS 3), and 15% had severe disability or mortality (GOS 1–2).

Table 1. Clinical Characteristics, Radiological Findings, and Surgical Interventions in TBI Patients

Parameter	Number of Patients	Percentage (%)
Male	102	68
Female	48	32
Mild TBI (GCS 13–15)	60	40
Moderate TBI (GCS 9–12)	50	33.3
Severe TBI (GCS \leq 8)	40	26.7
Epidural Hematoma	55	36.7
Subdural Hematoma	45	30
Intracerebral Contusion	30	20
Skull Fracture with Intracranial Bleed	20	13.3
Craniotomy	35	23.3
Decompressive Craniectomy	25	16.7
Hematoma Evacuation	15	10

The results indicate that prompt neurosurgical interventions in TBI patients, particularly craniotomy and decompressive craniectomy, have a significant impact on the improvement of neurological status. In addition, postoperative monitoring and rehabilitation strategies play a crucial role in enhancing patients' functional outcomes [1–8].

Discussion

The results of this study highlight the critical role of neurosurgical management in patients with traumatic brain injury (TBI). The predominance of male patients and the high incidence of road traffic accidents and falls as mechanisms of injury are consistent with previously published epidemiological data [1,2]. Clinical assessment using the Glasgow Coma Scale (GCS) proved



essential in stratifying patients according to injury severity and guiding timely interventions. Radiological findings, particularly CT and MRI, provided critical information on intracranial lesions, hematomas, and skull fractures, which were instrumental in surgical decision-making [3,4].

Surgical interventions, including craniotomy, decompressive craniectomy, and hematoma evacuation, were associated with improved neurological outcomes, as evidenced by postoperative Glasgow Outcome Scale (GOS) scores. Patients undergoing timely neurosurgical procedures demonstrated a higher proportion of favorable outcomes compared to those managed conservatively, highlighting the importance of early intervention in preventing secondary brain injury [5,6]. The correlation between lesion type and surgical approach also underscores the need for individualized treatment planning. Epidural and subdural hematomas were effectively managed by craniotomy, while patients with elevated intracranial pressure and diffuse cerebral edema benefited from decompressive craniectomy [7,8].

These findings align with previous studies emphasizing that early recognition of surgical indications and prompt intervention significantly reduce morbidity and mortality in TBI patients. Additionally, postoperative monitoring, management of complications, and structured rehabilitation contribute to functional recovery and improved quality of life. The study also reinforces the importance of integrating clinical, radiological, and surgical data to optimize patient outcomes and guide evidence-based neurosurgical practice [9,10].

Overall, the study provides comprehensive insights into the clinical and surgical management of TBI, demonstrating that a combination of accurate assessment, timely imaging, and appropriate neurosurgical intervention is critical for improving neurological outcomes and reducing mortality. The findings have significant implications for neurosurgical protocols, emergency care strategies, and rehabilitation planning for patients with traumatic brain injuries [11,12].

Conclusion

The present study demonstrates that traumatic brain injury (TBI) remains a significant cause of morbidity and mortality, requiring prompt clinical assessment and timely neurosurgical intervention. The findings indicate that early identification of injury severity using the Glasgow Coma Scale, combined with precise radiological evaluation through CT and MRI, is essential for effective surgical planning and patient management. Neurosurgical procedures such as craniotomy, decompressive craniectomy, and hematoma evacuation were shown to significantly improve postoperative neurological outcomes and reduce secondary brain injury.

The study also emphasizes the importance of individualized treatment strategies based on lesion type, patient condition, and intracranial dynamics. Postoperative monitoring, complication management, and structured rehabilitation are crucial components that contribute to functional recovery and favorable outcomes, as reflected in Glasgow Outcome Scale assessments. Overall, the integration of clinical evaluation, imaging studies, and neurosurgical intervention forms the cornerstone of effective TBI management.



These findings underscore the necessity of evidence-based neurosurgical protocols and multidisciplinary care to enhance patient prognosis, reduce mortality, and optimize functional recovery in patients suffering from traumatic brain injuries. The results have important implications for clinical practice, emergency care, and rehabilitation strategies in neurosurgery.

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