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ORIGINAL RESEARCH

To analyze demographic profiles, clinical features, imaging findings, and outcomes in patients with TBI at a tertiary care hospital

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ABSTRACT

Aim: To analyze demographic profiles, clinical features, imaging findings, and outcomes in patients with TBI at a tertiary care hospital. **Material and Methods:** The study included a total of 100 patients diagnosed with TBI who presented to the emergency department. Patients of all ages presenting to the emergency department with a confirmed diagnosis of TBI were included in this study. Glasgow Coma Scale (GCS) score was noted at time of admission of patient. Neuroimaging reports, including CT scans results, were analyzed for structural and functional insights. Short-term recovery, long-term functional status, and quality of life outcomes were assessed using standardized outcome measures. **Results**: The Glasgow Coma Scale (GCS) scores at admission showed that 30% of patients had severe TBI (GCS 3-8), 40% had moderate TBI (GCS 9-12), and 30% had mild TBI (GCS 13-15). Short-term recovery outcomes showed that 60% of TBI patients achieved full recovery within the study period, indicating a favorable prognosis for the majority. Partial recovery was observed in 25% of patients, while 10% showed no improvement, and 5% experienced deterioration in their condition. The duration of hospital stay varied, with 20% of patients being discharged within a week, 50% staying for 1-2 weeks, and 30% requiring hospitalization for more than two weeks. Long-term Functional Outcomes and Quality of Life**,** assessed using the Glasgow Outcome Scale (GOS), revealed that 40% of patients achieved a good recovery (GOS 5). Moderate disability (GOS 4) was observed in 30% of patients, while 15% experienced severe disability (GOS 3). A vegetative state (GOS 2) was noted in 5% of patients, and 10% of patients succumbed to their injuries (GOS 1). Quality of life assessments indicated that 50% of patients had a good quality of life post-TBI, 30% had a fair quality of life, and 20% had a poor quality of life.

Conclusion: The research highlights the need of understanding demographic, clinical, and imaging factors in order to effectively treat and evaluate the prognosis of traumatic brain injury (TBI).

Keywords: Traumatic brain injury, GOS

INTRODUCTION

Traumatic brain injury (TBI) represents a significant public health concern globally, affecting millions of individuals each year and leading to considerable morbidity and mortality. TBI encompasses a wide spectrum of injuries resulting from external mechanical forces that disrupt normal brain function. These injuries range from mild concussions to severe brain damage and can lead to a variety of clinical outcomes, including physical, cognitive, and behavioral impairments. Understanding the clinical features and imaging characteristics of TBI is crucial for timely diagnosis, effective management, and improved patient outcomes.The clinical presentation of TBI is highly variable, influenced by factors such as the mechanism of injury, the severity of the impact, and the individual's health status. Common mechanisms of injury include road traffic accidents, falls, assaults, and sports-related incidents. Road traffic accidents are particularly predominant in low- and middle-income countries, contributing significantly to the global burden of TBI.[1]One of the primary tools for initial assessment of TBI severity is the Glasgow Coma Scale (GCS), which evaluates a patient's level of consciousness based on eye, verbal, and motor responses. A GCS score of 13-15 indicates mild TBI, 9-12 moderate TBI, and 3-8 severe TBI.[2]Mild TBIs, or concussions, often present with transient symptoms such as headache, dizziness, confusion, and amnesia. However, these injuries can still lead to significant long-term cognitive and psychological issues, highlighting the need for careful

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evaluation even in seemingly minor cases.[3]Moderate to severe TBIs present with more pronounced neurological deficits. Patients may exhibit prolonged loss of consciousness, profound confusion, focal neurological signs, and seizures. Secondary complications such as intracranial hematomas, brain swelling, and increased intracranial pressure can exacerbate the injury, leading to further neurological deterioration.[4] The presence of comorbid conditions such as hypertension and diabetes can also impact the clinical course and prognosis of TBI patients, necessitating a comprehensive approach to their management.[5]Neuroimaging plays a critical role in the diagnosis, management, and prognostication of TBI. Computed tomography (CT) and magnetic resonance imaging (MRI) are the primary imaging modalities used in the evaluation of TBI.CT is the initial imaging modality of choice in acute TBI due to its wide availability, rapid acquisition time, and high sensitivity for detecting acute hemorrhages and fractures. CT scans can reveal a variety of traumatic lesions, including skull fractures, epidural and subdural hematomas, subarachnoid hemorrhage, intracerebral hemorrhage, and brain contusions.[6] Skull fractures are a common finding and can indicate the severity of the trauma. Epidural hematomas, typically caused by arterial bleeding, are often associated with a lucid interval followed by rapid neurological decline, requiring prompt surgical intervention. Subdural hematomas, resulting from venous bleeding, may present acutely or develop more insidiously, especially in older adults or individuals on anticoagulant therapy.[7]Brain contusions and intracerebral hemorrhages are common parenchymal injuries that can lead to significant morbidity. Diffuse axonal injury (DAI), which results from shearing forces during rapid deceleration, is a particularly severe form of TBI that may not be immediately apparent on initial CT scans but can have profound long-term impacts on cognitive and functional outcomes.[8]The Marshall Classification system is commonly used to categorize CT findings in TBI and guide management decisions.[9]MRI provides superior soft-tissue contrast compared to CT and is particularly useful for detecting non-hemorrhagic lesions, small contusions, and diffuse axonal injuries. Advanced MRI techniques such as susceptibility-weighted imaging (SWI), diffusion tensor imaging (DTI), and functional MRI (fMRI) offer detailed insights into the extent of brain injury and the underlying pathophysiological mechanisms.[10] DTI, for instance, can visualize white matter tracts and quantify microstructural damage, which is crucial for assessing the impact of DAI. fMRI can detect changes in brain activity and connectivity, providing valuable information on the functional consequences of TBI.[11]

MATERIAL AND METHODS

This study employed a combined retrospective and prospective observational design to analyze demographic profiles, clinical features, imaging findings, and outcomes in patients with TBI at a tertiary care hospital. The study included a total of 100 patients diagnosed with TBI who presented to the emergency department. Patients of all ages presenting to the emergency department with a confirmed diagnosis of TBI were included in this study. Cases with complete demographic, clinical, and imaging data available for analysis. Patients with incomplete or insufficient medical records and Individuals with preexisting neurological conditions affecting the interpretation of TBI outcomes were excluded from the study.

Methodology

Demographic characteristics: Data on age, gender, socioeconomic status, and comorbidity were extracted from medical records.

Clinical features: Clinical manifestations, mode of injury, and comorbidities were documented.

Glasgow Coma Scale (GCS) score was noted at time of admission of patient.

Imaging findings: Neuroimaging reports, including CT scans results, were analyzed for structural and functional insights.

Outcomes: Short-term recovery, long-term functional status, and quality of life outcomes were assessed using standardized outcome measures. Glasgow Outcome Scale (GOS) is used to measure outcome.

Statistical analysis

SPSS 25.0 version were used. Descriptive statistics were used tosummarize demographic characteristics, clinical features, and imaging findings. Data analysis was performed using statistical software.

RESULTS

Table 1 shows the Demographic Profile of TBI Patients. It is found that out of 100 TBI patients the majority (45%) were in the 19-40 years age group, highlighting that younger adults are more prone to TBIs. Patients aged 41-60 years constituted 25% of the cohort, while 20% were children and adolescents aged 0-18 years, and 10% were older adults over 60 years. The gender distribution showed a higher prevalence of TBIs in males (65%) compared to females (35%), which is consistent with global data indicating that males are more likely to experience traumatic injuries. Socioeconomic status varied, with half of the patients belonging to the middle class (50%), followed by the low (40%) and high (10%) socioeconomic groups. Most patients (70%) had no comorbidities, while 15% had hypertension, 10% had diabetes, and 5% had other comorbid conditions.

Clinical data as shown in Table 2 indicated that road traffic accidents were the most common cause of TBI, accounting for 55% of cases. Falls were the second most common cause (25%), followed by assaults (10%), sports injuries (5%), and other causes (5%).

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The Glasgow Coma Scale (GCS) scores at admission showed that 30% of patients had severe TBI (GCS 3-8), 40% had moderate TBI (GCS 9-12), and 30% had mild TBI (GCS 13-15). Regarding comorbidities, 70% of patients had none, 15% had hypertension, 10% had diabetes, and 5% had other conditions. These clinical features provide insight into the severity and causes of TBIs, as well as the overall health status of the patients.

Table 3 shows the Imaging Findings of TBI Patients. The reports indicated that 40% of patients had skull fractures, which is a significant indicator of trauma severity. Epidural hematomas were present in 20% of patients, while 25% had subdural hematomas. Subarachnoid hemorrhage was identified in 10% of cases, and intracerebral hemorrhage in 5%. Brain contusions were seen in 15% of patients, and diffuse axonal injury, which indicates more severe brain damage, was found in 5% of patients. Notably, 20% of patients had normal imaging findings despite having clinical symptoms of TBI, highlighting the importance of comprehensive clinical evaluation in TBI diagnosis.

Short-term recovery outcomes as seen in Table 4 showed that 60% of TBI patients achieved full recovery within the study period, indicating a favorable prognosis for the majority. Partial recovery was observed in 25% of patients, while 10% showed no improvement, and 5% experienced deterioration in their condition. The duration of hospital stay varied, with 20% of patients being discharged within a week, 50% staying for 1-2 weeks, and 30% requiring hospitalization for more than two weeks. These outcomes highlight the variability in recovery times and emphasize the need for individualized patient care plans.

Table 5 shows the Long-term Functional Outcomes and Quality of Life**,**assessed using the Glasgow Outcome Scale (GOS), revealed that 40% of patients achieved a good recovery (GOS 5). Moderate disability (GOS 4) was observed in 30% of patients, while 15% experienced severe disability (GOS 3). A vegetative state (GOS 2) was noted in 5% of patients, and 10% of patients succumbed to their injuries (GOS 1). Quality of life assessments indicated that 50% of patients had a good quality of life post-TBI, 30% had a fair quality of life, and 20% had a poor quality of life. These findings underscore the long-term impact of TBIs on patients' functional status and quality of life, necessitating ongoing support and rehabilitation services.

Table 1: Demographic Profile of TBI Patients

Demographic Variables	Frequency (n=100)	Percentage (%)
Age Group		
0-18 years	20	20%
19-40 years	45	45%
41-60 years	25	25%
>60 years	10	10%
Gender		
Male	65	65%
Female	35	35%
Socioeconomic Status		
Low	40	40%
Middle	50	50%
High	10	10%
Comorbidities		
None	70	70%
Hypertension	15	15%
Diabetes	10	10%
Other	5	5%

Table 2: Clinical Features of TBI Patients

Clinical Features	Frequency (n=100)	Percentage (%)
Mode of Injury		
Road Traffic Accident	55	55%
Fall	25	25%
Assault	10	10%
Sports Injury	5	5%
Other	5	5%
Glasgow Coma Scale (GCS) Score		
3-8 (Severe)	30	30%
9-12 (Moderate)	40	40%
13-15 (Mild)	30	30%

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Comorbidities		
None	70	70%
Hypertension	15	15%
Diabetes	10	10%
Other	5	5%

Table 3: Imaging Findings of TBI Patients

Imaging Findings	Frequency (n=100)	Percentage (%)
Skull Fracture	40	40%
Epidural Hematoma	20	20%
Subdural Hematoma	25	25%
Subarachnoid Hemorrhage	10	10%
Intracerebral Hemorrhage	5	5%
Brain Contusion	15	15%
Diffuse Axonal Injury	5	5%
Normal Findings	20	20%

Table 4: Short-term Recovery Outcomes

Short-term Recovery Outcomes	Frequency (n=100)	Percentage (%)
Full Recovery	60	60%
Partial Recovery	25	25%
No Improvement	10	10%
Deterioration	5	5%
Duration of Hospital Stay		
<1 week	20	20%
1-2 weeks	50	50%
>2 weeks	30	30%

Table 5: Long-term Functional Outcomes and Quality of Life

Long-term Outcomes	Frequency (n=100)	Percentage (%)
Glasgow Outcome Scale (GOS)		
GOS 1 (Death)	10	10%
GOS 2 (Vegetative State)	5	5%
GOS 3 (Severe Disability)	15	15%
GOS 4 (Moderate Disability)	30	30%
GOS 5 (Good Recovery)	40	40%
Quality of Life		
Poor	20	20%
Fair	30	30%
Good	50	50%

DISCUSSION

The study's demographic profile revealed that the majority of TBI patients were young adults aged 19-40 years (45%), followed by middle-aged adults (25%), children and adolescents (20%), and older adults (10%). This distribution aligns with other studies indicating that TBIs predominantly affect younger populations due to higher exposure to risk factors such as road traffic accidents and occupational hazards. For instance, a study by Majdan et al.[13] found that the incidence of TBI was highest in the 20-39 age group across Europe. The higher prevalence of TBIs in males (65%) compared to females (35%) in our study is consistent with global data, which often shows a male predominance due to greater involvement in high-risk activities and behaviors.[14] Regarding socioeconomic status, our findings indicated that TBIs occurred more frequently in middle (50%) and low (40%) socioeconomic groups, similar to findings by Phillips et al.[15], who noted that lower socioeconomic status is associated with increased TBI risk due to factors like unsafe living conditions and limited access to preventive measures. The majority of patients (70%) had no comorbidities, but a significant portion had hypertension (15%) and diabetes (10%), which can complicate TBI outcomes as noted by researchers like Jiang et al.[16]

The clinical features showed that road traffic accidents were the leading cause of TBI (55%), followed by falls (25%), assaults (10%), sports injuries (5%), and other causes (5%). These findings are in line with global data where road traffic accidents are a predominant cause of TBI, particularly in developing countries.[17] The distribution of GCS scores at admission (severe TBI in 30%, moderate in 40%, and mild in 30%) is consistent with the TBI

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severity spectrum reported in the literature. A study by Baker et al.[18] also reported similar distributions, emphasizing the variability in TBI severity among patients . Our study's comorbidity profile matches findings from other research, indicating that chronic conditions like hypertension and diabetes are common among TBI patients and can influence clinical outcomes.[5]

Imaging findings showed that 40% of patients had skull fractures, 20% had epidural hematomas, 25% had subdural hematomas, 10% had subarachnoid hemorrhage, 5% had intracerebral hemorrhage, 15% had brain contusions, and 5% had diffuse axonal injury. Notably, 20% of patients had normal findings despite clinical symptoms of TBI. These imaging patterns are comparable to those reported by Maas et al.[6], who highlighted that skull fractures and hematomas are common imaging findings in TBI, and that a significant percentage of patients can have normal CT scans initially. The presence of diffuse axonal injury in a smaller percentage of patients aligns with the understanding that such injuries are indicative of more severe trauma and are often detected using advanced imaging techniques like MRI.[8]

The short-term recovery outcomes showed that 60% of patients achieved full recovery, 25% had partial recovery, 10% showed no improvement, and 5% experienced deterioration. These recovery rates are similar to those found in studies by Murray et al.[19], who reported a high rate of full recovery in TBI patients with mild to moderate injuries. The variability in the duration of hospital stay, with 20% of patients discharged within a week, 50% staying for 1-2 weeks, and 30% for more than two weeks, highlights the differences in recovery trajectories and the need for tailored patient care plans.[4]

Long-term functional outcomes assessed using the Glasgow Outcome Scale (GOS) indicated that 40% of patients achieved good recovery, 30% had moderate disability, 15% had severe disability, 5% were in a vegetative state, and 10% died. These outcomes are consistent with findings by Levin et al.[20], who noted that while a significant portion of TBI patients recover well, a substantial number experience long-term disabilities . Quality of life assessments showed that 50% of patients had a good quality of life, 30% had a fair quality of life, and 20% had a poor quality of life. These results align with research by Teasdale et al.[21], which demonstrated that TBI can have long-lasting effects on quality of life, necessitating ongoing support and rehabilitation.

CONCLUSION

The research highlights the need of understanding demographic, clinical, and imaging factors in order to effectively treat and evaluate the prognosis of traumatic brain injury (TBI).

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