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THE CLINICAL AND INJURY-RELATED CHARACTERISTICS OF TRAUMATIC BRAIN INJURY PATIENTS ADMITTED TO INTENSIVE CARE UNITS

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Abstract

Background: Traumatic Brain Injury (TBI) results from external trauma to the head, causing cognitive, physical, and emotional impairments varying in severity from brief mental changes to prolonged unconsciousness or coma. TBI is a leading cause of mortality and disability globally, affecting both developed and developing nations. Objectives: To identify the risk factors and severity of Traumatic Brain Injury patients admitted to ICUs. Methods: The study was conducted in three tertiary care hospitals in Peshawar, including Lady Reading Hospital, Hayatabad Medical Complex, and Khyber Teaching Hospital, over a period of six months (July–December 2023). Using a cross-sectional design, data were collected from ICU-admitted TBI patients aged ≥14 years with GCS scores of 3–12, and excluding pediatric patients, GCS 13–15, and a history of epilepsy or mental disorders. A standardized checklist recorded demographic and clinical information was used. Data collection focused on identifying TBI risk factors and outcomes. Results: A total of 60 traumatic brain injury (TBI) patients admitted to the intensive care unit (ICU) were included in the study. The majority of patients were male (73.3%) and belonged to the 26–35 years age group (36.7%). Road traffic accidents (65.0%) were the most common cause of TBI, followed by falls (20.0%). Most patients had a Glasgow Coma Scale (GCS) score of 3–8 (88.3%), and 85.0% were classified as having severe TBI. Regarding outcomes, 40.0% of patients were discharged, 35.0% remained admitted, 18.3% died, and 6.7% were referred. Additionally, 90.0% of patients had skull fractures, and 91.7% experienced loss of consciousness. Conclusion: RTA is the leading cause of TBI, predominantly in males, due to cultural norms. Falls and blasts follow as major causes. TBI incidence is higher in non-work-related cases and among individuals not using protective gear.

Introduction

Traumatic brain injury (TBI) is defined as a disruption in the normal functioning of the brain caused by an external force or trauma to the head (1). It is a major global public health concern and remains one of the leading causes of mortality and disability across all age groups. TBI can result from a variety of mechanisms, including falls, road traffic accidents (RTAs), assaults, sports injuries, industrial accidents, penetrating trauma, and explosive blasts. The severity of TBI ranges from mild concussion to severe brain injury associated with prolonged unconsciousness, coma, and death (2). TBI has significant clinical, social, and economic consequences. Depending on the severity and location of injury, patients may experience a wide range of physical, cognitive, behavioral, and emotional impairments (3). Common manifestations include headache, nausea, vomiting, sensory disturbances, memory impairment, confusion, poor concentration, mood changes, anxiety, and depression. Even mild traumatic brain injuries may result in persistent neurological and psychological deficits that affect daily functioning, productivity, and quality of life. Therefore, understanding the burden and determinants of TBI is essential for improving prevention, acute management, and long-term rehabilitation (4). Patients with moderate to severe TBI often require admission to the intensive care unit (ICU) for close neurological monitoring, airway protection, mechanical ventilation, hemodynamic stabilization, and management of secondary brain injury. The prognosis of these patients is influenced by multiple factors, including the severity of the primary injury, associated systemic trauma, timely intervention, and availability of critical care resources (5). In severe cases, early diagnosis and prompt management are crucial to reduce intracranial complications, prevent secondary neurological deterioration, and improve survival outcomes (6). Diagnosis is commonly established through neurological examination, imaging modalities such as computed tomography (CT) scan and magnetic resonance imaging (MRI), and clinical assessment tools such as the Glasgow Coma Scale (GCS) (7). Management may involve initial stabilization, surgical intervention when indicated, and multidisciplinary rehabilitation including physical therapy, occupational therapy, and speech and language therapy. Despite advances in neurosurgical and intensive care management, TBI continues to contribute substantially to ICU admissions and poor clinical outcomes, particularly in low- and middle-income countries (8). Globally, TBI is more common among males and is frequently observed in younger and economically productive age groups. Epidemiological evidence indicates that falls and RTAs remain the most common causes of TBI, while penetrating injuries, industrial hazards, domestic violence, and blast injuries may also contribute significantly in specific populations and settings (9). Although TBI represents a major cause of morbidity and mortality, the pattern of associated risk factors among ICU-admitted TBI patients remains insufficiently explored in many resource-limited settings. Identifying these risk factors is important for early risk stratification, prioritization of critical care interventions, and improvement of patient outcomes.

Materials and Methods

A descriptive cross-sectional study was conducted among 60 TBI patients admitted to the ICUs of three tertiary care teaching hospitals in Peshawar, Khyber Pakhtunkhwa (KPK), Pakistan, namely Lady Reading Hospital Peshawar, Hayatabad Medical Complex Peshawar, and Khyber Teaching Hospital Peshawar. The study was carried out over a period of six months, from July 2023 to December 2023. A non-probability convenient sampling technique was used to select the study participants. The study included all male and female TBI patients aged 14 years and above who were admitted to the ICU with a Glasgow Coma Scale (GCS) score of 3 to 12. Patients with a history of epilepsy or other mental disorders were excluded from the study. Data were collected using a structured standard proforma, which included demographic and clinical variables such as date of admission, age, sex, address, and other relevant patient information**.** The collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS)**.** Descriptive statistics, including frequencies and percentages, were used

to summarize the data. Ethical approval was obtained from the Institutional Review Board (IRB) prior to data collection, and confidentiality of patient information was maintained throughout the study.

Results

A total of 60 patients with TBI admitted to the ICU were included in the study. The age distribution of the patients showed that the majority belonged to the 26–35 years age group, accounting for 22 (36.7%) patients, followed by the 16–25 years age group with 15 (25.0%) patients. The 36–45 years age group comprised 10 (16.7%) patients, while 4 (6.7%) patients each were in the 46–55 years, and 55 years and above age groups. Regarding gender distribution, 44 (73.3%) patients were male, and 16 (26.7%) were female, indicating a male predominance among TBI patients.

Table 1: ***Demographics Information***

Variable	Frequency (n)	Percentage (%)
Age Group (Years)		
14–25	19	25.0
26–35	22	36.7
36–45	10	16.7
46–55	4	6.7
55 and above	4	6.7
Gender		
Male	44	73.3
Female	16	26.7

Road traffic accidents (RTAs) were the most common cause of TBI, accounting for 39 cases (65.0%), followed by falls in 12 patients (20.0%). Blast accidents were reported in 5 (8.3%) cases, domestic accidents in 3 (5.0%) cases, and industrial accidents in only 1 (1.7%) case. Assessment of injury severity based on the Glasgow Coma Scale (GCS) revealed that the majority of patients, 53 (88.3%), had a GCS score of 3–8, indicating severe TBI, while only 7 (11.7%) patients had a GCS score of 9–12, indicating moderate TBI. Similarly, the initial clinical assessment showed that 51 (85.0%) patients had severe TBI, whereas 9 (15.0%) had moderate TBI.

Table 2: ***Causes and Injury-Related Characteristics of TBI Patients***

Variable	Frequency (n)	Percentage (%)
Cause of TBI		
Road Traffic Accident (RTA)	39	65.0
Fall	12	20.0
Blast Accident	5	8.3
Domestic Accident	3	5.0
Industrial Accident	1	1.7
Injury Event Type		
Single Event Injury	47	78.3
Multiple Event Injury	13	21.7

Work-Related Injury		
Yes	53	88.3
No	7	11.7
Use of Protective Gear		
Yes	8	13.3
No	35	58.3
Not Applicable / Not Related	17	28.3
History of Previous TBI		
Yes	2	3.3
No	50	83.3
Unknown	8	13.3

Regarding ICU outcomes, 24 (40.0%) patients were discharged, 21 (35.0%) remained admitted in the ICU, 11 (18.3%) patients died, and 4 (6.7%) patients were referred to other hospitals. The duration of ICU stay showed that 30 (50.0%) patients stayed for less than 10 days, 25 (41.7%) remained admitted for 11–20 days, and 5 (8.3%) stayed in the ICU for more than 30 days. Most patients, 52 (86.7%), had no previous medical history, whereas 8 (13.3%) had a history of past medical illness. In terms of injury pattern, 47 (78.3%) patients sustained injury due to a single event, while 13 (21.7%) were injured as a result of multiple events. The majority of cases, 53 (88.3%), were found to be work-related, while 7 (11.7%) had no relation to work. With regard to safety measures, 35 (58.3%) patients had not used any type of protective gear, while only 8 (13.3%) reported using protective equipment. The remaining 17 (28.3%) cases were not related to situations requiring protective gear.

Table 3: ***Clinical Characteristics of TBI Patients Admitted to ICU***

Variable	Frequency (n)	Percentage (%)
Glasgow Coma Scale (GCS)		
3–8	53	88.3
9–12	7	11.7
Severity of TBI		
Severe	51	85.0
Moderate	9	15.0
Past Medical History		
Yes	8	13.3
No	52	86.7
Loss of Consciousness		
Yes	55	91.7
No	5	8.3
Skull Fracture		
Yes	54	90.0
No	6	10.0

History of previous traumatic brain injury was absent in most patients, as 50 (83.3%) had no prior history of TBI, while only 2 (3.3%) patients had been previously treated for TBI. In 8 (13.3%) cases, the history was unknown. Loss of consciousness was present in the majority of patients, with 55 (91.7%) experiencing loss of consciousness, while only 4 (6.7%) did not report loss of consciousness. Skull fractures were observed in 54 (90.0%) patients, whereas 6 (10.0%) patients had no skull fracture. With regard to pre-hospital care, 38 (63.3%) patients received first aid within 24 hours at primary or secondary healthcare centers or in the operating room, while 22 (36.7%) received first aid after 24 hours. Most patients, 40 (66.7%), were transported to the hospital by ambulance, whereas

20 (33.3%) were brought by attendants in private vehicles. Regarding the source of ICU admission, 31 (51.7%) patients were shifted from the emergency department, 13 (21.7%) from the neurosurgery ward, 15 (25.0%) from the operation theatre (OT), and only 1 (1.7%) patient was admitted to the ICU from other departments.

Discussion

In this study of 60 traumatic brain injury (TBI) cases, road traffic accidents (RTA) were the leading cause, accounting for 65% (39/60), predominantly affecting males, likely due to socio-cultural norms restricting female outdoor activity. This contrasts with developed countries, where gender distribution in RTAs is more balanced (10). National data indicate that approximately 30% of trauma patients in Pakistan sustain TBI, with 10% experiencing moderate to severe injury, particularly in densely populated urban centers (11). Falls were the second most common cause (20%, 12/60), primarily involving adults and children in high-risk activities such as climbing trees, construction sites, or flying kites. This aligns with global data, where falls account for 20–30% of TBIs among children and older adults (12). Blast-related injuries represented 8.3% of cases, higher than previously reported national estimates (2%), possibly reflecting unrecorded militant or suicide attacks (5). Domestic accidents, including falls and violence, accounted for 5% of cases, highlighting gender-based vulnerability in male-dominated communities (6). Industrial accidents were rare (1.7%), consistent with limited industrial activity and potentially high on-site fatality. Most TBIs were single-event injuries (47/60), and preventive measures were largely neglected; 58% of patients had not used protective gear. Critical presentation was common, with 88.3% exhibiting low Glasgow Coma Scale (GCS 3–8) scores and 55% unconscious. Comorbidities were uncommon. Prehospital care showed gaps, with 36.7% receiving delayed first aid beyond 24 hours, and 33% transported without ambulance services, reflecting systemic limitations (8). ICU care demonstrated favorable outcomes; 51% of patients recovered, 18.3% died, and 8.3% were referred elsewhere, highlighting the value of tertiary care in resource-limited settings (2). These findings emphasize the need for strict enforcement of traffic and occupational safety, public awareness of preventive measures, and enhanced prehospital and emergency care systems.

Conclusion

Road traffic accidents were the leading cause of traumatic brain injury (TBI), predominantly affecting males due to socio-cultural factors, while falls, blasts, and domestic accidents contributed less frequently. Most patients presented with severe injuries and low Glasgow Coma Scale scores, with the majority not using protective measures, highlighting preventable risk factors. Delays in prehospital care were common, but ICU management in tertiary facilities improved outcomes for over half of the patients. These findings underscore the need for stronger road safety enforcement, public awareness of protective measures, and improved emergency and prehospital care systems to reduce TBI incidence, severity, and mortality in urban areas.

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