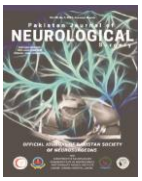

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Original Article

Emergency Department Outcome of Patients with Traumatic Brain Injury: A Cross-sectional Study from Pakistan

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ABSTRACT

Objective: Traumatic brain injury (TBI) is a leading cause of global morbidity and mortality in both adults and children. As with other severe injuries, the outcome of TBIs is also gravely related to the quality of emergency care. Effective emergency care significantly contributes to reduced morbidity and mortality. This study was ensued to evaluate the characteristics of TBIs in Pakistan and their outcomes in the emergency department (ED).

Material and Methods: This cross-sectional study included records of TBI patients seen in the Neurosurgical ED of Jinnah Postgraduate Medical Centre, Karachi, Pakistan. All patients of any age with TBI were included in the study. The outcome was assessed at the end of ED treatment.

Results: During the study period, 5,546 patients with TBI were seen in the ED; an estimated 56.5 patients per day. There were 73.1% male patients and 26% were of age < 10 years. The most common culprit of TBI was road traffic accidents (RTAs) (39%) followed by accidental fall (32.2%). Head injury was mostly mild (72.8%) and only 4.7% had a severe injury. Only 10% patients were admitted for further treatment, 16% were managed in the ED then discharged, and 67% were immediately discharged from the ED after initial management. The ED mortality rate of TBIs was 2.2% in our study. All of these cases had severe head injuries.

Conclusion: Traumatic brain injuries are mostly mild-to-moderate with low mortality rate in the emergency department.

Keywords: Traumatic brain injury, head injury, emergency department, road traffic accidents, Glasgow coma score.

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INTRODUCTION

Traumatic brain injury (TBI) is an external mechanical insult to the brain which may be mild where the person remains alert and conscious or a moderate concussion, or it may be severe enough to render the person in a comatose state or even result in death. It may have a focus or may diffusely affect the brain resulting in swelling or even bleeding.[1] According to a recent meta-analysis estimating the incidence of TBI World Health Organization (WHO) regions and World Bank (WB) income groups, it was deduced that annually 69 million people sustain a TBI. The incidence of TBI due to road traffic accidents (RTAs) was highest in Southeast Asia (56%) making an average of 1.5% of the annual population is a victim of TBI secondary to RTA.[2]

TBI is a leading cause of global morbidity and mortality in both adults and children and has also significantly burdened healthcare economics.[3,4] There are various factors that affect the short-term and long-term outcomes of patients with TBI. There are four basic predictors: patient age, Glasgow Coma Scale (GCS) score, pupil reactivity, and major extracranial injuries. An area of injured brain visualized over computed tomography (CT) scan also helps understand the severity of the injury and its outcome.[5]

As with other severe injuries, the outcome of TBIs is also gravely related to the quality of emergency care. Effective emergency care significantly contributes to reduced morbidity and mortality. According to the statistics, low-to-middle-income countries (LMICs) have not produced as effective emergency care outcomes as those in high-income countries (HICs).[6-8] The difference is most certainly related to the human resource as well as the quality of medical equipment and the conditions of EDs.[6] In TBI, appropriate and timely disposal of emergency care plays a crucial role in preventing long-term disability.[9] In a retrospective longitudinal study from a HIC– Netherlands – the overall incidence, as well as hospitalization due to TBI, increased over a period of fourteen years; however, the rate of mortality did not increase significantly which indicates improved patient care and early identification and intervention for patients with a high risk of adverse outcome due to severe TBI.[10] Comparatively, little data is available about emergency care and its outcome in TBI from LMICs.[11,12]

Pakistan is a densely populated LMIC where TBIs are a frequent encounter in the EDs and neurosurgery.[11,13] In a large RTA surveillance study from Pakistan, which included more than one hundred thousand RTAs, it was deduced that as many as one-third individuals had a TBI; 10% of these had severe TBI.[13] Despite this burden and severity, the literature related to TBI emergency care in Pakistan is limited.[11,13,14] This study was ensued to evaluate the characteristics of traumatic brain injuries in Pakistan and their immediate outcomes in the emergency department.

MATERIAL AND METHODS

Study Design and Study Setting

This descriptive cross-sectional study included patient records for around four months – 1st September 2019 till 7th December 2019from the Neurosurgical ED (emergency department) of Jinnah Postgraduate Medical Centre, Karachi, Pakistan. The study was conducted after approval from the institutional review board. Patients consents were taken for data collection.

Inclusion Criteria

All TBI patients of any age and either gender were included in the study.

Exclusion Criteria

Patients not agreed to consent for the study were excluded.

Data on Trauma and Outcome

The cause of trauma was classified as RTA, fall, gunshot injury (GSI), and others. The severity of TBI was assessed on the GCS score. Mild TBI was at GCS 13 – 15 at the presentation. Moderate TBI was defined as GCS 9 – 12, loss of consciousness (LOC) >5 minutes, with post-trauma amnesia > 30 minutes. Severe TBI was classified as GCS < 8 at the time of presentation.

The immediate outcome was classified into four categories (i) Admissions – those who required hospital admission (ii) Disposed – Discharged from the ED after the initial examination and management only (iii) Detained and Disposed – Observed in the ED for deterioration of symptoms or changes in repeat radiological assessment and then discharged; the minimum duration of observation was four hours (iv) Transferred – those who were referred to another hospital due to any reason including those who left against medical advice. CT head was performed in all patients. All information was assembled on a structured proforma.

Statistical Analysis

All statistical analysis was processed through IBM Statistical Package for the Social Sciences for Windows version 24.0. For continuous variables, the mean and standard deviation was calculated. For categorical variables, frequencies and percentages were calculated.

RESULTS

Enrolled Patients

A total of 5,546 patients presenting to the ED with TBI were registered during the study period making an estimated 56.5 patients per day. There were 1,916 patients enrolled in the month of September (63.8 patients/day), 1,820 in October (58.7 patients/day), 1,488 in November (49.6 patients/day), and 322 (an estimate of 46 patients/day) in the first seven days of December. There were 4,054 (73.1%) male patients and 1,492 (26.9%) female patients.

Age & Gender Distributions

The mean age of these patients was 26.8±3.7 years and categorical ages according to the genders are shown in Table 1.

Table 1: Categorization of age groups of patients with TBI according to their gender.

Age (Years)	Male (%)	Female (%)	Total (%)
0 – 10	824 (20.3%)	595 (39.8%)	1,419 (25.6%)
11 – 20	777 (19.2%)	121 (8.1%)	898 (16.2%)
21 – 30	870 (21.4%)	243 (16.3%)	1,113 (20.1%)
31 – 40	756 (18.6%)	325 (21.8%)	1,081 (19.5%)
41 – 50	383 (9.4%)	88 (5.8%)	471 (8.5%)
51 – 60	229 (5.6%)	69 (4.6%)	298 (5.4%)
61 – 70	162 (3.9%)	38 (2.5%)	200 (3.6%)
71 – 80	53 (1.3%)	13 (0.8%)	66 (1.2%)
Total	**4,054 (73.1%)**	**1,492 (26.9%)**	**5,546 (100%)**

Mode of Head Trauma

When the mode of trauma was assessed, RTAs were found to be the most prevalent cause of TBI. There were 2,163 (39%) cases of RTA reported during the study period. There were 749 (of 1,916; 39.1%) of cases of RTA in September, 698 in October (of 1,820; 38.4%), 576 (of 1,488; 38.7%) in November, and 140 (of 322; 43.5%) in the first seven days of December. An estimate of 22 cases of RTA per day was reported. The second most common cause of trauma was accidental fall (n = 1,785; 32.2%). There were 699 (of 1,916; 36.5%) of cases of fall in September, 555 in October (of 1,820; 30.5%), 528 (of 1,488; 35.6%) in November, and 83 (of 322; 25.7%) in the first seven days of December. An estimate of 18 cases of falls per day was reported. "Other" causes of trauma comprised of 1,590 (28.7%) cases. There were 547 (of 1,916; 28.5%) of cases of other traumas in September, 565 in October (of 1,820; 31.0%), 380 (of 1,488; 25.2%) in November, and

Table 2: Stratification of type of trauma in patients with TBI according to their gender.

Gender	RTA (%)	Fall (%)	Gunshot (%)	Other (%)	Total (%)
Male	1,548 (71.6%)	1,453 (81.4%)	5 (62.5%)	1,048 (65.9%)	4,054 (73.1%)
Female	615 (28.4%)	332 (18.6%)	3 (37.5%)	542 (34.1%)	1,492 (26.9%)
P value	0.03*	< 0.000*	0.49	< 0.000*	----
Total	2,163 (39.0%)	1,785 (32.2%)	8 (0.1%)	1,590 (28.7%)	5,546 (100%)

*Significant

98 (of 322; 30.4%) in the first seven days of December. There were only 8 (0.1%) cases of gunshot injuries reported during the study period. Of these, 1 (0.05%) was reported in September 2 (0.1%) in October, 4 (0.3%) in November, and 1 (0.3%) in December. Types of traumas were stratified according to the genders which showed that RTA, fall, and other traumas were significantly more common in men (Table 2).

Table 3: Findings of CT scan head (n=3,677).

CT Scan Findings	Male (%)	Female (%)	Total (%)
Epidural hemorrhage	94 (2.5%)	23 (0.6%)	117 (3.2%)
Subarachnoid hemorrhage	181 (4.9%)	62 (1.7%)	243 (6.6%)
Subdural hemorrhage	127 (3.5%)	62 (1.7%)	189 (5.1%)
Intracranial hemorrhage	59 (1.6%)	19 (0.5%)	78 (2.1%)
Brain edema	58 (1.6%)	11 (0.3%)	69 (1.8%)
Contusion	311 (8.5%)	73 (6.7%)	384 (10.4%)
Skull fracture	31 (0.8%)	17 (1.9%)	48 (1.3%)
No finding	1,656 (45.0%)	893 (24.3%)	3,677 (100%)

Table 4: Stratification of the severity of head injury according to the patient gender.

Gender	Mild (%)	Moderate (%)	Severe (%)	Total (%)
Male	3,010 (74.6%)	886 (71.1%)	158 (59.6%)	4,054 (73.1%)
Female	1,024 (25.4%)	361 (28.9%)	107 (40.4%)	1,492 (26.9%)
P-value	0.000*	0.06	< 0.000*	----
Total	4,034 (72.8%)	1,247 (22.5%)	265 (4.7%)	5,546 (100%)

*Significant

Types of TBI

Four thousand and ninety-three (73.8%) patients had suffered from polytrauma. Lacerations (n = 2,441; 59.6%) and limb fractures (n = 1,705; 26.3%) were the most common. Most of the poly-trauma patients were injured in RTA (n = 987; 24.1%). Head lacerations were present in 936 (16.8%) patients in this study. Immediate intubation and ventilation were required in 348 (6.2%) patients. Head CT scan findings were present in 4,805 (86.6%) records which are summarized in Table 3.

Severity of TBI

In our study, most of the cases of TBI were mild (n = 4,034; 72.8%)according to their GCS score and only 265 (4.7%) had a severe head injury. The severity of head injury in patients of TBI was stratified according to the genders which showed that severity was significantly related to the male gender (Table 4).

Outcome

After a full assessment and all first aid measures in the emergency department, the immediate outcome of TBI patients was categorized into four classes. The most common outcome was "Disposed – immediately discharged" (n = 3,711; 66.9%). There were 881 (15.9%) patients retained in the ED for intervention and monitoring and were then discharged, 549 (9.9%) were admitted, 405 (7.3%) were transferred from the ED to any

other medical facility or left against medical advice.

There were 151 (7.8%) admissions in September, 179 (9.8%) in October, 181 (12.2%) in November, and 38 (11.8%) in December. There were 1,349 (70.4%) dispositions in September, 1,233 (67.7%) in October, 921 (61.8%) in November, and 208 (64.6%) in December. There 296 (15.5%) patients who were detained then disposed in September, 282 (15.5%) in October, 264 (17.7%) in November, and 39 (12.1%) in December. There were 120 (6.3%) patients transferred in September, 126 (6.9%) in October, 122 (8.2%) in November, and 37 (11.5%) in December. An estimated 5 patients of TBI were admitted, 38 were disposed, 9 were detained and disposed, and 4 were transferred daily from the emergency department. The ED mortality rate of TBIs was 2.2% (n = 123/5,546) in our study. All of these cases had a severe head injury. Immediate outcomes of patients with TBI were stratified according to the genders which showed that "disposed," "detained and disposed" and "transferred" were significantly more common in men (Table 5).

Table 5: Stratification of the immediate outcome of patients with TBI according to their gender.

Gender	Admissions (%)	Disposed (%)	Detained and Disposed (%)	Transferred (%)	Total (%)
Male	401 (73.0%)	2,848 (76.7%)	528 (59.9%)	277 (68.4%)	4,054 (73.1%)
Female	148 (27.0%)	863 (23.3%)	353 (40.1%)	128 (31.6%)	1,492 (26.9%)
P-value	0.97	< 0.000*	<0.000*	0.02*	-
Total	549 (9.9%)	3,711 (66.9%)	881 (15.9%)	405 (7.3%)	5,546 (100%)

*Significant

DISCUSSION

In this cross-sectional study of traumatic brain injuries from the largest public-sector emergency department of Karachi, road traffic accidents were identified to be the most common cause. TBIs were found to be more common in children and young adults. Most of the TBIs were mild in severity, and as few as 10% were severe enough to require hospital admission.

The weak quality of data and recall bias due to retrospective methodology are the major limitations of this study. It also did not include the outcomes of patients who were admitted which may have altered the actual mortality rate in TBI. However, the study is valuable in contributing to the local data of TBI, its causes, severity, and immediate outcome.

The largest multicenter study in the EDs of Pakistan – Pakistan National Emergency Departments Surveillance Study (Pak-NEDS) included ED outcomes of 1,787 TBI patients.[15] Comparatively this study included ED outcomes of 5,546 TBI patients. In Pak-NEDS 79% were males (vs. 73% in our study) and 46% were of <25 years (vs. 62% ≤ 30 years in our study). CT head was performed in 40% vs. all patients in our study. The admission rate was 26% in Pak-NEDS as compared to 10% in our study. The mortality rate was comparable (3% vs. 2.2%).[15]

In another older 4-year review of TBI related ED visits from Pakistan, there were 75% of men and most patients (32%) were 11 – 20 years old. RTAs were responsible for 62% cases, falls for 28%, and there were 6% of cases of firearm injuries. Based on their GCS score, 52% cases had mild injury (vs. 73% in our study), 30% had moderate (vs. 22% in our study), and 18% had severe head injury (vs. 5% in our study).[16] In another study, RTA and falls were the common causes of traumatic head injuries. RTA has been

reported to be responsible for as many as 63% TBI previously in Pakistan and 32% TBI were reported to be secondary to falls.[11]

Comparatively, in a 15-year long retrospective review from the Netherlands, the rate of hospital admission for TBI was 11% and the mortality rate was as high as 20%.[10] As compared to our study, their mortality rate was very high. Since their mortality group was mostly middle-aged to elderly, Van den Brand and colleagues attributed their results to the aging of the population and hence, increased incidence of falls along with increased use of anticoagulants and antiplatelet therapy.[10] In a retrospective report of 8-year ED records from Canada, there were 900,000+ TBI patients; 92% patients were disposed, 5% admitted, and 3% were transferred. Their mortality rate was as low as 0.1%. The most common mechanism of injury in their report was fall (45% vs. 32% in our study) and RTAs caused TBI in as few as 11% (vs. 39% in our study) patients.[17] In an epidemiological study from India, 56% of TBI cases were due to falls, and 36% RTA. Upon arrival to the ED, 27% had LOC. On GCS, 62% had mild TBI, 22% moderate, and 16% had severe. The in-hospital mortality rate was 20%.[18]

Among the factors affecting the prognosis of TBI, gender is the most debatable. Various authors believe that females have a worse clinical outcome compared to their male counterparts. A research performed on 1627 TBI patients resulted in mortality rates of 1.6% and 3.4% in males and females respectively with higher severity of injuries (according to GCS) in females.[19-21] However, others found fewer complications in female TBI patients, with better prognosis and outcomes. These differences may be because many studies disproportionately studied the males and ignore the differences. Separate studies just to highlight these gender discrepancies in TBI are needed at this time.[19,22] Our results on stratification showed a significant proportion of males having a severe TBI (< 0.000). However, there was a higher percentage of males that got discharged just after the initial management (< 0.000).

Dunne J et al in their narrative review concluded that males have a higher tendency of getting involved in traumatic outcomes as they found a higher prevalence of males (77%) in their compilation of eight studies on RTAs.[23] On the other hand, females are believed to be more prone to fall from balconies, rooftops, and stairs. Here in this study, we found a statistically significant rate of RTA (0.03), falls (< 0.000), and other trauma (< 0.000) in males comparatively.

CONCLUSION

The trends of traumatic brain injury are not very distinct in LMICs. Major culprits include RTAs and accidental falls. TBIs are mostly mild-to-moderate and the ED mortality rate is low; however, it may vary from place to place depending on the disposable resources and their efficient and timely utilization.

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Additional Information

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Conflicts of Interest:
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Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Uzair Yaqoob	Study design and methodology
2.	Farrukh Javeed	Paper writing and data calculations
3.	Mashika Pahwani	Data collection and calculations
4.	Sara Madni	Analysis of data and interpretation of results etc.
5.	Muhammad Muizz-ud-Din	Literature review and referencing
6.	Lal Rehman	Analysis of data and quality insurer