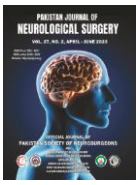

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Original Article

Management and Outcome of Severe Traumatic Brain Injury

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ABSTRACT

Objective: To assess the management of patients with severe traumatic brain injury and their outcomes.

Materials and Methods: A prospective observational study was conducted at the Department of Neurosurgery of a tertiary care hospital. Our study included 279 patients in total. After meeting the requirements for inclusion, the patient's baseline information, such as age, gender, arrival GCS, and outcome, were noted. Three months of post-trauma observation were employed to assess the outcome. SPSS version 22.0 was used to evaluate the data obtained.

Results: According to our study out of the total, 118 (42.3%) patients with severe TBI showed good outcomes while 161 (57.7%) showed poor outcomes at 3 months. In our study, the arrival GCS and arrival pupillary reactivity were statistically significant outcome factors (p = 0.040 and 0.010 respectively). Overall mortality was 35.13% (98) at 3 months.

Conclusion: Patients presenting with severe TBI have high morbidity and mortality. Arrival GCS and pupillary reaction were important factors to significantly alter the outcome.

Keywords: Traumatic Brain Injury, Glasgow Coma Score, Head Trauma, Glasgow Outcome Score, Outcome.

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INTRODUCTION

Traumatic brain injury (TBI) is described as damage to the brain caused by an external physical impact that results in either temporary or permanent functional or structural impairment.[1] For patients between the ages of 18 and 45, it is the main cause of mortality and morbidity, with incidence increasing due to transportation-related injuries in low- and middle-income nations. This disparity is caused, at least in part, by the absence of laws intended to prevent injuries and the greater prevalence of risk factors

in these countries.[2-4] The majority of the victims, who are often young adults, survive with severe disabilities, which results in a tremendous economic burden for both the victims and their families.[3]

The common 15-point Glasgow Coma Scale, which measures motor, speech, and eye-opening abilities, is used clinically to categorize the severity of TBI (GCS).[5] As per the American Congress of Rehabilitation Medicine, mild TBI is classified as a GCS of 13 or higher, moderate TBI as a GCS of 9 – 12, and severe TBI as a GCS of 3 – 8.[6] The 1991 Traumatic Coma Data Bank was used to define the modern clinical criteria of severe traumatic brain injury (sTBI), which is GCS ≤ 8 after resuscitation within 48 hours of injury.[7]

An external force causes primary injury that results in the destruction of brain tissue, including parenchymal damage, intracerebral bleeding, and axonal cutting. This in turn results in secondary neurometabolic and neurochemical events that can affect the recovery and prognosis and last for months to years after the injury. These events include inflammation, brain edema, blood-brain barrier malfunction, oxidative stress, neuronal injury, and mitochondrial and metabolic disturbance.[8]

Although the pathophysiology is probably comparable, there are significant distinctions in lower-income countries' demographics and trauma mechanisms that influence the prognosis. For instance, TBI patients in low-income regions tend to be younger, arrive at the hospital later, and have a higher likelihood of being engaged in a motorbike or pedestrian road traffic collision.[3,910]

The most recent Brain Trauma Foundation (BTF) guidelines, released in 2016, are protocol-driven management techniques designed to enhance outcomes for patients hospitalized with sTBI while also delivering high-quality care.[11] The cornerstone of TBI therapy is the management of these patients in critical care, focusing mainly on the airway, oxygen saturation, and adequate hemodynamic support to prevent the subsequent damage connected to hypoxia and hypotension. By lowering the price of medical care, rehabilitation, and lost productivity, they are expected to reduce mortality, improve clinical results, and generate significant financial savings.[12]

In this research, we aimed to describe the treatment plan and results of severe traumatic brain injury in our studied population and to highlight risk factors.

MATERIALS AND METHODS

Study Design and Setting

This was prospective observational research carried out in the Neurosurgery Department of a Tertiary Care Hospital from January 1, 2022, to June 30, 2022.

Inclusion Criteria

We included 279 adult patients who had experienced a TBI during the previous 24 hours and had a Glasgow Coma Scale (GCS) score of 3 – 8 at the time of presentation.

Exclusion Criteria

The study excluded individuals with bilateral fixed and dilated (nonreactive) pupils, penetrating head trauma, imminent death, serious additional extracranial injuries, substantial comorbid conditions, or those who were lost to follow-up.

Clinical Management

All patients were admitted to the neurotrauma unit of our department, where they received a graded plan of care while being constantly monitored for vital signs and frequently examined neurologically. Within 24 hours of sustaining a head injury, all patients got a CT scan of the brain and the results were recorded. Clinical information, such as the individual's age, gender,

the nature of their head injury, time since injury, arrival GCS, pupil size and reactivity, surgical management provided, if any, and final clinical status at 3 months were all recorded. All 3-month assessments were performed via the outpatient department. The outcome was categorized using the Glasgow Outcome Scale (GOS) as Good or Poor at 3 months. GOS scores of 4 – 5 were considered a "Good" outcome, while scores of 1 – 3 were considered a "Poor" outcome.

Data Analysis

SPSS Version 24.0 was used to analyze the data to obtain the mean and p values. A P-value of 0.05 was regarded as significant.

RESULTS

Gender & Age Distribution

With a male-to-female ratio of 4.9:1, men accounted for the majority of head trauma patients (n = 232; 83.2%), while women made up only 47 cases (16.8%). The vast majority of study participants were between the ages of 18 and 36 (n = 107; 38.4%), followed by those between the ages of 37 and 50 (n = 89; 31.9%), and the remainder were older than 50 (n = 83; 29.7%) with the mean age being 42.3 ± 16.3 years as shown in Table 1.

Mechanism of Trauma

Road traffic accidents (n = 163; 58.4%) were the most common mode of head trauma, with Others (assaults and sports) (n = 71; 25.4%) being next in line and fall being least common (n = 45; 16.1%).

Time to Arrival and GCS

The most common GCS on admission was 7 (n = 68; 24.4%), while 3 (n = 29; 10.4%) was the least common, shown in Table 1. The mean time since injury (injury to hospital arrival) was 3.8 hours.

Injury Type

In 27 (9.7%) patients, a CT scan brain showed no intracranial traumatic lesion. The remainder, however, exhibited typical intracranial conditions associated with a head injury, including contusion (n = 120; 43.0%), subarachnoid hemorrhage (n = 165; 59.1%), extradural hematoma (n = 50; 17.9%), skull fracture (n = 115; 41.2%), subdural hematoma (n = 33; 11.8%), and intraventricular hemorrhage (n = 18; 6.5%) (See Table 1).

Pupillary Reactivity

53 patients (19.0%) had anisocoria, 68 (24.4%) had non-reactive (non-dilated) pupils, and 158 (56.6%) patients had equally responsive pupils.

Surgical Management

A total of 101 (36.2%) patients underwent surgical intervention (hematoma evacuation, elevation of depressed fracture, decompressive craniectomy, EVD placement), while the rest 178 (63.8%) were managed conservatively (See Table 1).

Tracheostomy

A total of 24 (8.6%) patients in our study underwent tracheostomy during the hospital stay.

Outcome at 3 Months

According to our study, 118 (42.3%) patients with head injuries had Good outcomes as opposed to 161 (57.7%) patients who had poor outcomes. The mortality rate in our study was 35.13%.

Comparison

As shown in Table 2, only 7 (24.2%) of the 118 individuals in the group with a satisfactory outcome initially presented with a GCS score of 3, 10 (27.8%) patients had a score of 4, 13 (42.0%) had a score of 5, 20 (40.0%) had a score of 6, 34 (50.0%) had a score of 7 and 34 (52.3%) patients had a GCS score of 8 on admission. When

considering GCS on admission, only 31 (47.7%) patients with a score of 8 had poor outcomes, while the majority of the patients presenting with a GCS of 3, 22 (75.8%) had poor outcomes. Therefore, in our study decreasing GCS score on admission correlated with poorer outcomes with P-value = 0.040.

Table 1: Patient Demographics, Injury Features, Patient Attributes, and Research Results.

	Frequencies (Percentage)
Patients' Data	
Age (Mean 42.33, S.D ± 16.23)	
18 – 36	107 (38.4%)
37 – 50	89 (31.9%)
> 50	83 (29.7%)
Gender	
Male	232 (83.2%)
Female	47 (16.8%)
Mechanism of Injury	
Road Traffic Accident (RTA)	163 (58.4%)
Fall	45 (16.1%)
Others (assault, sports)	71 (25.4%)
GCS on Admission	
3	29 (43.9%)
4	36 (12.9%)
5	31 (11.1%)
6	50 (17.9%)
7	68 (24.4%)
8	65 (23.3%)
CT Findings	
Extra Dural Hematoma (EDH)	
Yes	50 (17.9%)
No	229 (82.1%)
Contusion	
Yes	120 (43.0%)
No	159 (57.0%)
Subdural Hematoma (SDH)	
Yes	33 (11.8%)
No	246 (88.2%)
Subarachnoid Hemorrhage (SAH)	
Yes	165 (59.1%)
No	114 (40.9%)
Intraventricular Hemorrhage (IVH)	
Yes	18 (6.5%)
No	261 (93.5%)
Skull Fracture (SF)	
Yes	115 (41.2%)
No	164 (58.5%)
Pupils	
Bilateral equally reactive	158 (56.6%)
Anisocoria	53 (19.0%)
Nonreactive(non-dilated)	68 (24.4%)
Management	
Surgical	101 (36.2%)
Conservative	178 (63.8%)
Outcome at 3 Months	
Good Outcome	118 (42.3%)
Poor Outcome	161 (57.7%)

A total of 101 (36.2%) patients were managed surgically out of which 45 (44.5%) had good outcomes while 73 (41.0%) out of the 178 (63.8%) that were managed conservatively had good outcomes. There was no significant outcome association with management provided in our study (P value; 0.751).

Among the group of patients with favorable outcomes, 77 (65.3%) had equally reacting pupils, 22 (18.7%) had anisocoria, and 19 (27.9%) had non-reacting pupils. Apart from this, if we consider pupillary responsiveness, 77 (48.7%) patients who presented with equally reacting pupils had good outcomes compared to 81 (51.3%) patients, whereas 22 (41.5%) patients with anisocoria had good outcomes compared to 31 (58.5%) patients. Patients who came with non-reacting pupils had better outcomes in 19 cases (27.9%), compared to 49 cases (72.1%), where they fared worse. This came out to be statistically significant with a P-value of 0.010 (See Table 2).

No correlation with the outcome was identified when age and gender were taken into account (P values = 0.515 and 0.998, respectively).

DISCUSSION

TBI is a serious cause of mortality and disability that is a global health and socioeconomic burden.[13] Predicting outcomes across the TBI range is difficult due to the complex and variable nature of brain injury, especially for patients with more severe injuries. Critical care clinicians are frequently faced with the problem of assisting families in making key decisions, such as whether to continue or discontinue life-sustaining

Table 2: Cross-tabulation and Statistical Stratification of Factors with Study Results.

	Overall Outcome		Total (%)	P Value
	Good n =118 (42.3%)	Poor n = 161 (57.7%)		
Age				
18-36	47 (43.9%)	60 (56.1%)	107 (38.4%)	0.515
37-50	36 (40.4%)	53 (59.6%)	89 (31.9%)	
>50	35 (42.2%)	48 (57.8%)	83 (29.7%)	
Gender				
Male	98 (42.3%)	134 (57.7%)	232 (83.2%)	0.998
Female	20 (42.4%)	27 (57.5%)	47 (16.8%)	
Mode of Injury				
RTA	70 (42.9%)	93 (57.1%)	163 (58.4%)	0.190
Fall	24 (53.4%)	21 (46.6%)	45 (16.1%)	
Others	24 (33.8%)	47 (66.2%)	71 (25.4%)	
GCS on admission				
3	7 (24.2%)	22 (75.8%)	29 (43.9%)	
4	10 (27.8%)	26 (72.2%)	36 (12.9%)	
5	13 (42.0%)	16 (58.0%)	31 (11.1%)	**0.040***
6	20 (40.0%)	30 (60.0%)	50 (17.9%)	
7	34 (50.0%)	34 (50.0%)	68 (24.4%)	
8	34 (52.3%)	31 (47.7%)	65 (23.3%)	
Management				
Surgical	45 (44.5%)	56 (55.5%)	101 (36.2%)	0.751
Conservative	73 (41.0%)	105 (59.0%)	178 (63.8%)	
Pupils				
BERL	77 (48.7%)	81 (51.3%)	158 (56.6%)	**0.010***
Anisocoria	22 (41.5%)	31 (58.5%)	53 (19.0%)	
Nonreactive	19 (27.9%)	49 (72.1%)	68 (24.4%)	

treatment, based on information they believe is pertinent to predicting long-term functional outcomes.[14] Although there have been many publications on clinical outcomes following TBI, the majority of these researches have concentrated on clinical outcomes in high-resource regions. Even though the etiology is probably similar, there may be disparities in clinical management and socio-rehabilitative factors that affect clinical results.[15]

In our study, young adults aged 18 to 36 made up the majority of individuals (38.4%), with a mean age of 42.33 years and a standard deviation of 16.23. Research by Puffer RC et al. revealed that people between 18 – 45 years (58%) are most commonly affected by head injuries.[16] The 20–40 age bracket was shown to be the most commonly impacted by brain injury in another study by Kraus et al.[17]

McCrea et al, reported that the prevalence of severe head injury is higher in men compared to women, with 78.2% males and 21.8% females.[18] Likewise, Ruet A. et al, reported males to be more commonly affected by head trauma making up 79 percent of the total body.[19] Similar to other studies, ours found that, with a male-to-female ratio of 4.9:1, males were more frequently afflicted.

According to the literature, gender and age are significant outcome determinants.[20] According to research by Forslund MV et al. men who presented with moderate to severe TBI had better GOSE scores over 10 years than women.[21] Another study by Fabbri et al, revealed no conclusive data that patients' age affected their prognosis after sustaining head trauma.[22] Also, in

a study done by Palekar SG et al, age and gender had no role in predicting outcomes.[20] With respective p-values of 0.515 and 0.998, age and gender in our study did not significantly predict the outcome of head injury.

The literature indicates that the GCS score upon admission has a significant predictive value. Reduced admission GCS scores are linked to poor outcomes.[23] However, Lipper MH et al, demonstrated that GCS score on admission had no significant role in predicting outcomes in head trauma patients.[24] But, Palekar SG et al, demonstrated in their study that decreasing GCS on admission was linked to a worse outcome.[20] Lower GCS on admission in patients with severe TBI were related to worse prognosis, according to research by Bonow RH et al, conducted in a setting with quite limited resources.[15] Likewise, McCrea MA et al. reported 125 of 278 (45%) patients presenting with severe traumatic brain injury to reach good recovery at the end of 3 months.[18] In our study, out of a total of 279 patients, 118 (42.3%) patients had good outcomes, while 161 (57.7%) patients had poor outcomes, which is similar to other literature where there is a substantial correlation between worse outcomes and increasing TBI severity (p-value = 0.040).

Although the mortality rate among patients in our study was higher than that reported in the literature, the percentage of patients who achieved functional results did not significantly change. For instance, several studies on severe TBI found mortality rates between 24 to 30 percent, which is far lower than the 35.13 percent we saw. In these trials, 43 – 54% of patients had good outcomes, which were characterized as moderate disability or better; 42.3% of our patients had this result.[25-26] Another study done in Latin America, showed 38% mortality with 44% of patients reaching good functional outcomes, which is quite similar to our study.[15] Likewise, McCrea MA et al. reported a 12-month mortality of 30.6 percent in patients admitted with severe traumatic brain injury.[18]

According to the literature, the abnormal pupillary response is related to worse outcomes.[23] Palekar SG et al. reported abnormal pupillary response to be a significant factor in the outcome.[17] Bonow et al, in their study, did not find pupillary examination to have any significant effect on the outcome.[15] In our study, out of 68 patients, 49 (72.1%) patients presenting with non-reactive pupils had poor outcomes as compared to only 81 out of 158 (51.3%) of those with equally reacting pupils. Likewise, 31 patients out of 53 (58.5%) patients with anisocoria had poor outcomes. Thus, in our research, we found that abnormal pupillary reaction was significantly correlated with worse outcomes with a P value of 0.010.

Based on the GOSE score, earlier research on severe TBI has demonstrated a gradual improvement in satisfactory outcomes from 3 months to 24 months after the injury. The results of those research indicate that two years after their injuries, two-thirds of people with severe TBI improve their outcome from being unfavorable to favorable.[27] This highlights the significance of spontaneous natural recovery and neuro-rehabilitative therapies. Therefore, when comparing a study done by McCrea MA et al, acute management whether surgical or conservative did not have a significant effect on the outcome as most of the interventions are to prevent secondary brain injury.[18] Likewise in our study management plan did not affect the outcome (P value: 0.751)

RECOMMENDATIONS

According to a recent review of the literature, there is no difference in treatment outcomes between patients with severe TBI treated in high-resource versus low-resource setups like ours. This demonstrates that despite advancements in our understanding of the mechanisms behind TBI and general hospital care, people with severe TBI

may not have significantly improved outcomes as a result of existing research. Further research is needed to understand how sociocultural and rehabilitative elements affect patients' ability to recover from severe TBI over the long term.

LIMITATIONS

The major limitation of this study was the small sample size as compared to a very large trauma burden in our tertiary care hospital. A single hospital study cannot help in the prediction of outcomes and multiple tertiary care units must be taken into account to mean out the facilities available in our country. We did not employ ICP measurement techniques, which is a standard worldwide and affects the decision between medical and surgical management and should be used to measure ICP in severe traumatic brain injury. Another very important limiting factor of this study was the three-month follow-up period, which in actuality is very short as the rehabilitation of patients with severe traumatic brain injury continues for several months and therefore outcome changes over a matter of years. Larger multi-center studies are required to determine the outcome of such patients in our setup to help in guiding the clinicians with treatment strategy and realistic family counseling.

CONCLUSION

Despite the high mortality rate among patients with severe TBI in our study, the rate of good outcomes is comparable to that of other recent studies. The outcome of our study is related to initial injury severity and pupillary reactivity. This can aid in directing clinical judgment and setting reasonable expectations for family members.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.
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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.
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AUTHORS' CONTRIBUTION

S. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Arfa Qasim	Study design and methodology.
2.	Iram Bokhari	Literature review and referencing.
3.	Lal Rehman	Final review and approval.
4.	Farrukh Javeed	Data collection and calculations.
5.	Haris Hamid	Interpretation of results.
6.	Rubab Qadir	Analysis of data.
7.	Bisma Qasim	Data collection and calculations.