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KEY WORDS: Coagulopathy, Hyperglycemia, Hyperthermia, Hypotension

EVALUATION OF PATTERN, PROGNOSTIC FACTORS AND OUTCOME OF TRAUMATIC BRAIN INJURY IN THE INTENSIVE CARE UNIT

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ABSTRACT

Study Design: Retrospective hospital-based study. **Background:** Traumatic Brain Injury (TBI) is a major challenge in the Intensive Care Unit (ICU) with a high mortality. The management of TBI patients in the ICU involves a high level of general care along with strategies to prevent secondary brain insults. **Objectives:** 1. To study the clinical spectrum of TBI patients in ICU. 2. To evaluate the risk factors associated with poor outcome in these patients. **Method:** A retrospective hospital-based study was carried out on 224 patients of TBI. Information of patients such as socio-demographic profile, neuro-image findings, head injury related parameters and their associated outcome were recorded and analyzed. **Results:** Among 224 patients, male and female were 76.79% and 23.21% respectively. The mean age of patients was 32 years. The most frequent cause of TBI was Road Traffic Accidents (RTA) (85.27%) followed by assault (6.25%). Majority of the patients (92.41%) had severe TBI. During the course of hospital stay, 18.30% patients received blood transfusions, 95.98% patients underwent mechanical ventilation, 32.14% patients developed VAP, 42.41% patients had hyperglycemia, 46.88% patients developed hyperthermia within 48 hours of injury and 67.86% patients had hypotension on admission. The overall mortality rate was 48.21%. **Conclusion:** TBI is common in young males and prognosis is poor with increasing age. Coagulopathy, Hyperglycemia, Hyperthermia and Hypotension are poor prognostic factors in TBI patients. Aggressive and timely management of these parameters can improve the outcome in TBI patients.

INTRODUCTION

A Traumatic Brain Injury (TBI), also known as an intracranial injury, is an injury to the brain caused by an outside force. TBI is the third cause of death in all age groups, after malignancy and cardiovascular diseases[1] and is a is a major challenge in the Intensive Care Unit (ICU). Causes of TBI include Road Traffic Accidents (RTA), falls and physical assault. Due to increased urbanization and motorization, there has been a rise of TBI patients in developing countries like India.[2] TBI are classified as mild (GCS 13–15), moderate (GCS 9–12), and severe (GCS 8 and below). Patients with severe TBI are often admitted and managed in the ICU. It has been documented that morbidity and mortality following TBI is determined by the severity of head injury and the presence of secondary insults such as coagulopathy, hypoxia, hypotension, hyperglycaemia and acidosis.[3] The management of TBI patients in the ICU involves a high level of general care along with strategies to prevent secondary brain injuries. The outcome of TBI managed in the ICU of Gauhati Medical College & Hospital, Guwahati and Down Town Hospital, Guwahati was reviewed in terms of outcome and its associated factors.

METHOD

A retrospective hospital-based study was conducted at ICU of Gauhati Medical College & Hospital, Guwahati and Down Town Hospital, Guwahati on 224 patients of TBI admitted during July 2020 to June 2023. The admission and discharge registers, doctors' and nurses' notes were retrieved and examined. Data retrieved included socio-demographic profile, etiology of TBI, neuro – image findings, various head injury related parameters and their associated outcome in terms of mortality. All information were entered in individual case sheet.

Statistical Analysis

All data was plotted in Microsoft Excel Sheet. Data was calculated in absolute numbers and presented in percentage scale. Graphical representation of the data was done with Microsoft Word.

RESULTS

Among 224 patients, 172 (76.79%) were males and the rest 52 (23.21%) were females. Patients' age ranged between 11 - 80 years with a mean age of 32 years. Majority of the patients belonged to the age group 31 - 40 years 59/224 (26.34%), followed by 21 - 30 years 46/224 (20.54%). RTAs represented the most frequent cause of TBI 191/224 (85.27%), followed by assault 14/224 (6.25%), fall of heavy object on head 10/224(4.46%) and fall from height in 9 patients (4.02%) respectively. Patients with severe TBI represented the majority of the patients 207/224 (92.41%). This was followed by moderate TBI in 15 (6.69%) patients and mild TBI in 2 (0.89%) patients. Neuro – imaging studies revealed contusion in 102 (45.54%) patients, Epidural Hematoma (EDH) in 26 (11.61%) patients, Subdural Hematoma (SDH) in 48 (21.43%) patients, Subarachnoid Hemorrhage (SAH) in 38 (16.96%) patients, skull fracture in 17 (7.6%) patients, Intraventricular Hemorrhage (IVH) in 5 (2.23%) patients and Diffuse Axonal Injury (DAI) in 30 (13.4%) patients. Majority of the patients 163/224 (72.77%) with TBI stayed between 1 and 7 days, followed by 24 patients (10.71%) who stayed between 8–14 days. Out of the 224 patients, 108 patients (48.21%) expired, and the rest of the patients recovered and were shifted to the ward. Out of these 108 patients, 98 patients had a hospital stay of less than 7 days. During the course of hospital stay, 41 patients (18.30%) received blood transfusions out of which 12 expired. 215 patients (95.98%) underwent mechanical ventilation out of which, 72 patients (32.14%) developed VAP. 37/72 patients (51.39%) developing VAP after mechanical ventilation expired. Among the 224 patients, 95 patients (42.41%) had hyperglycemia out of which 65 expired. 105 patients (46.88%) developed hyperthermia within 48 hours of injury out of which 80 expired. 152 patients (67.86%) had

hypotension on admission out of which 99 expired.

Table 1: Socio - Demographics Of Study Participants

Variables	Numbers (%)
Sex	
Male	172(76.78%)
Female	52(23.21%)
Age (years)	
11 - 20	29(12.95%)
21 - 30	46(20.54%)
31 - 40	59(26.34%)
41 - 50	44(19.64%)
51 - 60	36(16.07%)
61 - 70	8(3.57%)
71 - 80	2(0.89%)

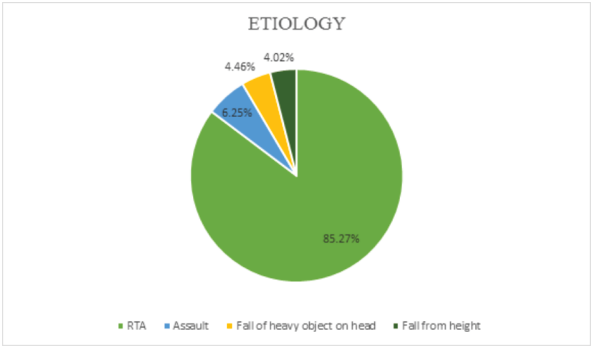

Figure 1: Etiology Of TBI

Table 2: Severity, Hospital Stay And Outcome Of Study Participants

Variables	Numbers (%)
Severity of head injury	
Mild	2(0.89%)
Moderate	15 (6.69%)
Severe	207(92.41%).
Hospital stay (days)	
1 - 7	163(72.77%)
8 - 14	24(10.71%)
15 - 21	20(8.93%)
22 - 28	13(5.8%)
> 28	4(1.79%)
Outcome	
Recovered	116(51.79%)
Died	108(48.21%)

Table 3: Neuro-image Findings Of Study Participants With Associated Outcome

Neuro image finding	Numbers	Mortality – Numbers (%)
Contusion	102	40 (39.21%)
EDH	26	4 (15.38%)
SDH	48	24 (50%)
SAH	38	30 (78.95%)
Skull Fracture	17	2 (11.76%)
IVH	5	3 (60%)
DAI	30	22 (73.33%)

Table 4: Head Injury Related Parameters Of Study Participants And Their Associated Outcome

Variables		Numbers (%) Recovered	Numbers (%) Died	Numbers Total
Age	11 - 20	18(62.1%)	11(37.93%)	29
	21 - 30	28(60.87%)	18(39.13%)	46
	31 - 40	34(57.63%)	25(42.37%)	59
	41 - 50	26(59.1%)	18(40.9%)	44
	51 - 60	8(22.22%)	28(77.78%)	36
	61 - 70	2(25%)	6(75%)	8
	71 - 80	0(0%)	2(100%)	2
Hospital stay (days)	1 - 7	67(41.10%)	96(58.89%)	163
	8 - 14	20(83.33%)	4(16.67%)	24
	15 - 21	16(80%)	4(20%)	20
	22 - 28	10(76.92%)	3(23.07%)	13
	> 28	3(75%)	1(25%)	4
Blood transfusion	Yes	29(70.73%)	12(29.27%)	41
	No	87(47.54%)	96(52.46%)	183
Mechanical ventilation	Yes	107(49.77%)	108(50.23%)	215
	No	9(100%)	0(0%)	9
VAP	Yes	35(48.61%)	37(51.39%)	72
	No	81(53.29%)	71(46.71%)	152
Hyper-glycemia	Yes	30(31.58%)	65(68.42%)	95
	No	86(66.67%)	43(33.33%)	129
Hyperthermia	Yes	25(23.81%)	80(76.19%)	105
	No	91(76.47%)	28(23.53%)	119
Hypotension on admission (SBP < 90 mm Hg)	Yes	53(34.87%)	99(65.13%)	152
	No	63(87.5%)	9(12.5%)	72

DISCUSSION

Developing countries like India are experiencing a rapid increase in economic growth leading to increased motorization and thereby increased incidence of RTAs leading to TBI. This retrospective study included analysis of various head injury related parameters of 224 patients and evaluating the prognostic indicators of TBI patients in ICU. Among 224 patients, 76.79% were males and 23.21% were females. Age of patients varied from 11 years to 80 years with a mean age of 32 years. Majority of the patients (26.34%) belonged to the age group of 31 - 40 years followed by age group of 21 - 30 years (20.54%). KU Tobi et al. in their study of 182 TBI patients in ICU had a M:F ratio of 3:1. Mean age of the patients was 34 years. The most common age group involved in TBI was 31 – 40 years (24.2%) followed by 21 – 30 years (19.8%).[4] Opondo et al. in their study had observed that the average age of severe TBI patients admitted in ICU was 34 years with more males affected.[5] Mean age of head injuries were 33.4 years, 32 years and 33.47 years in similar studies conducted by Tian et al., Aykut et al. and Agarwal et al., respectively.[6-8] This 31 – 40 years age group is active physically and socially and is therefore more vulnerable for injury. The male predilection has been postulated to be due to the fact that adult males are more engaged in active outdoor activities like fast driving, aggressive behaviour and influence of alcohol in contrast to females. The most common cause of TBI in our study was RTA 85.28% (191/224) which is comparable to the study by KU Tobi et al. at 89.6%.[4] Idowu OE et al. [9] and Hyder AA et al.[10] also found RTA to be the commonest cause of TBI in their studies. The increased incidence of TBI due to RTA may be attributed to sheer increase in the traffic volume and ignorance of safety measures and road safety rules while driving. The mortality rate in our study was 48.21% which is comparable to the study by KU Tobi et al. at 52.2%.[4] In our study, patients above 50 years had a mortality rate of 78.26% whereas patients younger than 30 years had a mortality rate of 38.67% (2.02: 1). In a study by Ashish Anand et al., patients above 50 years had a mortality rate of 11.77%, whereas patients younger than 30 years had a mortality rate of 6.57% (1.79 : 1).[11] Mosenthal et al. observed that geriatric population had twice the mortality from TBI as compared to younger patients.[12] Similarly, Munro et al. and few other authors also found that patients older than 65 years had a poor survival rate than patients who were less than 65 years old.[13-16] This high mortality in the older age group may be because of intrinsic changes of the ageing brain, pre-existing co-morbidities and adverse effects of general anesthesia and surgery. Majority of the patients (72.77%) had a hospital stay of less than 7 days. Patients who stayed longer than seven days had a better outcome. Mortality rate in patients whose hospital stay was <= 7 days was 3 times

as compared to those who stayed for more than 7 days. KU Tobi et al. in their study found that patients who stayed between 1 and 7 days were 4 times more likely to die in the ICU compared to those who stayed for more than 7 days.[4] Longer stay in the ICU could be a result of clinical improvement in these patients, which could be related to a lesser degree of injury. In our study, patients with SAH had the highest mortality (78.95%) followed by DAI (73.33%). Ashish Anand et al. in their study also found that traumatic SAH had the worst prognosis among all the various pathologies.[11] Coagulopathy is a common occurrence following brain damage and requires immediate and aggressive management to avoid anaemia, which could lead to secondary brain insult. In our study, 18.30% of the total TBI patients received blood transfusions. The mortality rate in TBI patients who received blood transfusion was 29.27% as compared to 52.46% in those who didn't receive blood transfusion. KU Tobi et al. in their study also found a better outcome in TBI patients who received blood transfusion.[4] In our study, 95.98% patients were mechanically ventilated, and 32.14% patients developed VAP. Mechanical ventilation is often indicated in patients with severe TBI to avoid hypoxia and to maintain normocarbia. The higher number of mechanically ventilated patients in our study may be due to the fact that majority of our patients had severe head injury with poor GCS. The mortality rate in patients who developed VAP was 51.39% as compared to 46.71% in patients who didn't develop VAP. Yating Li. et al. also found that VAP does not increase the mortality in patients with TBI.[17] In our study, 42.41% patients had hyperglycemia. The mortality rate in patients who had hyperglycemia was 68.42% as compared to 33.33% in those who didn't have hyperglycemia. In a study by Simin Babaie Kafaki et al. of 220 TBI patients, 39% of the patients had hyperglycemia. The mortality rate in patients who had hyperglycemia was 65.8% as compared to 23.7% in patients who didn't have hyperglycemia, which is comparable to our study.[18] Hyperglycemia is a common complication of critical illness.

Hyperglycemia has been shown to elicit direct vasoconstrictor effects in renal vessels resulting in endothelial dysfunction. It induces an exaggerated inflammatory response resulting in micro vascular complications that could contribute to increased morbidity and mortality.[19] Increased intracellular glucose levels also activate oxidative stress initiating a deleterious metabolic cascade of enhanced polyol activity, which increase the formation of advanced glycation end products, activation of protein kinase C and nuclear factor kB. Ultimately these responses have a detrimental effect on the health of the endothelium.[20] By increasing circulating concentrations of stress hormones, acute illness can exacerbate hyperglycemia which in turn can exacerbate acute illness by decreasing immune function and increasing oxidative stress. This leads to a vicious cycle of worsening illness and poor glucose control. In our study, 46.86% patients developed hyperthermia within 48 hours of injury. The mortality in patients who developed hyperthermia within 48 hours of injury was 3.24 times as compared to those who didn't develop hyperthermia. In a study by Srikrishna Majhi et al., 44.9 % patients developed hyperthermia within 48 hours of injury. The mortality in patients who developed hyperthermia within 48 hours of injury was 5.11 times as compared to those who didn't develop hyperthermia.[21] Fever occurs with an incidence of up to 70% in neurologically injured patients and typically is not an isolated event but rather a sustained response seen for as long as 2 weeks following injury.[22,23] The net effect of fever is reduction in internal perfusion pressure with diminished oxygenation of brain tissue resulting in cerebral oedema. The association of early development of fever with poor outcome is probably because a compromised brain tissue is more susceptible to oxygenation deficit.[24] In addition, fever causes a generalized increase in metabolic rate (7-10% increase per increase in core temperature), with corresponding increase in minute ventilation and oxygen consumption which can be detrimental.[25] In our study, 67.86% patients had hypotension on admission. Mortality in patients who had hypotension on admission was 65.13% as compared to 12.5% in patients who didn't have hypotension. Simon Rauch et al. and Geoffrey Manley et al. also found a higher mortality rate in TBI patients who presented with hypotension on admission.[26,27] The injured brain is sensitive to secondary ischaemic insults, which may be compounded by the relative inability to increase cerebral blood flow in response to hypotension. Three additional studies [28-30] have confirmed that the presence of shock on admission is associated with increased mortality in patients with head injury.

CONCLUSION

TBI is common in young males and prognosis is poor with increasing age. The incidence is rising day by day due to the increasing number of RTAs which constitute a significant proportion of TBIs. Patients with TBI are at high risk of developing coagulopathy and timely interventions including blood transfusion can help improve the prognosis in these patients. Hyperglycemia is related with increased mortality rate in TBI patients, and comprehensive treatment of hyperglycemia can improve the outcome of severe head injury patients. Fever acts as an independent prognostic factor in patients of TBI and is associated with a poor outcome. Hypotension in the initial phase of resuscitation is associated with increased mortality following TBI, even when episodes are relatively short. Prevention of hyperthermia and hypotension is necessary for speedy recovery of TBI patients.

Conflicts of Interest: The authors declare no conflict of interest.

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