DOI: https://doi.org/10.53350/pjmhs20221611407

ORIGINAL ARTICLE

Predictors of Early Outcome in Patients Admitted at the Emergency Department with Traumatic Brain Injury: a Retrospective Cross-Sectional Study

MUHAMMAD ASLAM SHAIKH[1], IRFANULLAH SHAH[2], KHALID MEHMOOD[3]
[1]*Associate Professor Neurosurgery Chandka Medical College Shaheed Mohtarma Benazir Bhutto Medical University Larkana*
[2]*Consultant NeuroSpine. King Fahad Armed Forces Hospital. Jeddah. Saudi Arabia*
[3]*Clinical Fellow in Neurosurgery. Ninewells Hospital Dundee. Scotland United Kingdom.*
Corresponding author: Muhammad Aslam Shaikh, Email: aslamdr71@yahoo.com

ABSTRACT

Aim: The purpose of this study was to determine the factors that help predict early mortality in patients in the emergency department that have suffered a severe traumatic brain injury.
Study design: A retrospective cross-sectional study
Place and duration: Chandka Medical College/ Civil Hospital Larkana.
April 2018- March 2020
Methodology: Retrospective analysis was used to study 198 patients that were admitted to the emergency department due to severe traumatic brain injury. The radiological, clinical, basic demographical, and biological data were all recorded when the patient was first admitted and while they were staying in the emergency department.
Results: The results showed that 42 patients died. According to the univariate analysis, the presence of low value of Glasgow coma scale, bilateral mydriasis, shock, the high value of injury severity score, and cardiac arrest played a major role in the deaths of such patients. Poor outcome was associated with cerebral hematoma, subdural hematoma, and meningeal hemorrhage. A link was seen between poor prognosis and cardiac arrest and cerebral hematoma.
Conclusions: In our study, subdural hematoma, intracranial hematoma, and meningeal hemorrhage were associated with mortality. To improve the prognosis of severe traumatic brain injury, prehospital care has to be improved. Additionally, futile resuscitations should be avoided. It is also very important to take a CT scan of the head as urgently as possible to detect operable mass lesions.
Keywords: traumatic brain injury, early outcome, emergency department

INTRODUCTION

Traumatic brain injury has been listed as one of the major causes of death, disability, and economic cost in the world. The abbreviation of traumatic brain injury is TBI. It is one of the major problems faced by public health departments. In Europe, the estimated annual incidence of traumatic brain injury is 500 for 100,000 people. In every 100,000 hospital admissions, 200 are traumatic brain injuries. Traumatic brain injury is said to be heterogeneous in prognosis, pathology, cause, and severity. If a Glasgow coma scale (GCS) score of 8 or less than 8 is recorded during the first post-traumatic day, the injury is said to be TBI (1). Intensive care is required for such trauma in the intensive care unit or the ICU. The emergency department faces a lot of pressure from the management as the death rate is very high on the first day. On the first day, more than 40% of death occur. Whereas 60% of deaths occur by the second day. There has been a lot of research conducted on trying to identify the early predictors of mortality as well as the functional outcome (2). Many factors affect the results of head trauma including GCS, age, intracranial pressure, gender, hypoxia, pupillary size and responsiveness, and computed tomography results (3). In most hospitals in our area every patient is admitted first to the emergency room and then later transferred to the ICU. The study aims to examine the incidence and the reasons for head injuries. It also focuses on finding and defining the predictive factors that are indicators of a poor prognosis that can be utilized in the emergency department

METHODOLOGY

All the patients arrived with severe traumatic brain injury in the emergency room of Chandka Medical College/ Civil Hospital Larkana from April 2018 to March 2020 were included in the retrospective study. Permission was taken from the ethical review committee of the institute. Clinical notes were used in the data collection. Three emergency rooms were, medical, trauma, and surgical, in our institute. Our hospital is a government hospital that caters to the needs of the people of the remote area of Pakistan. Most patients involved in this study were admitted to the hospital within six hours of injury. Before the use of any sedative, the patients were examined, and their neurological status was measured by the GCS score when they arrived at the hospital. Patients that had a GCS score of eight or less than 8, shock, or respiratory distress, or sedated were ventilated, and incubated according to their need in the resuscitation room. As soon as possible, the patients had a secondary brain CT scan. If a prominent operable lesion was discovered, the patient underwent an operation. The patients that did not require such measures were treated using ICP monitoring, ventilatory support, anti-edema drugs, and anti-convulsion. If there was a suspicion of extracranial pathology, it was investigated accordingly. The collection of data from the medical files of the patients was based on the cause of injury, age, vital signs (respiratory rate, systolic and diastolic blood pressure, heart rate), gender, GCS score, RVT (revisited trauma score), AIS (abbreviated injury score), TISS (Trauma injury severity score), ISS (injury severity score), pupil response, convulsion, motor deficit, use of inotropic drugs, use of mechanical ventilation, cardiac arrest, shock, and fluid intake volume. Hemoglobin concentration, arterial blood gases and acid, platelet count, blood urea, and sodium level were measured when the patient was first admitted. All patients had a plain radiographic study of the neck and cranial CT scan done. The results of the CT scan showed whether hematoma was present or absent, as well as if there was cerebral edema, meningeal hemorrhage, cerebral contusion, intracranial mass lesion, and pneumocephalus. When the patient was admitted, the relevant therapeutic measures, as well as all the biological, radiological, clinical parameters were registered.

Categorical data was defined as subgroups (survival and death) and proportions. Statistical package for social science version 22 was used to analyze data. The evaluation of subgroups was done using the t-test. Whereas continuous data was defined as mean ± standard deviation. The relationship between mortality and factors that affect it (age, ICP, traumatic subarachnoid hemorrhage, gender, cerebral contusion, GCS, intracranial hematomas) was evaluated using the Chi-squared test. If a P-value was less than 0.05, it was considered important. Multivariate analysis was used to evaluate risk factors. It involved a stepwise logistic regression. The estimation of odds ratios was done by the b coefficients. The GCS score, RTS, ISS score, and TRISS were analyzed and utilized in predicting mortality. The analysis was done using receiver operating characteristic curves.

RESULTS

A total of 198 people participated in this study, 21 out of 198 were female and 177 out of 198 were male. These patients represented 19.8% of post-traumatic adult admissions and 37.2% of patients admitted for head trauma. The mean of their age was 30.40±16.0 years, ranging from 4 to 78 years. In 86.4% of the cases, the traumatic head injury was because of a road traffic accident. In 13.6% of the cases, the injury was due to a fall from a height. The prehospital team provided stabilization of vital functions and transport in 44% of the case, while in the 7.1% cases, fighters provided it. In the case of 68 patients, ambulances had provided the transport. Table 1 represents the clinical and demographical parameters of the patients at admission.

All patients that were admitted had a brain CT scan. Table 2 shows the findings of the brain CT scan. Skull fracture (61%) and meningeal hemorrhage (59.2%) are the most frequent according to results. In 22.2% of the cases, the head trauma was isolated. It was related to other conditions in the other cases, such as it was related to chest trauma in 53% of the cases, pelvis trauma in 51% of the cases, and abdominal trauma in 32% of the cases. Table 3 represents the number of occurrences of secondary systemic insult. While at the emergency, catecholamines were needed by 28.8%, epinephrine by 6.1%, and norepinephrine by 22.7% of the patients. A total of 46 patients that is 23.2% of the patients, required transfusion. 36% of the patients were admitted to the operative room. The mortality rate of the patients was 21.2%. Table 4 represents the factors that affect death using univariate analysis. In this table, the population is divided into two categories: non-survivors and survivors. According to the univariate analysis, there is a link between death and bilateral mydriasis and cardiac arrest. In the study, there was not much difference in the mean age of a non-survivor (37.3±21.1) and of a survivor (32.7±15.0) (P=0.20). Another noticeable point is that poorer outcome was linked with cerebral hematoma, meningeal hemorrhage, and subdural hematoma.

When a patient was admitted, if they have a low value of GCS and a high value of ISS, there was a significant effect on the result. The mean hospital stays of non survivors (0.7±0.7) and survivors (0.92±1.1) had no major difference.

Table 1: The clinical parameters and demographic parameters of the population under study in an emergency room.

Parameter	Mean +-SD	Number (%)
Age (years)	30.40±16.0	-
Gender M/F	-	180/22
HR (beats/min)	90.5±30.00	-
SBP (mmHg)	112±29.00	-
Cardiac arrest		18 (10.0)
GCS score	5.02±2.10	-
Anisocoria	-	19 (9.0)
Bilateral mydriasis	-	14 (8.2)
Convulsion	-	10 (5.0)
Epistaxis	-	16 (8.1)
Otorrhagia	-	10 (5.4)
AIS chest ≥4	-	49 (26.3)
AIS abdomen ≥4	-	10 (5.1)
AIS extremities ≥4	-	4 (1.9)
ISS	30.3±12.34	-
RTS	6.2 ±5.1	-
TRISS	42± 32.2	-
Pathologic antecedent		21(10)

Table 2: Brain CT scan results

CT scan signs	Number (%)
Normal	7 (4)
Meningeal hemorrhage	119 (59.2)
Cerebral edema	61 (32.4)
Cerebral contusion	99 (49.2)
Extradural hematoma	38 (19.1)
Subdural hematoma	80 (40.4)
Pneumocephalus	41 (20.2)
Mass lesion	19 (9.1)
Skull fracture	120 (61.0)
Depressed skull fracture	30 (15.2)

Table 3: Number of occurrences of secondary systemic insult

Insult	Number (%)
Arteriel hypotension (<90 mmHg)	44 (22.1)
Hyponatraemia	21 (9.8)
Hypernatraemia (>145 mmol/L)	22 (10.2)
Hypoxaemia	24 (13.1)
Hypercapnia (>>45 mmHg)	33 (17.2)
Hypocapnia	32 (16.0)
Anaemia (<10 g/dL)	60 (32.1)
Hyperglycaemia (>11 mmol/L)	33 (17.2)

Table 4: Factors that affect death in univariate analysis

Factor	Non-survivors (n=42)	Survivors (n=156)	P-value
Age (years)	37.3±21.1	32.7±15.0	0.20
Gender M/F	38/4	140/16	0.6
HR (beats/min)	100.1±35.30	89.7±27.1	0.13
Pre-hospital ventilation	36/44	100/152	0.09
Shock	22/24	27/129	<0.001
Cardiac arrest	16	2	<0.001
GCS score	4.6±2.02	4.92±19.20	<0.001
Anisocoria	6/36	9/146	0.29
Bilateral mydriasis	7/36	10/150	0.04
Convulsion	4/40	6/150	0.3
ISS	29.72±13.01	24.93±12.01	0.012
RTS	4.94±1.60	5.93±4.90	0.18
TRISS	49.32±30.22	40.40±33.30	0.27
Meningeal haemorrhage	29/13	90/70	0.04
Intra-cerebral haematoma	9/29	8/150	<0.001
Subdural hematoma	24/20	52/99	0.011
Cerebral contusion	20/26	90/69	0.14
pH	6.99±0.14	8.02±0.12	0.0012
HCO3-(mmol/L)	17.02±4.02	19.10±3.50	0.0031
Hypercapnia (>45 mmHg)	9/29	20/139	0.13
Anemia	20/29	39/115	0.031
Platelet count (x10/mL)	167.13±59.40	189.02±70.04	0.032
Prothrombinaemia (%)	51.01±17.02	59.0±16.02	<0.001
Hypernatraemia (>145 mmol/L	9/34	11/139	0.0091
Emergency department stay (days)	0.7±0.7	0.92±1.1	0.20

DISCUSSION

Brain Trauma results in 5 million deaths every year and it is ranked as the 9th leading cause of global disease burden (4). Traumatic brain injury is said to be one of the main socioeconomic and health problems faced globally (5). Young adults, particularly men, are the most common victims of TBI. This is a great concern for society as it leads to many disabilities and deaths (6). The mean age of the patients in our study was 30.40±16.0 and TBI caused by road accidents happened in 86.4% of the cases. Even though Traumatic Brain Injury can be isolated, it is linked to extracranial injuries in extracranial injuries for 35% of the patients. Due to this, the risk of systemic insults increases, which ultimately leads to secondary brain damage (7). The head trauma in our study was isolated in 22.2% of the patients. The Glasgow outcome scale is globally used to assess TBI (8). The rates of morbidity and mortality of patients who suffered TBI are very high. Another point to notice is that the number of deaths due to TBI in developing countries lies in the range from 29% to 62% of the cases (9). These percentages are much higher as compared to those of developed countries, such as the USA. In 21.2% of the cases, we noticed early mortality. The rates were analyzed using the variables we measured initially while assessing the patient. There is a univariate link between the outcome of TBI and its predictors (10).

Significant prognostic factors, such as laboratory variables (platelets, hemoglobin, and glucose), hypoxia, hypotension, and eye and verbal components of GCS, are linked to poorer outcomes (11). Poor outcome and hypotension also had a link. In our study, there was no link found between hypoxia and poor outcome. Of all the patients that required airway support, 31.8% of them were already intubated when they arrived at the Emergency Department. Many studies showed that a risk factor associated with mortality is a need for MV, however, the results of our study did not support this (12). TBI deaths due to cardiac arrest are also very high. Our study supports this as 16 patients that suffered from cardiac arrest due to TBI died.

In traumatology, the ISS scoring system is commonly used (13). In our study, the relationship between ISS and prognosis was proved in univariate analysis. A few lesions are linked with a poor prognosis. A lot of studies show that midline shift has a huge effect on the outcome (14). Mortality rates increase with an increase in midline shift (15). In the cases of both univariate and multivariate analysis, a subdural hematoma was linked with mortality (16). This is proved by the presence of lesions such as meningeal hemorrhage and contusion (17). Mortality also has a strong relationship with post-traumatic meningeal hemorrhage (18). In our study, subdural hematoma, intracranial hematoma, and meningeal hemorrhage were associated with mortality in univariate analysis. Cerebral contusions' dynamic nature can result in an increase in intracranial pressure as well as delay neurological deterioration (19). It is a very difficult decision to decide which hematoma to evaluate first and it is mostly based on the location and the size of the hematoma as well as the clinical picture of the patient (20).

CONCLUSION

In our study, subdural hematoma, intracranial hematoma, and meningeal hemorrhage were associated with mortality. It is the priority of everyone working with trauma patients to improve the outcome of the patient. To optimize the use of resources, identifying the factors that predict the outcome is very essential. Pre-Hospital care needs improvement. Another area of improvement is CT scans. They should be done as urgently and as quickly as possible to locate operable mass lesions.

Funding source: None

Conflict of interest: None

Permission: Permission was granted by the ethical review committee of the institute.

REFERENCES

1 Reynolds S. Predicting Outcome after Traumatic Brain Injury. Journal of the Intensive Care Society. 2011 Jul;12(3):196–200.

2 Rizoli S, Petersen A, Bulger E, Coimbra R, Kerby JD, Minei J, et al. Early prediction of outcome after severe traumatic brain injury: a simple and practical model. BMC Emergency Medicine [Internet]. 2016 Aug 24 [cited 2019 Jul 24];16(1). Available from: https://bmcemergmed.biomedcentral.com/articles/10.1186/s12873-016-0098-x

3 Majdan M, Brazinova A, Rusnak M, Leitgeb J. Outcome Prediction after Traumatic Brain Injury: Comparison of the Performance of Routinely Used Severity Scores and Multivariable Prognostic Models. Journal of Neurosciences in Rural Practice. 2017 Jan;08(01):020–9.

4 Zador Z, Sperrin M, King AT. Predictors of Outcome in Traumatic Brain Injury: New Insight Using Receiver Operating Curve Indices and Bayesian Network Analysis. Ai J, editor. PLOS ONE [Internet]. 2016 Jul 7 [cited 2022 Jan 30];11(7):e0158762. Available from: https://dx.doi.org/10.1371%2Fjournal.pone.0158762

5 Oremakinde AA, Malomo AO, Dairo MD, Shokunbi TM, Adeolu AA, Adeleye AO. Assessment of predictors of one-month outcome in head injury in a Nigerian tertiary hospital. Interdisciplinary Neurosurgery. 2019 Mar;15:89–97.

6 Mac Donald CL, Barber J, Jordan M, Johnson AM, Dikmen S, Fann JR, et al. Early Clinical Predictors of 5-Year Outcome After Concussive Blast Traumatic Brain Injury. JAMA Neurology. 2017 Jul 1;74(7):821.

7 PART 2: EARLY INDICATORS OF PROGNOSIS IN SEVERE TRAUMATIC BRAIN INJURY. Journal of Neurotrauma. 2000 Jun;17(6_7):555–5.

8 Mosenthal AC, Lavery RF, Addis M, Kaul S, Ross S, Marburger R, et al. Isolated Traumatic Brain Injury: Age Is an Independent Predictor of Mortality and Early Outcome. The Journal of Trauma: Injury, Infection, and Critical Care. 2002 May;52(5):907–11.

9 Walker WC, Stromberg KA, Marwitz JH, Sima AP, Agyemang AA, Graham KM, et al. Predicting Long-Term Global Outcome after Traumatic Brain Injury: Development of a Practical Prognostic Tool Using the Traumatic Brain Injury Model Systems National Database. Journal of Neurotrauma. 2018 Jul 15;35(14):1587–95.

10 van der Naalt J, Timmerman ME, de Koning ME, van der Horn HJ, Scheenen ME, Jacobs B, et al. Early predictors of outcome after mild traumatic brain injury (UPFRONT): an observational cohort study. The Lancet Neurology. 2017 Jul;16(7):532–40.

11 Liu C, Xie J, Xiao X, Li T, Li H, Bai X, et al. Clinical predictors of prognosis in patients with traumatic brain injury combined with extracranial trauma. International Journal of Medical Sciences. 2021;18(7):1639–47.

12 Peters AJ, Schnell E, Saugstad JA, Treggiari MM. Longitudinal Course of Traumatic Brain Injury Biomarkers for the Prediction of Clinical Outcomes: A Review. Journal of Neurotrauma. 2021 Sep 15;38(18):2490–501.

13 Shi H-Y, Hwang S-L, Lee I-Chen, Chen I-Te, Lee K-T, Lin C-L. Trends and outcome predictors after traumatic brain injury surgery: a nationwide population-based study in Taiwan. Journal of Neurosurgery. 2014 Dec;121(6):1323–30.

14 Kulesza B, Nogalski A, Kulesza T, Prystupa A. Prognostic factors in traumatic brain injury and their association with outcome. Journal of Pre-Clinical and Clinical Research. 2015 Dec 16;9(2):163–6.

15 Abouhashem S, Albakry A, El-Atawy S, Fawzy F, Elgammal S, Khattab O. Prediction of early mortality after primary decompressive craniectomy in patients with severe traumatic brain injury. Egyptian Journal of Neurosurgery. 2021 Apr 15;36(1).

16 Impact of pre-hospital oxygenation and ventilation status on outcome in patients with isolated severe traumatic brain injury. Signa Vitae. 2014;9(1):42.

17 Galgano M, Toshkezi G, Qiu X, Russell T, Chin L, Zhao L-R. Traumatic Brain Injury. Cell Transplantation [Internet]. 2017 Jun 30;26(7):1118–30. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5657730/

18 Twomey DM, Allen N, Agan MLF, Hayes AM, Higgins A, Carton S, et al. Self-reported outcomes and patterns of service engagement after an acquired brain injury: a long-term follow-up study. Brain Injury. 2021 Dec 6;35(14):1649–57.

19 Groswasser Z, Peled I. Survival and mortality following TBI. Brain Injury. 2017 Dec 4;32(2):149–57.

20 Bratt M, Skandsen T, Hummel T, Moen KG, Vik A, Nordgård S, et al. Frequency and prognostic factors of olfactory dysfunction after traumatic brain injury. Brain Injury. 2018 May 9;32(8):1021–7.