

Outcome of traumatic brain injury in the intensive care unit: a five-year review

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Introduction: Traumatic brain injury (TBI) is a major challenge in the intensive care unit (ICU) with a high mortality. In a recent study, severe TBI accounted for 14.3% of all ICU admissions with a mortality of 54.0%.

Methodology: This was a retrospective, case-control study of all cases of TBI admitted into the ICU during the study period. Data retrieved included socio-demographic parameters, causes of TBI, blood transfusion, length of stay and ICU outcome in terms of mortality.

Result: One hundred and eighty-two (182) TBI patients were admitted into the ICU, with a mean age of 34 ± 18.92 years. The male:female ratio was 3:1, but females had a better outcome with a p -value of 0.026. Patients who stayed between 1 and 7 days were > 4 times more likely to die in the ICU compared with those who stayed for more than 7 days. In addition, TBI patients who had blood transfusion had a better outcome ($p = 0.004$). Also, TBI patients who received ventilatory support had higher mortality compared with those who did not, ($p = 0.006$).

Conclusion: Patients with traumatic brain injury admitted to the intensive care unit have a high mortality. A review of the present line of management and strict compliance with guidelines of management may perhaps improve outcome.

Keywords: ICU, outcome, traumatic brain injury

Introduction

Traumatic brain injury (TBI) is a common cause of morbidity and mortality and a major challenge in the intensive care unit (ICU). In a recent study conducted in Kenya, severe traumatic brain injury accounted for 14.3% of all admissions to a general ICU with a mortality rate of 54.0%. About 33% of these patients remained in a persistent vegetative state.¹ It has been documented that morbidity and mortality following TBI is determined by the severity and presence of secondary injuries such as hypoxia, hypotension, hypercapnia, hyperglycaemia and acidosis.²

Teasdale and Jennett³ described the Glasgow Coma Scale, which was initially designed to assess the level of consciousness after TBI in a neurosurgical intensive care unit. It has become the gold standard for classifying the severity of TBI as mild (GCS 13–15), moderate (GCS 9–12), and severe (GCS 8 and below). Patients with a GCS of 8 and below, which corresponds to severe TBI, are often admitted and managed in the ICU.

The management of brain-injured patients in the ICU involves a high-level quality of general care and other management strategies aimed at preventing secondary brain insults. Despite the introduction of guidelines for the management of severe traumatic brain injury,⁴ there exist differences in the protocol of care for these patients, which vary from one centre to another. However, it has been shown that the implementation of a protocol of management results in better outcome in terms of mortality and functional recovery following TBI.⁵

The outcome of TBI managed in the intensive care unit of the University of Benin Teaching Hospital, a tertiary hospital, was reviewed in terms of outcome and its associated factors. To our knowledge, no such study has been carried out in our centre.

Methodology

The study was conducted at the intensive care unit of the University of Benin Teaching Hospital, a tertiary centre located in the South-South region of Nigeria. The ICU is a seven-bed level III multidisciplinary unit catering for patients of all age groups and all specialties. The care of patients in the unit is coordinated by consultants in the hospital's Department of Anaesthesiology.

This was a retrospective, case-control study of all cases of TBI admitted to the ICU during the five-year study period. The admission and discharge register, and doctors' and nurses' notes were retrieved and examined. A patient before or after each TBI case was selected to serve as control for the study without necessarily matching the patients by age and/or comorbidities. This is due to the fact that our unit admits patients across all specialties and age groups. Data retrieved included socio-demographic parameters, causes of TBI, therapeutic interventions, length of stay and ICU outcome in terms of mortality (see Figure 1).

Data obtained were entered into a pro forma and analysed using SPSS[®] version 16.0 (SPSS Inc, Chicago, IL, USA). Parametric data were analysed with Student's t -test and categorical data were analysed with chi-square and Fisher's exact test. A p -value of < 0.05 was set for statistical significance.

Results

A total of 182 cases of traumatic brain injury (TBI) were admitted into the ICU during the five-year study period. Patients' ages ranged between 1 year and > 70 years with a mean age of 34 ± 18.92 years. Patients aged between 31 and 40 years accounted for the majority (24.2%), followed by patients between 21 and 30 years old (19.8%). Elderly patients aged > 70 years represented 3.8% of the total cases of TBI in this

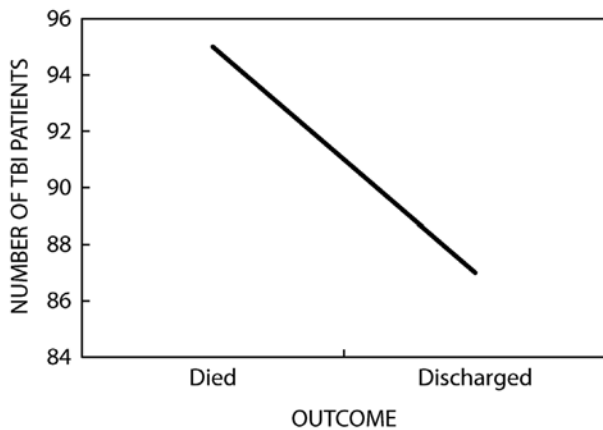


Figure 1: Outcome of TBI in the ICU.

X-axis represents outcome in terms of death and discharge. Y-axis represents the number of TBI patients admitted to the ICU.

study. The male:female ratio was 3:1. Although more males suffered TBI, more females had a better outcome (*p*-value 0.026, OR = 2.178, and 95% confidence interval 1.091–4.346; Tables 1a and 1b).

Table 1a: Socio-demographic characteristics

	Frequency	Percentage
Age		
1–10	21	11.5
11–20	19	10.4
21–30	36	19.8
31–40	44	24.2
41–50	28	15.4
51–60	13	7.1
61–70	16	8.8
>70	07	3.8
Sex		
Male	137	75.3
Female	45	24.7
Total	182	100

Table 1b: Sex versus outcome

Outcome	Sex		Total
	Male	Female	
Discharged	59 (43.1%)	28 (62.2%)	87
Died	78 (56.9%)	17 (37.8%)	95
Total	137	45	182

Note: *p* = 0.026.

Table 2: Aetiology of TBI in patients admitted to the ICU

Aetiology	Frequency	Percentage
Road traffic accident	163	89.6
Assault	14	7.7
Fall	05	2.7
Total	182	100

Road traffic accident represented the most frequent cause of TBI (89.6%), followed by assault (7.7%) and fall (2.7%) respectively (Table 2).

Patients' length of stay is as represented in Tables 3a and 3b. The majority of these patients (76.4%) with TBI stayed between 1 and 7 days, followed by those who stayed 8–14 days (11.5%). Patients with 15–21 days and > 21 days stays accounted for 8.8% and 3.4% respectively. Length of stay in the ICU had a significant impact on outcome as patients who stayed longer than seven days had a better outcome (*p* = 0.001). Patients who stayed between 1 and 7 days were > 4 times more likely to die in the ICU compared with those who stayed for more than 7 days (OR = 4.443, 95% CI 2.068–9.545; see Tables 3a and 3b).

Patients with severe TBI represented the majority of cases of TBI admitted to the unit (94%). This was followed by moderate TBI (5.5%); only a fraction (0.5%) of mild TBI were admitted to the ICU (Table 4).

Mortality following TBI in the ICU was high (52.2%), with the remainder discharged to the ward. When compared with control (47.8%), the difference did not achieve statistical significance (*p* = 0.249; Tables 5a and 5b).

Blood transfusion was more frequent among the control (non-TBI patients) than the patients with TBI (30.2% and 15.4% respectively with a *p*-value of 0.001). In addition, TBI patients who had blood transfusion had a better outcome (*p* = 0.004; Tables 5a and 5b).

Mechanical ventilation among the TBI patients and the controls was similar (25.3% and 18.7% respectively, *p* = 0.124). However, TBI patients who received ventilatory support had higher mortality compared with those who did not (*p* = 0.006, OR = 2.648, 95% CI 1.298–5.402; Table 6).

Discussion

The mortality rate following traumatic brain injury in the ICU of 52.2% is high and comparable to another study conducted in Kenya.¹ Although mortality rate following TBI is higher than for the control group of 47.8%, the nature of patients admitted to our ICU varies widely, it being a multidisciplinary unit. Patients in respiratory failure from different causes who require ventilatory support, postoperative patients who require intensive monitoring and care, and stroke patients are among the array of patients managed in the unit. This factor may be responsible for the high mortality rate recorded in this study.

Table 3a: Patients' length of stay in the ICU

Length of stay	Frequency	Percentage
1-7	139	76.4
8-14	21	11.5
15-21	16	8.8
>21	06	3.3

Table 3b: Length of ICU stay versus mortality

Length of ICU stay	Discharged	Died	Total
1-7	55	84	139
8-14	15	06	21
15-21	13	03	16
>21	04	02	06
Total	87	95	182

Note: $p = 0.001$.

Table 4: Blood transfusion vs. outcome

Transfusion	Outcome		Total
	Discharged	Died	
Yes	21 (24.1%)	8 (8.4%)	29
No	66 (75.9%)	87 (91.6%)	153
Total	87	95	182

Note: $p = 0.004$.

Table 5a: Blood transfusion among TBI and non-TBI patients in the ICU

Blood transfusion	TBI	Non-TBI
Yes	28 (15.4%)	55 (30.2%)
No	154 (84.6%)	127 (69.8%)
Total	182	182

Note: $p = 0.001$.

Table 5b: Mechanical ventilation among TBI and non-TBI patients in the ICU

Ventilation	TBI	Non-TBI
Yes	46 (25.3%)	34 (18.7%)
No	136 (74.7%)	148 (81.3%)
Total	182	182

Note: $p = 0.128$.

In this study, patients aged between 31 and 40 years with a mean age of 34 ± 18.97 accounted for the majority of cases of TBI admitted to the ICU. In addition, more males were affected than females at a ratio of 3:1. Opopo and colleagues¹ had observed that the average age of severe TBI admitted to the ICU was 34 ± 7 years with more males affected. Furthermore, TBI has been recognised as one of the commonest causes of morbidity and mortality of young adults less than 45 years of age.⁶ This finding stands to reason as this age group represents the most active part of the community. The chances of suffering head injury are thus higher among younger males, with devastating consequences in terms of loss of the country's workforce.

We also observed that road traffic accident represented the most frequent cause of TBI (59.9%), followed by assault. Idowu and Akinbo had reported earlier that road traffic accident and assault were the commonest causes of TBI in their study.⁷ Road traffic accidents have been identified as the leading cause of TBI in Latin America and sub-Saharan Africa.⁸ The poor and deplorable state of the roads in the developing world in countries such as Nigeria, coupled with poor maintenance of most of the vehicles

plying the roads, sometimes accounts for the high number of road traffic accidents. There is an urgent need for road construction and rehabilitation to curb this menace.

In addition, it is a known fact that the management of patients with severe TBI should start in the pre-hospital period, at the scene of the accident. Unfortunately, pre-hospital care in our environment is less than optimal and, as such, patients with severe TBI often arrive at the hospital in a terrible clinical state, worsening their outcome. Studies have shown that implementation of protocols for the management of severe TBI, which includes pre-hospital care, is associated with better outcomes in terms of mortality, functional recovery and length of hospital stay.^{5,9} It is therefore obvious that instituting proper pre-hospital care by our hospital and other non-governmental agencies may help reduce mortality following TBI.

Coagulopathy is a common occurrence following brain damage¹⁰ and requires immediate and aggressive management to avoid anaemia, which could lead to secondary brain insult. Patients in the ICU are transfused with blood when their haemoglobin level is lower than 10 g/dl. It was observed that though fewer patients with TBI had blood transfusion during their ICU stay, those who were transfused had a better outcome regarding mortality. More non-TBI patients had blood transfusion, probably because of the divergent nature of this group of patients. For instance, these patients comprise postoperative and poly-traumatised patients who would require blood transfusion to maintain their haemodynamic status. Early blood transfusion aiming to achieve a target haemoglobin (Hb) concentration of 10 g/dl would thus seem appropriate in this group of patients.

Table 6: Ventilation versus patients' outcome

Ventilation	Outcome		Total
	Discharged	Died	
Yes	14 (16.1%)	32 (33.6%)	46
No	73 (83.9%)	63 (66.4%)	136
Total	87	95	182

Note: $p = 0.006$.

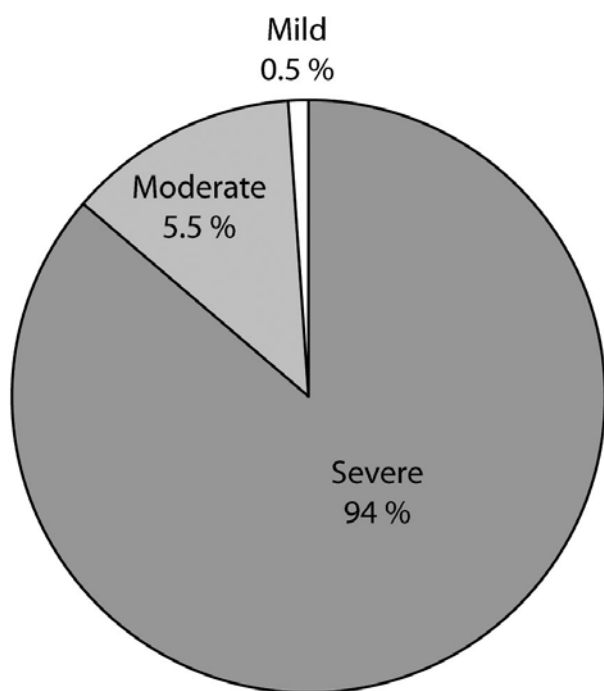


Figure 2: Severity of TBI admitted to the ICU.

We further noted that patients with a longer ICU stay had a better outcome than those who were in the ICU for a shorter period. Although this may seem contradictory, longer stay in the ICU could be as a result of clinical improvement in these patients, which could be related to a lesser degree of injury. Length of stay in the ICU following brain injury could be a result of a number of factors such as severity of the injury, the need for prolonged mechanical ventilation such as in ARDS and complications arising from ICU stay. Different scoring systems have been used to predict length of stay in the ICU following TBI. Okasha and co-workers found that the traditional GCS had similar predictive value regarding length of stay in ICU to the Full Outline of UnResponsiveness (FOUR) score.¹¹ It is therefore imperative to utilise any of the available scoring systems to predict likely length of stay in ICU for TBI patients as this may impact on resource allocation and outcome (see Figure 2).

Mechanical ventilation is often indicated in patients with severe TBI to avoid hypoxia, which is defined as $SpO_2 < 90\%$ or $PaO_2 < 60$ mmHg, and to maintain normocarbia.¹² We observed that about one-quarter (25%) of patients with TBI were mechanically ventilated. This could be due to the finding that acute respiratory distress syndrome (ARDS)/acute lung injury (ALI) occurs in 10–30% of patients with severe brain injury.¹³ The provision of ventilatory

support to brain-injured patients who develop ARDS/ALI is quite a challenge and difficult to achieve. This is because the ventilatory guidelines for brain injury require a low positive end-expiratory pressure (PEEP) and high tidal volume while ARDS requires high PEEP and low tidal volume. Furthermore, it has been observed that mechanical ventilation in severe brain injury is associated with a threefold risk of death.¹³ This is similar to our finding that patients who had mechanical ventilation had a worse outcome compared with those who did not. It is, however, difficult to ascertain the probable reason for this finding. Nevertheless, as previously asserted by Holland and colleagues,¹³ the need for ventilatory support in severe TBI is often an independent risk factor for mortality irrespective of the duration and mode of ventilation.

Conclusion

Mortality following traumatic brain injury managed at the intensive care unit of the University of Benin Teaching Hospital is high. Aggressive effort, which includes proper pre-hospital care, early blood transfusion and strict compliance with guidelines of management, may improve outcome.

Limitation

The retrospective nature of this study made retrieval of some data difficult. Nevertheless, the study has shown that traumatic brain-injured patients admitted to the Intensive Care Unit have a high mortality.

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