Research Article

Intensive Care Admission Variables May Predict Outcome Following Severe Traumatic Brain Injury: A Prospective Observational Study

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Received: 28 October 2019; **Accepted:** 19 December 2019; **Published**: 31 January 2020

Citation: Rabiu MB, Eguma S, Ismail NJ, Abdullahi AA. Intensive Care Admission Variables May Predict Outcome Following Severe Traumatic Brain Injury: A Prospective Observational Study. Anesthesia and Critical Care 2 (2020): 008-021.

Abstract

Background: Severe traumatic brain injury (STBI) is a significant health concern and a major social and financial burden for society. It is a leading cause of death in both developed and developing countries. Outcome prediction following severe traumatic brain injury is of great clinical and economic importance especially in developing countries, where health resources are limited. This study aimed at predicting outcome among patients with severe traumatic brain injury using selected admission.

Patients and Method: Following institutional ethic committee approval, forty consecutive patients admitted into ICU were enrolled in the study, after consent was obtained from patient relations. Patients who were apneic, did not have CT-scan, had penetrating head trauma or severe extra cranial injury were excluded from the study. Demographic variables were age, gender, cause of injury. Intensive Care admission variables recorded were post resuscitation GCS, admission haemoglobin concentration, blood sugar level, systolic blood pressure, CT scan profile and type of brain injury. All Patients were initially mechanically ventilated using IPPV for 48 hours, thereafter patients were placed on weaning mode of either SIMV or BiPAP. Sedation was reduced for spontaneous breath trial Patient outcome was categorized into two groups: favourable outcome for those with good recovery and moderate disability and unfavourable outcome for those who died, were severely disabled and those in persistent vegetative state, using the Glasgow Outcome Scale at 14 days and 3 months follow up. The data obtained was analyzed electronically using SPSS version 20 and presented using relevant tables and figures. Descriptive statistical analysis was used to determine incidence of unfavourable outcome at 14 days and 3 months. Chi square test was used to determine the association between the selected variables and outcome. All selected variables were subjected to univariate regression to determine the predictors of outcome at 3 months, with confidence interval set at 95%. P<0.05.

Results: Fourty patients were enrolled in the study, 3 patients were not available for follow up and were removed from the study. The overall incidence of unfavourable outcome at 14 days was 100% while at 3 months post-injury it was 81.1%. Road traffic accident was the major cause of traumatic brain injury and there was a Male: Female ratio of 8:1. Hypotension (*P*=0.015), hyperglycemia (*P*=0.016), midline brain shift>5 mm (*P*=0.039), absent or compressed cistern (*P*= 0.007), heamoglobin concentration<10 g/dl (*P*=0.041), were significant predictors of unfavourable outcome at 3 months on univiriate regression analysis.

Conclusions: Our study revealed hypotension, hyperglycaemia, anaemia mid-line brain shift greater than 5 mm and absent or compressed cistern on brain CT-scan are statistically significant predictors of unfavourable outcome at univiriate analysis following severe traumatic brain injury at 3 months post trauma.

Keywords: Severe traumatic brain injury; Prediction; Unfavourable outcome

1. Introduction

Severe traumatic brain injury (STBI) is defined as head trauma associated with post resuscitation Glasgow coma score (GCS) of less than or equal to 8 [1, 2]. It is a major challenging problem in critical care medicine and one of the most life threatening conditions in trauma victims. In Jos Nigeria, Emejulu et al. [3] found the incidence of moderate to severe head injury to be 11%. Brown and Nell [4] in a study in South Africa found an incidence of STBI of 355/100,000 among blacks and 109/100,000 among whites. In Britain, approximately 500 persons are affected per year, majority of them young male adults. World-wide 1.5 million people die from STBI yearly [1]. Some of these deaths are inevitable while some are potentially preventable. With an estimated 10 million people affected annually world-wide by STBI, the burden of mortality and morbidity that this condition imposes on society, makes TBI a pressing public health and medical problem [5]. Outcome after severe brain injury has major social and financial implications for both patients and families. In developed countries with well organised health systems, society may bear most of the burden but in low income countries such as those in the West African sub–region where case fatality is high and resources are limited, the burden rests solely on the family to provide financial and physical support and rehabilitation. A study on Sierra Leone found that households with persons with disability spent about 3 times more on healthcare and were poorer than those without family members with disability [6].

Clinicians treating patients often make decisions based on their assessment of prognosis. According to a survey in United Kingdom (UK) 2008, 80% of doctors believed that an accurate assessment of prognosis is important in making clinical decisions in the management of patients with STBI [7]. Accurate prediction of outcome may help in rational allocation of scarce health resources. The ability to accurately predict the outcome after STBI will also help doctors in designing protocols relevant to their practice environment, which will improve clinical management of severe head injury.

A review of literature reveals that several predictors of outcome following STBI differ in their strengths of association with outcome according to the income level of the country [7]. Most studies on outcome prediction for patients with STBI have been done in high income countries. There is need, therefore, to carry out this study in this part of the world since it may be inappropriate to use models from high income countries in poorer settings. This study hopes to unveil those prognostic factors that may enable effective protocols development for the management of severely head injured patients in limited resource settings and perhaps in West Africa. Road traffic accident is the principal cause of head injury, accounting for about 25% of head injuries [5]. In a retrospective study of 112 children with severe closed head injury carried out during a fifteen year period at the Jos University Teaching Hospital, Nigeria, Igun et al. [8] found that road traffic accidents accounted for 69% of cases of head injuries seen. Other causes include falls, assaults, work related injuries, domestic accidents and sports injuries. The relative frequency of each cause varies between different age groups and from place to place throughout each country.

A variety of methods have been devised to categorize the outcome of severe head injured patients. One such method is the Glasgow Outcome Scale. In 1975 Jennet et al. [9] developed the Glasgow outcome scale (GOS) for assessment of head injured patients. They categorised patients recovering from TBI into five groups depending upon their ability to perform activities of daily living and the amount of supervision they need as follows: Death, Persistent vegetative state: severe bilateral hemisphere damage in which the patients have no awareness of themselves or of their environment. Although period of eye opening and closure occur, the patient is dependent and does not communicate or interact with others in any way. Severe disability where patient is dependent for some support in every 24 hour period. Moderate disability: patient is independent but disabled. May or may not be capable of return to work. Good recovery: good, but not necessarily complete recovery, cranial nerve deficit could occur, although patient may not return to work.

King et al. [10] used the Glasgow Outcome Scale to predict outcome in patients with STBI at 3 and 12 months post TBI. They subjected one hundred and fifty nine patients with severe TBI (GCS 8 and below on admission) to neuropsychiatric assessment at three, six and 12 month post –injury. Demographic and admission clinical data were collected at 3, 6 and 12 months and analyzed using multivariate logistic regression. They found that GOS at three months was the strongest independent predictor of outcomes at 12 months. They also found prolonged hypotension, diffuse axonal injury and fixed dilated pupils on admission to be significant independent predictors of poor outcome at 12 months.

The Glasgow Outcome Scale (GOS), though popular due to its simplicity and ease of use, is limited by its broad and flexible categories. Several studies have tried to modify the GOS in a bid to increase its sensitivity. This has resulted in the Extended Glasgow Outcome scale (GOSE), which incorporates a structured interview process and extends the categories from five to eight. This gives greater sensitivity for detecting changes in patient condition over time and improves accuracy when assessing ongoing treatment or care needs.

Many clinical variables have been used either in isolation or in combination to help in the prediction of outcome following TBI. These include age, Glasgow Coma Score on admission, pupillary reactivity to light, hypotension, blood glucose levels, CT scan findings and presence of anaemia [4, 7, 8, 10]. The ability to accurately predict the outcome after STBI will also help doctors in designing protocols relevant to their practice environment, which will improve clinical management of severe head injury. A review of literature reveals that several predictors of outcome following STBI differ in their strengths of association with outcome according to the income level of the country [7]. Most studies on outcome prediction for patients with STBI have been done in high income countries. There is need, therefore, to carry out this study in this part of the world since it may be inappropriate to use models from high income countries in poorer settings.

2. Patients and Method

Following institutional ethical approval, forty consecutive patients admitted into Intensive Care Unit from January 2014 to December 2016 were enrolled in the study, after consent was obtained from patient relations. Patients who were apneic, did not have CT-scan, had penetrating head trauma or severe extra cranial injury were excluded from the study. Demographic variables used for the study were age, gender, occupation, cause of injury. Intensive Care admission variables were post resuscitation GCS, admission haemoglobin concentration, blood sugar level, systolic blood pressure, CT scan profile and type of brain injury. All Patients were initially mechanically ventilated using IPPV for 48 hours, thereafter patients were placed on weaning mode of either SIMV or BiPAP. Sedation was reduced for spontaneous breath trial Patient outcome was categorized into two groups: favourable outcome for those with good recovery and moderate disability and unfavourable outcome for those who died, were severely disabled and those in persistent vegetative state, using the Glasgow Outcome Scale at 14 days and 3 months follow up.

The data obtained was analyzed electronically using SPSS version 20 and presented using relevant tables and figures. Descriptive statistical analysis was used to determine incidence of unfavourable outcome at 14 days and 3 months. Chi square test was used to determine the association between the selected variables and outcome. All selected variables were subjected to univariate regression to determine the predictors of outcome at 3 months, with confidence interval set at 95%. $P<0.05$.

Variables	Frequency (n=37)	Percentage (%)
Age group (in years)		
≤ 20	6	16.2
21-40	19	51.4
41-60	9	24.3
>60	3	8.1
Gender		
Male	33	89.2
Female	4	10.8
Occupation		
Non-labour force	14	37.8
Self employed	16	43.2
Civil servant	7	18.9
Cause of Injury		
Motor vehicle	26	70.3
Motor cycle	6	16.2
Fall from height	4	10.8
Assault	1	2.7

Table 1: Socio-Demography profile of patients.

Table 1 shows the socio-demographic profile of the patients with severe traumatic brain injury. The age range of patients was 10-80 years (mean age=36.43; SD=17.748). Majority of the patients were in their, third and fourth decades of life, with the largest proportion in the age range of 21-40 years 19 (51.4%), followed by 41-60 years age range 9 (24.3%). Only 3 (8.1%) were aged above 60 years old. There were more male patients 33 (89.2%) than females 4(10.8%). Sixteen 16(43.2%) were self-employed (both skilled and un-skilled). Non-labour force accounted for 14 (37%) while only 7 (18.9%) were civil servants. Motor vehicle accidents accounted for 26 (70.3%) as cause of injury, motor cycle 6(16.2%), falls from height 4(10.8%) and assault 1(2.7%). Motor vehicle was the major cause of injury followed by motor cycle accidents. Among the patients who fell from heights and the one who was assaulted, none had a favourable outcome Table 1.

Variables	Unfavourable outcome	Favourable outcome	Total	*P*-Value
GCS				
GCS<5	26 (70.3%)	0 (0.0%)	26 (70.3%)	
GCS>5	4 (10.8%)	7 (18.9%)	11 (29.7%)	*P*= 0.001
Midline shift (on CT Scan)				

MLS> 5mm	22 (59.5%)	2 (5.4%)	24 (64.9%)	
MLS<5mm	8 (21.6 %)	5 (13.5%)	13 (35.1%)	*P*= 0.025
Cistern(on CT Scan)				
Absent or compressed	24 (64.9%)	1 (2.7%)	25 (67.6%)	
Present	6 (16.2%)	6 (16.2%)	12 (32.4%)	*P*= 0.001
Type of lesion				
Surgical	10 (27.0%)	3 (8.1%)	13 (35.1%)	
Non-surgical	20 (54.1%)	4 (10.8%)	24 (64.9%)	*P*= 0.635

GCS=Glasgow Coma Score, MLS=Midline Shift, CT-scan= Computed tomography scan

Table 2: Association between GCS (post-resuscitation), CT-scan profile, type of injury and outcome at 3 months.

Table 2 shows majority 26 (70.3%) of patients had GCS ≤ 5 and all had unfavourable out come at 3 months, while 11 (29.7%) had GCS>5 and 4 (10.8%) of them had unfavourable outcome, (*P*= 0.001). The outcome was better in those who had GCS>5, Table 4 CT scan revealed midline shift is common among the study population 24 (64.9%) patients. However, midline shift >5 mm is significantly associated with unfavourable outcome 22 (54.5%). The difference was statistically significant (*P*=0.025), compressed or absent cistern in 25 (67.6%) patients while cistern was preserved among 12 (32.4%). Only 1 (2.7%) had favorable outcome. The association was found to be significant (*P*=0.001). Presence of non-surgical pathology was found among 24 (64.9%) patients and lesions that required surgical intervention in 13 (35.1%) patients. There was no statistically significant difference in outcome at 3 months between those who required surgical intervention and those who did not (*P*=0.635).

Variables	**Unfavourable Outcome**	**Favourable Outcome**	**Total**	***P*-Value**
SBP(mmHg)				
Hypotension <90	22 (59.5%)	1 (2.7%)	23 (62.2%)	
No hypotension	8 (21.6%)	6 (16.2%)	14 (37.8%)	*P*= 0.004
Glucose level (mg/dl)				
Normogycaemia (110-200)	6 (16.2%)	5 (13.5%)	11 (29.7%)	
Hyperglycemia(>200)	24 (64%)	2 (5.4%)	26 (70.3%)	*P*=0.007
Haemoglobin level(g/dl)				
< 10 g/dl	19 (51.4%)	1 (2.7%)	20 (54.1%)	
≥ 10 g/dl	11 (29.7%)	6 (16.2%)	17 (45.9%)	*P*= 0.019

SBP=Systolic Blood Pressure

Table 3: Clinical and laboratory parameters.

Twenty three patients (62.2%) had hypotension during admission in ICU. Among the patients with hypotension 22 (95.6%) had unfavorable outcome at 3 months indicating strong association of hypotension and unfavourable outcome.The association was statistically significant (*P*=0.004) Table 3. Hyperglycaemia was a common finding during ICU admission among 26 (70.3%) patients, 11 (29.7%) patients had normoglycaemia. Only 2 (5.4%) out of 26 (70.3%) patients with hyperglycemia had favorable outcome at 3 months. The difference in outcome between patients with STBI who developed hyperglycaemia and those with normoglycaemia was statistically significant (*P*=0.007) Table 3. Twenty (54.1%) patients had haemoglobin concentration less than 10g/dl at presentation while 17 (45.9%) had haemoglobin concentration greater than 10g/dl. Fifty one percent (19) of those who were anaemic had unfavorable outcome at 3 months. Among the patients with haemoglobin concentration ≥ 10 g/dl, 11 (29.7%) and 6 (16.2%) had unfavorable and favorable outcomes respectively. Anaemia during admission was found to be statistical associated negative outcome at 3 months (*P*=0.019) Table 3.

Predictors	**Co-efficient**	***p*-value**	**OR**	**95%CI**	
				lower	**upper**
GCS					
≤ 5	1.012	0.154	5.600	0.521	24.649
> 5	-35.660	0.999	0.001	0.001	
Blood glucose(mg/dl)					
Hyperglycaemia	2.303	0.016*	10.000	1.544	64.152
Normoglycaemia	0.018	0.989	0.001	0.492	3.286
Systolic BP (mmHg)					
Hypotension	2.803	0.015*	16.500	1.711	159.134
Normotension	-0.9116	0.996	0.020	0.310	3.148
CT-Scan findings					
Midline shift>5mm	1.928	0.039*	6.875	1.104	29.612
Midline shift ≤ 5mm	-23.012	0.673	0.001	0.100	
Absent of cistern	3.178	0.007*	24.000	2.410	238.965
Cistern preserved	1.810	0.882	4.000	0.426	26.249
Non-Surgical lesion	-0.405	0.636	0.667	0.124	3.571
Surgical-lesion	1.010	0.994	2.000	0.342	10.218

OR: Odds Ratio; CI: Confidence Interval; *: Statistically significant (i. e. *p* value<0.05) ;BP: Blood Pressure

Table 4: Univariate Regression Analysis to Identify Predictors of Unfavourable outcome.

3. Discussion

Predicting outcome following severe traumatic brain injury is very important for clinical, social and financial reasons in developing countries where healthcare resources are limited. Several studies have attempted to predict prognostic factors for neurological outcome after severe traumatic brain injury [1, 3, 6, 7, 11,12], but most of the studies were done in developed countries. The burden of STBI is manifest throughout the world, and is especially prominent in Low and Middle Income Countries which face a higher preponderance of risk factors for TBI, and have inadequately prepared health systems to address the associated health outcomes. Considering the resources needed for management of severe traumatic brain injury, in most developing countries where this resources are limited, the financial and social burden of treatment is solely on the patient's family, a very useful clinical tool would be the ability to accurately predict patient outcome on admission to hospital, what the outcome of a given injury might be. The ability to accurately predict the outcome after STBI will also help doctors in designing protocols relevant to their practice environment, plan patient rehabilitation, and help in the rational allocation of scarce healthcare resources. Severe traumatic brain injury (STBI), according to the World Health Organization, will surpass many diseases as the major cause of death and disability by the year 2020 [5]. Review of literature reveals that several predictors of outcome following STBI differ in their strengths of association with outcome according to the income level of the country [8]. Most studies on outcome prediction for patients with STBI have been done in high income countries. There is need, therefore, to carry out this study in this part of the world since it may be inappropriate to use models from high income countries in poorer settings. This study hopes to unveil those prognostic factors that may enable effective protocols development for the management of severely head injured patients in limited resource settings and perhaps in West Africa.

Twenty four hour Glasgow Coma Score is said to be the strongest predictor of cognitive recovery at 2 years after injury in patients with moderate to severe head injury [13]. It has also been shown that the admission GCS score, when combined with age and pupillary or oculocephalic response, was 80%-84% accurate in predicting patient outcome into one of two categories, good outcome (as defined by no disability or moderate disability), or poor outcome (defined by severe disability or persistent vegetative state). The development of Glasgow outcome scale has allowed a more accurate clinical assessment of outcome after severe traumatic brain injury [18]. The Glasgow outcome scale identifies neurological and functional signs that are associated with the prognosis of improved recovery of physical function and was used to evaluate outcome in this study.

This study found that GCS ≤ 5 is associated with unfavourable outcome in patients with STBI at 3 months when compared with those with GCS greater than 5, the association was statistically significant. Navdeep et al. [15] reported that GCS at the time of admission was a reliable predictor of clinical outcome after STBI.Several studies have assessed the relationship between post-resuscitation GCS, mortality and functional outcome in STBI. Combes et al. [16] in a multi centre study noted a high mortality of 42% among patients with GCS ≤ 5. In a related study, similar results were obtained in studies by Leach et al. [14], Grosswasser et al. [17], Lee et al. [18] and Settervall et al. [19]. It follows therefore that GCS scores are related to mortality; low scores indicating higher mortality and high scores indicating a more likely chance of survival. One criticism of the GCS as a prognostic tool, however, is that the summed score does not always provide an accurate depiction of a patient's condition. For example, the verbal score may be poor due to the fact that the patient requires endotracheal intubation, and might result in the patient being assigned a much lower verbal score, which would give a falsely low GCS score.

Systolic blood pressure SBP of <90 mmHg is a major determinant and an independent predictor of outcome after severe traumatic brain injury and is significantly associated with increasing mortality [20]. In our study, patients with hypotension at admission were found to have unfavourable outcome at 3 months compared to those with normotension. The association between hypotension and unfavourable outcome was statistically significant (*P*=0.004). Univariate regression analysis in this study showed hypotension to be a strong predictor of unfavourable outcome. This finding agrees with that of Chestnut et al. [21] when they prospectively investigated the impact on outcome of hypotension (SBP<90 mm Hg) a as secondary brain insults, occurring from injury. They found hypotension to be independently associated with significant increases in morbidity and mortality from severe head injury, however mortality reported in their study was higher compared to this study, because in their study data was obtained from 24 hours continuous blood pressure monitoring while the current study used single episodes during the first 6 hour of ICU admission. Hypotension, particularly, was a major determinant of outcome from severe head injury. They therefore advised that resuscitation protocols for brain injured patients should assiduously avoid hypovolemic shock. Similar findings were reported by Christopher et al. [22]. Data from their study suggested that mortality was significantly higher among those with single episodes or persistent hypotension. Hypotension impairs blood flow to vital organs following trauma. The increased morbidity and mortality related to severe trauma to an extracranial organ system has been primarily attributed to associated hypotension.

Initial CT-Scan findings of patients was one of the factors used to predict outcome in this study. Majority (64.9%) of patients with a midline shift (MLS)>5 mm were found to have unfavorable outcome at 3 months follow up among patients with STBI. MLS>5 mm was found to be statistically significant predictor of unfavourable outcome on univiriate logistic regression analysis (*P*=0.039, OR 6.875). Both the cerebrum and cerebellum are symmetrical with lobes, ventricles and deep nuclei of similar size and shape in both hemispheres. The presence of an intracranial mass can cause brain shift, followed by herniation, brainstem compression and death. Midline shift and basal cistern effacement are both indicators of mass effect and the degree of brain compression by an intracranial mass and can therefore be used to quantify the change of symmetry for diagnosis and outcome prediction.

Similar finding was obtained by collaborators in MRC CRASH Trial [8] in their study, they analyzed CT – scan profile of data's pooled from both developed and developing countries such as where this study was conducted and they found that midline shift >5 mm was found to be a signifiacant predictor of unfavourable outcome at both 14 days and 3 months. Similarly Navdeep et al. [15] reported that unfavourable outcome was significantly higher among the patients with midline shift >5 mm on brain CT-scan compared to those patients with midline shift <5 mm, and therefore the authors concluded similar finding reported in this study that, midline shift >5 mm is a significant predictor of unfavourable following

STBI. Chiewwit et al. [23] found that increased degree of midline shift predicted not only poor clinical outcome but was also related to severity of the head trauma. Other significant CT-Scan findings were absent or compressed cistern and the presence or absence of intracranial space-occupying lesions that required surgical evacuation. Quattrochi et al. [24] found that mid-line brain shift was associated with unfavourable outcome. This finding was similar to that in several other studies [8, 15, 23], absent or compressed cistern was found to be a strong predictor of poor outcome.

In our study patients were grouped into two based on the type of brain injury seen on CT-Scan as a surgical lesions-for those patients that had neuro-surgical procedures and non-surgical lesions- for those patients that needed no neuro-surgical procedure. We found that majority (64.9%) of the patients enrolled in this study had no neuro-surgical procedure, while 35.1% had neuro-surgical exploration as part of their management, surgical lesion was found to be associated with unfavourable outcome, however this finding was not statistically significant (x^2= 0.226, *P* =0.635) irrespective of which statistical test it was subjected to. This is similar finding was reported by Leach et al. [25] the authors conclude in there study that, there is no statistical significant difference between the patients with diffuse lesion and haematoma that had surgical evacuation of haematoma compared to those with diffuse lesion without haematoma.

Anaemia is a common secondary systemic insult in traumatic brain injury and should be avoided with a target haemoglobin>10 g/dl or haematocrit ≥ 30% [26]. In this study anaemia was found to be associated with unfavourable outcome at 3 months among the patients with severe traumatic brain injury. Twenty 20 (54.1%) patients were found to have Hb<10 g/dl and among them 19 (51.4%) had unfavorable outcome at 3 months. The relationship between poor outcome and anaemia was statistically significant (*P*=0.019). Patients with Hb<10 g/dL are said to be 31 times more likely to have unfavourable outcomes compared to those with Hb ≥ 10 g/dl [27]. Sekhon and colleagues [28] in a single center study of 169 patients concluded that Hb<9 g/L was an independent increased risk factor in STBI patients. This is consistent with findings of other researchers [25, 28, 29]. Although most of the studies including the current study only asses the association of anaemia and functional outcome, Sanchez-Olmez et al. [29] asses association of some selected secondary brain insult such as aneamia and brain death, in their study the authours found that anaemia at multivariate analysis was not significantly associated with brain death, however in their study presence of severe extracranial injuries was considered which was excluded in this stud. Most head injuries are associated with injuries to other parts of the body and these contribute significantly to the overall outcome [10].

Hyperglycaemia (RBS>200 mg/dl) is negatively correlated with favourable outcome following STBI [1, 30]. On the other hand, tight glycaemic control may result in hypoglycaemia which is more detrimental and also results in poor outcome [1, 31]. The exact role hyperglycemia in the clinical outcome of the patients following brain injury is not clearly defined, although there is evidence of adverse effects of glucose on the nervous system recovering from focal ischemia. Results from this study indicated an association between higher concentration blood glucose and poor clinical outcome in head injury victims. The odds of having unfavorable outcome at 3 months was high among the patients with hyperglycaemia at multivariate analysis. Hyperglycaemia on ICU admission was found to be statistically significant significant predictor of unfavourable outcome among patients at following STBI at 3 months follow up. Similar findings was reported by Rovlias et al. [30], in their study of patients with head trauma demonstrated that clinical course was worse in patients with a blood glucose level greater than 200 mg/dl. Similar finding was reported by Chiaretti et al. [32].that majority of patients with severe head trauma had high blood glucose level, the researchers concluded that hyperglycaemia is significantly associated with poor neurological outcome. Similar result was reported by Merguerian et al. [33], although in their study they used mean of serial blood glucose concentration and 270 mg/dl was used as hyperglycaemia compared to 200 mg/dl used in this study, the authors found that, hyperglycaemia is a common findings among patients with STBI and strongly associated with poor outcome.

In a study conducted by Bahadir et al. [34] similar findings with current study was reported, that presence of hyperglycaemia after severe traumatic brain injury at an early stage may be a reliable marker of cerebral injury and is a predictor of poor prognosis. These studies demonstrate negative correlation between blood glucose level and GCS. That is, GCS dropped as blood glucose level increased which may be due the facts that hyperglycemia may increase mortality by augmenting brain edema and hypoxia. In agreement with the literatures, this study demonstrated a worsening in brain injury with elevating blood glucose level which may result in unfavourable outcome. This finding agrees with those of Rovalis et al. [30], Chiaretti et al. [32], Mergurian et al. [33] and Bahadir et al. [34], Lam et al. [35] have found that normoglyceamia within the first 48 hours of ICU stay was found to be predictor of good neurological outcome, but however it could not predict long term neurological outcome of the patients at 6 months follow up. Similarly, Monwery et al. [36] also found that though blood glucose levels increase proportionally to the severity of the injury, it alone cannot be used as a sole determinant of mortality in clinical practice whereas Rechangachary et al. [37], following their study, concluded that hyperglycaemia predicts poor outcome better than vital signs. Nevertheless, glucose metabolism is severely altered following severe traumatic brain injury. Activation of sympathetic activity and release of catecholamines impair the utilization of glucose by a wide variety of cells which results in a clinical condition similar to insulin resistance. The extent of the catecholamine surge in the body is directly related to the severity of the insult and may adversely affect the clinical outcome of the patients. In addition, hyperglycaemia increase plasma osmolality thereby increasing the water content of brain resulting in cerebral eodema. For that reason, free water (as dextrose solutions) should not be administered to head injured patients as the ischaemic brain metabolises glucose to lactic acid, lowering tissue pH and potentially exacerbating ischaemic injury.

In determining the prognostic factors for predicting outcome of TBI in this study, the Glasgow outcome scale (GOS) score at 3 months was used as the endpoint. Majority of the predictors had statistical significant associations with GOS scores at 3 months post injury are preventable, however due to lack of well-organized trauma respond systems among others, lack of government will to invest in human resource development, paucity of trained manpower, lack of basic facilities resulted in poor patient outcome. This re-enforces the well-known fact that traumatic brain injury takes a heavy toll on the population especially in a developing environment. A different study is required to unearth the factors responsible for this high incidence of unfavourable outcome in this environment so that efforts can be directed at addressing them. Clinicians treating patients often make decisions based on their assessment of prognosis. According to a survey in United Kingdom (UK) 2008, 80% of doctors believed that an accurate assessment of prognosis is important in making clinical decisions in the management of patients with STBI [8]. Since anaesthetists are the primary managers of ICU in the West African sub- region due to lack of intensivists, accurate prediction of outcome may help in rational allocation of scarce health resources. The ability to accurately predict the outcome after STBI will also help doctors in designing protocols relevant to their practice environment, which will improve clinical management of severe head injury.

4. Conclusions

This study revealed hypotension, hyperglycaemia and anaemia were significant predictors of unfavourable outcome should be avoided on an absolute basis and mid-line brain shift greater than 5 mm and absent or compressed cistern on brain CT-scan indicate unfavourable outcome following severe traumatic brain injury. The use of simple, clinical prognostic factors such as those found in this study in the prediction of immediate outcome following head injury should be adopted as an essential part of the management plan of all severely head injured patients in ICU in West Africa. This is because the factors found to be strongly predictive of outcome are all easily attainable in this environment without having to resort to sophisticated monitoring and investigative techniques.

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