PREDICTORS OF FIRST WEEK MORTALITY IN SEVERE TRAUMATIC BRAIN INJURY PATIENTS

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Abstract

Background and objectives: Traumatic brain injury (TBI) is one of the leading causes of death in developing countries. Outcome prediction after severe head injury is very important especially for developing countries for better use of limited healthcare resources. The aim of this study is to evaluate various factors as predictors of early mortality in severe TBI.

Patients and methods: This study is based on prospective analysis of patients admitted at Mansoura University Emergency Hospital with severe head injury (GCS≤8) over a period of six months from April to October 2014. Patients with associated severe chest, abdominal or orthopedic trauma were excluded. Various clinical, radiologic and laboratory parameters were taken at arrival and statistically analyzed to identify the predictors of early mortality.

Results: The study included 82 patients with severe head injury. We reported a mortality of 63.4% during the first week. Road traffic accident was the commonest (75.6%) mode of injury. Age, hypoxia, anemia and presence of mass and diffuse lesions on CT scan were significantly related to early mortality. Younger age and presence of operable mass lesion was associated with less mortality.

Conclusion: Patients with severe traumatic brain injuries have high mortality rates. Early mortality in patients with severe TBI is significantly shown in patients having both mass and diffuse lesion on CT scan hypoxia and low hemoglobin. Surgical intervention was significantly associated with less mortality.

Key wards: traumatic brain injury, prognostic factors, early mortality

{**Citation:** Ahmed Gaber Marei, Ihab Helmy Zidan, Hosam Shata Mohamed Ali, Ahmed Ibrahim Mahmoud Harraz. Predictors of first week Mortality in severe traumatic brain injury patients. American Journal of Research Communication, 2015, 3(11): 21-29} www.usa-journals.com, ISSN: 2325-4076.

Introduction

Traumatic brain injury (TBI) is a major cause of death and disability among trauma patients [(1)], and a critical socio-economic and public health problem throughout the world especially in developing countries. Severe TBI is associated with poor prognosis and its management is complicated and requires adequate pre-hospital care, a rapid diagnostic process and intensive treatment in intensive care unit (ICU). After surviving a severe TBI, aggressive rehabilitation is important for the long-term outcome. This demands the dedication of expensive but limited health care resources. There is increasing attention to resource allocation in all societies and the ability to accurately predict outcome becomes very important for targeting of scarce resources. [(2)]

In order to predict outcome, both simple physiological parameters and more advanced technologies, such as CT imaging, are used as prognostic factors [(3-5)].

Aim of the work

The aim of this study is to identify the various predictors of early mortality (within one week) in patients with severe traumatic brain injury.

Patient and methods

This prospective study included all patients with severe traumatic brain injury (GCS ≤ 8) admitted in Mansoura University Emergency Hospital over a period of six months from April to October 2014.

Exclusion criteria

1. Polytraumatized patients.
2. Patients with associated cervical spine injury.
3. Patients with GCS=3 and dilated pupils after resuscitation.
4. Admission > 8 hours after injury.

After initial resuscitation, patients are re-evaluated and the following data are collected: age, sex, mode of injury, time of presentation, blood pressure, oxygen saturation, GCS, pupillary size and reaction, hemoglobin, blood sugar.

Head CT scan is done to all patients and CT findings are categorized either:

- Diffuse lesions (including multiple intracerebral hemorrhagic contusions, massive cerebral edema, subarachnoid hemorrhage, intraventricular hemorrhage, diffuse axonal injury and cerebral infarct) or
- Mass lesions (including extradural hematoma, subdural hematoma and intracerebral hematoma with or without midline shift).

Patients are grouped into two groups; survived and unsurvived within one week period after admission and the collected data are used as predictors of outcome.

Statistical analysis

The collected patients' data are statistically analyzed to identify the predictors of early mortality among patients with severe TBI included in the present study. Data were analyzed with **SPSS** version 21. The normality of data was first tested with one-sample Kolmogorov-Smirnov test. Qualitative data were described using number and percent. Association between categorical variables was tested using Chi-square test (χ^2) When more than 25% of the cells have expected count less than 5, Fisher exact test was used .

Continuous variables were presented as mean ± SD (standard deviation) for parametric data and Median for non-parametric data. The two groups were compared with Student ***t test*** (parametric data) and Mann–Whitney test (non parametric data).

Level significance: For all above mentioned statistical tests done, the threshold of significance is fixed at 5% level (p-value). The results were considered:

- Non-significant when the probability of error is more than 5% ($p > 0.05$).
- Significant when the probability of error is less than 5% ($p < 0.05$).
- Highly significant when the probability of error is less than 0.1% ($p < 0.001$).

The smaller the p-value obtained, the more significant are the results.

Results

The current study was carried out on 82 patients with severe traumatic brain injury. The influence of the epidemiological factors on the outcome is shown in (Table 1). The majority of patients were males (85.4%) with road traffic accident (75.6%) as most common mode of head injury. Mortality during the first week had statistically significant (p value = 0.005) relationship with age of the patient. We had 50% mortality in 20-40 years age group which was much higher than 26.9% in below 20 year age group and 23.1% in patients > 40 years age group. Mode of injury whether road traffic accident (75.6%), history of fall (14.6%) or direct trauma to head (9.8%) did not have any significant relation with early mortality.

The influence of various clinical and laboratory factors on neurological outcome is shown in (Tables 2 and 3). 4.9% of patients were hypotensive when they presented in casualty, its relation with mortality was not significant. Hypoxia affected first week mortality in patients with severe head injury. 76.9% of the unsurvived patients had hypoxia at the time of presentation, as compared to 23.1% in non-hypoxic patients. So hypoxia was significantly associated with mortality with p value 0.027. The GCS score and presence of pupillary abnormalities at the time of admission have not been shown to be a reliable predictor of mortality during the first week after severe head injury. The patient hemoglobin was significantly associated with first week mortality with P value = 0.05 while his RBS was not.

Table 1 Relation between sex, age and mode of injury and mortality during the first week

Items	Survived (n=30)		Died (n=52)		Test of sig. P value
	No	%	No	%	
Sex					
Male	26	86.7	44	84.6	X^2= 0.064 P= 0.80
Female	4	13.3	8	15.4	
Age					
<20y	20	66.7	14	26.9	X^2= 12.84 P= 0.005
20-<40y	6	20.0	26	50.0	
40-<60y	2	6.7	4	7.7	
≥60y	2	6.7	8	15.4	
Mode of injury					
RTA	22	73.3	40	76.9	X^2= 0.708 P= 0.702
FFH	4	13.3	8	15.4	
DHT	4	13.3	4	7.7	

n = Number, RTA = Road Traffic Accident, FFH = Fall From Height, DHT = Direct Head Trauma, X^2 = chi-square test, $p < 0.05$ is significant.

Table 2 Relation between hypotension, hypoxia, pupillary reflex and GCS score and mortality during the first week

Items	Survived (n=30)		Died (n=52)		Test of sig. P-value
	No	%	No	%	
Hypotension					
Absent	30	100.0	48	92.3	Fisher's Exact P= .291
Present	0	0	2	7.7	
Hypoxia					
Absent	14	46.7	12	23.1	X^2= 4.889 P= 0.027
Present	16	53.3	40	76.9	
Pupil					
Normal	26	86.7	44	84.6	X^2= 0.064 P=0.80
Anisocoria	4	13.3	8	15.4	
GCS					
3-4	4	13.3	10	19.2	X^2= .851 P=.653
5-6	18	60.0	26	50.0	
7-8	8	26.7	16	30.8	

n = Number, GCS = Glasgo Coma Scale Score, X^2 = chi-square test, $p < 0.05$ is significant.

Table 3 Relation between anemia and RBS and mortality during the first week

Items	Survived (n=30)		Died (n=52)		Test of sig. p-value
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	
HB	9.19± 2.78	4.40- 13.10	10.45±2.78	3.10-13.80	t= 1.994 P= 0.05
RBS	Median=155	112- 406	Median=176.5	80-348	Z= 0.385 P= 0.70

n = Number, SD = Standard Deviation, Min = Minimum, Max = Maximum, t=Student t test, Z= Mann–Whitney test, P < 0.05 is significant.

The influence of the CT scan findings on mortality is shown in (Table 4). The analysis of CT scan findings showed that 30 patients had mass lesion and 30 had diffuse lesion representing 36.6% each. There were 22 patients with both types of lesions representing 26.8%. The presence of both types of lesions was significantly associated (P value < 0.001) with mortality during first week.

Table 4 Relation between CT scan finding and mortality during the first week

Items	Survived (n=30)		Died (n=52)		Test of sig. p-value
	No	%	No	%	
CT					
Mass lesion	16	53.3	14	26.9	X^2= 17.634 P<0.001
Diffuse lesion	14	46.7	16	30.8	
Mass and diffuse lesion	0	0	22	42.3	

n = Number, X^2 = chi-square test, p < 0.001 is highly significant.

(Table 5) shows that 69.2% of the unsurvived group of patients were treated conservatively as compared to 30.8% of patients who had had operative intervention. This signifies the important role of early operative intervention in the management of severe head injury (p value 0.044).

Table 5 Relation between mode of management and mortality during the first week

Items	Survived (n=30)		Died (n=52)		Test of sig. p-value
	No	%	No	%	
Management					
Surgical	16	53.3	16	30.8	X^2= 4.071 P=0.044
Conservative	14	46.7	36	69.2	

n = Number, X^2 = chi-square test, p < 0.05 is significant.

Discussion

Accurate assessment of prognosis is important when making decisions about the use of specific methods of treatment, in deciding whether or not to withdraw treatment and counseling patients and relatives. [6]

The aim of the present study is to determine and evaluate the various predictors of early mortality (within one week) in patients with severe traumatic brain injury.

The study describes the outcome of 82 patients who have severe TBI, and reports a mortality of 63.4%. There are very few studies of this group of cases. Demetriades et al. in 2004 studied the outcome and prognostic factors among people with head injury and a GCS score of 3. They found an overall mortality of 76 %. [7]

Several investigators have stated that age is a good predictor of mortality in traumatic brain injury [8-12]. In our study we don't have this stepwise effect of increasing age on mortality. We found unexpectedly less mortality in patients aged >40 years. This may be attributed to more outdoor exposure of younger patients and hence vulnerability to road traffic accidents which was the mode of injury in about 80% of our cases.

It is well known that the GCS score at hospital admission has prognostic value [13], and it is an important factor in all prognostic scores [14]. In our study we did not find a significant relation between initial GCS score (after resuscitation) and mortality during the first week in severe head injuries. Our finding is supported by the finding of D. Woischneck et al [15].

In this study, hypotension was not significantly associated with poor outcome. This is in contrast to previous studies, [16-18] probably because of selection bias as all patients with severe chest, abdominal or orthopedic trauma were excluded. It has been seen that a large number of patients with severe head injury die, not because of primary brain damage but because of additional brain insults, hypoxia being one of the most important of them [16-20]. In our study hypoxia was significantly associated with first week mortality.

Various studies have proved that absence of pupillary reactivity in one or both eyes is a strong prognostic factor [21-23]. In our study we excluded Patients with GCS 3 with dilated fixed pupils after resuscitation and evaluated the presence of unequal pupils as a predictor of first week mortality which was not significant.

CT scan is of utmost importance to guide further management as shown in various previous studies [24, 25]. Prognostic role of CT scan in predicting outcome is also agreed. [25-27] In our study the presence of both mass and diffuse lesions was significantly associated with mortality during first week. Only 30.8% of patients who died during the first week had had operative intervention as compared to 69.8% of died patients who were treated conservatively. This signifies the importance of early operative intervention in the management of severe TBI.

In a retrospective study, Jeremitsky et al. assessed the impact of hyperglycemia during the first 5 days of admission on outcomes in 77 patients with severe TBI. They found an association between hyperglycemia, as measured by a hyperglycemia score, and lower day 5

GCS and prolonged hospital length of stay, but found no correlation with mortality. [28] Also in our study we didn't find relation between initial plasma glucose and mortality in the first week. However various studies concluded that elevated blood glucose levels are associated with increased mortality and morbidity [29-32].

Several studies demonstrate poor outcomes with anemia [33-35], whereas others have shown that transfusion itself, rather than anemia, conferred a risk of mortality [36]. In our study initial hemoglobin level was significantly associated with first week mortality.

Conclusion

Early mortality in patients with severe TBI is significantly shown in patients having both mass and diffuse lesion on CT scan hypoxia and low hemoglobin. Surgical intervention was significantly associated with less mortality.

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