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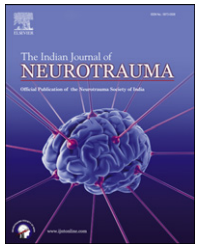

Original article

Factors predicting outcome in patients with severe head injury: Multivariate analysis☆,☆☆

*Navdeep Singh Saini**, *Vikas Rampal*, *Yashbir Dewan*, *Sarvpreet S. Grewal*

Christian Medical College and Hospital, Ludhiana, India

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ABSTRACT

Background: Outcome prediction after severe head injury is of great clinical importance especially for countries like India for better targeting of limited healthcare resources. This study was undertaken to evaluate various factors as predictors of outcome in severe head injury.

Patients and Methods: This study is based on prospective analysis of 110 patients admitted over a period of one and half year with severe head injury. Patients with associated severe chest, abdominal or orthopedic trauma were excluded. Clinical outcome was evaluated at the time of discharge and after six months, according to Glasgow outcome score.

Results: Road traffic accident was commonest (83.64%) mode of severe head injury. Only 5.71% of patients were following traffic rules. Increasing age of patients, hypoxia, low GCS and abnormal pupillary reflex were found to be significant predictors of adverse clinical outcome. Early operative intervention, when indicated as per CT findings, was significantly associated with favorable outcome. Greater degree of midline shift and effacement of Basal cisterns were associated with adverse outcome.

Conclusion: Predicting outcome is an assimilative and integrative process of various pre-injury, injury and post-injury variables. Strict enforcement of traffic rules can help us to save precious life. Hypoxia should be avoided on absolute basis. CT scan should be done on urgent basis to look for operable mass lesions.

1. Introduction

The management of severe head injury patients demands the dedication of expensive but limited intensive care resources for considerable length of time. In spite of these efforts, mortality and long term morbidity remains high. In all reported series of significant number of patients, a mortality rate of the order 30–40% was seen.[1] Outcome prediction after severe head injury continues to be an area of intense interest. In part, this reflects the natural curiosity of the neurosurgeon, but as an increasing attention is paid to resource allocation in all societies, our ability or inability to accurately predict outcome becomes very important for targeting of scarce resources.[2] Commonly used predictors of outcome both individually or in combination include age, Glasgow coma scale score, pupillary reactivity, early hypoxia and hypotension,

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* *Corresponding author*. Department of Surgery, Christian Medical College and Hospital, Brown Road, Ludhiana, Punjab 141008, India. Tel.: +91 9876716475 (mobile); fax: +91 1615014716.
E-mail address: navmalwai@yahoo.com (N.S. Saini).

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Table 1 – Epidemiological prognostic factors in severe head injury.

Prognostic factor	Sub-group	No.	Glasgow outcome score					% age of UO	Significance/ p value
			I	II	III	IV	V		
Age	<20	22	4	–	2	4	12	27.27	S/<0.001
	20–40	45	18	–	–	13	14	40.00	
	>40	43	30	–	1	9	3	72.09	
Sex	Male	94	46	–	2	21	25	51.06	NS/>0.05
	Female	16	6	–	1	5	4	43.75	
Mode of Injury	RTA	92	42	–	3	21	26	48.91	NS/>0.05
	Fall	14	8	–	–	4	2	57.14	
	Assault	4	2	–	–	1	1	50.00	
H/O Alcohol Intake	Yes	18	8	–	0	3	7	44.44	NS/>0.05
	No	92	44	–	3	23	22	51.09	
Time of Presentation	≤8 h	88	42	–	2	21	23	50.00	NS/>0.05
	>8 h	22	10	–	1	5	6	50.00	

RTA: Road traffic accident, S: Significant, NS: Not significant, UO: Unfavorable outcome.

brain stem reflexes and CT findings.[3] This prospective study was undertaken to evaluate these factors as predictors of outcome in patients with severe head injury.

2. Patients and methods

This study is based on the prospective analysis of patients admitted in our hospital from 1st August 2005 to 31st January 2007 with severe head injury with GCS of 8 or less. Patients with associated severe chest, abdominal or orthopedic trauma were excluded. After initial resuscitation they were evaluated and investigated. CT scan was done in all patients and if any significant operable lesion was found, they were operated upon immediately. Other patients were managed conservatively using ventilatory support, anti convulsants, ICP monitoring, anti edema drugs. Clinical outcome was evaluated at the time of discharge and at six months according to Glasgow outcome score: Grade I (death), Grade II (vegetative), Grade III (mostly dependant), Grade IV (minimally dependant) and Grade V (good recovery) GOS of I–III was considered as unfavorable outcome and GOS of IV, V was considered as favorable outcome for statistical analysis. The data was analyzed as mean ± SD, non-parametric data was analyzed by chi square, Fischer's exact test and parametric test was applied to the interval data. The association was calculated by correlation and regression analysis.

3. Results

During this eighteen-month study period, 110 consecutive patients of severe head injury were enrolled in this study. The influence of the epidemiological factors on the outcome is shown in Table 1. The majority of patients were males (85.45%) with road traffic accident (83.64%) as most common mode of head injury. Unfavorable outcome had statistically significant (p value <0.001) relationship with age of the patient. 72.09% of patients with age above than 40 years had adverse outcome which was much higher than 27.27% in below 20 year age group and 40% in patients between age group 20–40 years. Mode of injury whether road traffic accident (48.91%), history of fall (57.14%) or assault (50%) did not had any significant relation with adverse outcome. 16.36% patients had history of alcohol intake, but alcohol intake was not a significant predictor of outcome. 80% of patients

Table 2 – Clinical prognostic factors in severe head injury.

Prognostic factor	Sub-group	No.	Glasgow outcome score					% age of UO	Significance/ p value
			I	II	III	IV	V		
Hypotension	Present	20	10	–	0	4	6	50	NS/>0.05
	Absent	90	42	–	3	22	23	50	
Hypoxia	Present	23	19	–	0	2	2	82.61	S/<0.005
	Absent	87	33	–	3	24	27	41.38	
GCS	3–4	41	31	–	1	6	3	78.05	S/<0.0001
	5–6	19	9	–	1	5	4	52.63	
	7–8	50	12	–	1	15	22	26.00	
Pupillary reflex	Normal	96	42	–	3	23	28	46.87	S/<0.001
	Both dilated	6	4	–	–	2	–	66.67	
	Anisocoria	8	6	–	–	1	1	75.00	
Treatment	Non-operative	78	43	–	2	17	16	57.69	S/<0.05
	Operative	32	9	–	1	9	13	31.25	

GCS: Glasgow coma score, UO: Unfavorable outcome, NS: Not Significant, S: significant.

Table 3 – Prognostic factors on CT scan in severe head injury.

Prognostic factor	Sub-group	No.	Glasgow outcome score					% age of UO	Significance/ p value
			I	II	III	IV	V		
Midline shift	Absent	56	20	–	1	15	20	37.50	S/<0.005
	≤5 mm	33	19	–	2	6	6	63.64	
	>5 mm	21	13	–	–	5	3	61.90	
EDH	Absent	88	45	–	3	20	20	54.55	NS/>0.05
	≤10 mm	19	6	–	–	6	7	31.58	
	>10 mm	3	1		–	–	2	33.33	
SDH	Absent	71	33	–	1	17	20	47.89	NS/>0.05
	≤10 mm	30	14	–	2	6	8	53.33	
	>10 mm	9	5	–	–	3	1	55.56	
Basal cisterns	Effaced	83	43	–	3	20	17	55.42	S/<0.05
	Uneffaced	27	9	–	0	6	12	33.33	
SAH	Present	105	49	–	3	25	28	49.52	NS/>0.05
	Absent	5	3	–	–	1	1	60	

UO: Unfavorable outcome, EDH: Extradural hematoma, SDH: Subdural hematoma, SAH: Subarachnoid hemorrhage, NS: Not significant, S: Significant.

presented to trauma center within 8 h. Only 13.6% of patients came within golden first hour. Time taken before presentation to trauma center whether less than or more than 8 h, was not related to clinical outcome. The influence of various clinical factors on neurological outcome is shown in Table 2. 18.18% of patients were hypotensive when they presented in casualty, its relation with clinical outcome was not significant. Hypoxia, being one of the preventable secondary brain insults, greatly affected outcome in patients with severe head injury. 82.61% of patients who had hypoxia at the time of presentation had unfavorable outcome, as compared to 41.38% in non-hypoxic patients. So hypoxia was significantly associated with adverse outcome with p value <0.005. The GCS score at the time of admission has been shown to be a reliable predictor of clinical outcome after severe head injury. 78.05% of patients with GCS of 3–4 had unfavorable outcome as compared to 52.63% in patients with 5–6 GCS and 26% in patients with 7–8 GCS. It was statistically highly significant with P value. <0.0001. Normal pupillary reflex was associated with good outcome. 46.87% of patients with normal reflex had unfavorable outcome as compared to 66.67% in patients with both dilated pupils and 75% in patients with anisocoria. Thus association of abnormal pupillary reflex with adverse unfavorable outcome was statistically highly significant (p value <0.001). 29.09% of patients with severe head injury had operative intervention with adverse unfavorable outcome in only 31.25% cases as compared to 57.69% of patients managed conservatively. This signifies the important role of early operative intervention in the management of severe head injury (p value <0.05). The influence of the CT scan findings on the final outcome is shown in Table 3. Greater degree of midline shift on CT scan was associated with unfavorable outcome. It was 37.5% for midline shift of <1 mm, 57.58% for<5 mm and 71.43%for midline shift of >5 mm. This increase in unfavorable outcome with greater degree of midline shift is statistically important with (p value <0.005). 55.42% of patients in whom ventricles were effaced had an unfavorable outcome (p value <0.05%). Presence of extradural or subdural hematoma did not significantly influence the outcome. CT scan revealed normal findings in five patients out of which four had favorable outcome.

4. Discussion

The term severe head injury has been defined differently by different authorities. The international traumatic data bank has defined it as a Glasgow coma scale of 8 or less at 6 h after injury following neurosurgical resuscitation or deterioration to Glasgow coma scale of 8 or less within 48 h of injury and lasting for at least 6 h.[4] Mortality and morbidity rates in patients sustaining severe head injuries remain high. In spite of various combinations of predictors, no model has satisfied all the requirements of an ideal model.[2] This was a clinical study to determine and evaluate factors predicting outcome in patients with severe head injury. Patients were studied till the period of six months after discharge. A common Glasgow outcome scale (GOS) was used to compare the outcome. Many variables were analyzed to predict prognosis, using GOS as dependent variable. Road traffic accident was commonest (83.64%) mode of severe head injury. It was comparatively high as compared to previous studies may be because of location of our hospital on national higway-1 and majority of people not following traffic rules. Only 5.71% patients were wearing seat belts or helmets while driving, thus increasing the adverse outcome after severe head injury in our study. Increasing age was one of the factors that adversely affected the outcome in our study. There was increase in unfavorable outcome with increasing age in previous studies also.[5,6] Livingston et al[7] and Lewin et al[8] showed similar results. Although persons under the influence of alcohol are more likely to sustain head injury, association of alcohol intake was not significantly associated with clinical outcome. It should not be the reason to delay procedures like CT scan, ventriculostomy or other treatment plans.[9,10] Majority of patients (86.4%) came after 1 h of injury. In this study, hypotension was not significantly associated with poor outcome. This is in contrast to previous studies,[11–13] 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.[11–15] In our study majority of patients (82.62%) who were hypoxic at the time of admission had unfavorable outcome. Majority of previous studies have shown that GCS at the time of admission is a reliable predictor of final outcome.[16–23] In our study, unfavorable outcome was significantly increasing with decreasing GCS. In our study, none of the surviving patients with both fixed pupils at admission was in grade V of GOS after six months. Various other studies have also proved that impaired pupillary response have a well documented correlation with unfavorable outcome.[3,20,24] CT scan is of utmost importance to guide further management as shown in our study and various previous studies. Prognostic role of CT scan in predicting outcome is also undisputed. Among all the CT findings which we studied, midline shift is the most important factor that influences the outcome.[2,25,26] In our study, there was increase in mortality with increase in midline shift, with mortality reaching up to 61.90% in patients with midline shift of more than 5 mm. One out of five patients who had normal CT scans died. He had severe hypoxia at the time of presentation. It can be concluded from this study that strict enforcement of traffic rules can help us to save life by reducing the incidence of severe head injury. Hypoxia should be avoided on an absolute basis. Urgent CT scan of the head should be done to look for operable mass lesions as early detection and evacuation of the mass lesions saves life. Thus predicting outcome following traumatic severe head injury is an assimilative and integrative process of various pre-injury, injury and post-injury variables.

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