

Original Research Article

A study of prognostic score for predicting the outcome in cases of traumatic brain injury

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ABSTRACT

Background: Glasgow coma scale (GCS) and the Glasgow outcome scale help us with confident predictions after 24 h following the injury, but not on admission. The IMPACT and CRASH studies provided new methods for performing prognostic studies of traumatic brain injury. And this prognostic scoring system has been studied in our study.

Methods: This is an observational prospective cohort study performed at the department of surgery, Gandhi medical college and Hamidia hospital, Bhopal on 87 patients during a period of 2 years. A preformed pro-forma was filled for each patient after 6 hours of resuscitation which included all the details of the patients like name, age, sex, CR no., and GCS after resuscitation, mode of injury, the clinical evaluation score used by IMPACT trial and neurological finding, management details, CT scan was done as soon as possible for all patients and findings were included in the pro-forma. The final outcome was recorded at the time of discharge.

Results: Among Patients with mean total prognostic score of 0-4, 97% patients discharged without deficit, 3% discharged with deficit with no mortality. Among score of 15-20, only 7 % can be discharged without deficit and 7% could be discharged without deficit, while 86 % patient died.

Conclusions: The mean total prognostic score of discharged groups was significantly lower than the patients in discharged group. We concluded that this prognostic model helps us to individually identify patients who will succumb to death and early need for surgical intervention.

Keywords: GCS, IMPACT, Traumatic brain injury

INTRODUCTION

Traumatic brain injury (TBI) is a leading cause of death and disability for which reliable factors for the outcome prediction on admission is clinically relevant as is captured in age old Hippocratic aphorism, "no head injury is too severe to despair of, nor too trivial to ignore." Glasgow coma scale (GCS) and the Glasgow outcome scale help us with confident predictions after 24 h following the injury, but not on admission.¹ The incidence of requiring admission and causing death is

approximately 100 per 100000 inhabitants/ year due to rapid surge in urbanization, motorization and economic liberation.^{2,3} In developing countries, the incidence of TBI is very high and rapidly increases day by day. WHO predicts it to be 3rd major cause of death by 2020, RTA being the M.C. case of TBI.⁴

India, had many deficiencies in the present trauma management system and disabilities also increases considerable burden and health care system. To improve the favorable outcome, we need to develop some

generalized approaches that are universally applicable. A holistic approach embracing all disciplines is needed for effective primary prevention activities, policy improvement, and planning to guarantee satisfactory health care for people with TBI.

Because of the inability of previous randomized controlled trials (RCTs) on TBI to demonstrate the expected benefit of reducing unfavorable outcomes, the IMPACT (International Mission on Prognosis and Analysis of Clinical Trials in TBI) and CRASH (Corticosteroid Randomization After Significant Head Injury) studies provided new methods for performing prognostic studies of TBI.²

Primary aim was to study a prognostic model for death and to identify patients who are more likely to succumb to death in cases of isolated traumatic brain injury. Secondly, for early identification of surgical management/craniotomy.

METHODS

This is an observational prospective cohort study performed at the department of surgery, Gandhi Medical College and Hamidia Hospital, Bhopal on 87 patients during a period of 2 years from April 2018 to June 2019.

Ethical committee clearance was taken from the ethical committee of Gandhi Medical College, Bhopal before initiating the study. All Patients older than 14 years; suffering from blunt (non-missile) isolated TBI, surviving the first 6 hours after the injury were included in the study. Only the patients with severe instability and who died within 6 hours of injury, thereby precluding computed tomography (CT) scanning, were excluded. Patient with any medical (history of hypertension, diabetes, CAD, TB, Asthma, etc.) or major surgical comorbidities (e.g. blunt trauma abdomen and long bone fracture, etc.) were also excluded.

Primary resuscitation and stabilization of patient was conducted as per department protocol. A preformed pro-forma was filled for each patient after 6 hours of resuscitation which included sampling of the patients like name, age, sex, CR no., and GCS after resuscitation, mode of injury, the clinical evaluation score used by IMPACT trial and neurological finding, management details, CT scan was done as soon as possible for all patients and findings were included in the pro-forma. The final outcome was recorded at the time of discharge.

All admission CT scans were obtained within the first 6 hours after the injury. If a second CT scan was done within the first 6 hours, the final category giving the worst prognosis (worst CT) was used in the analysis. The following CT head findings were collected.

- Traumatic subarachnoid hemorrhage (SAH) was defined as the presence of blood in the subarachnoid

space either over the convexity or fissures or in the basal cisterns. These traumatic SAHs were graded according to the amount of extravasated blood as follows: no blood; mild traumatic SAH, defined as a small amount of blood at 1 or 2 sites; moderate traumatic SAH, defined as more than 2 sites moderately filled with blood; and severe traumatic SAH, defined as more than 2 sites completely filled bilaterally with blood or clots that had expanded to the original size of the cistern or fissure.

- Intraventricular blood was categorized as present or absent.
- The basal cisterns were categorized as normal or abnormal (compressed or absent).
- The presence and type of mass lesions (subdural or intracerebral) were categorized based on volume into 3 groups: <15 ml, 15–24 ml, and ≥25 ml.
- Epidural hematomas were scored as present or absent.
- Midline shifts were documented (No shift or 1 to 4 mm or 5 to 9 mm or more than 10 mm).

All these data were filled in preformed pro-forma that includes the score given by the IMPACT trial as shown in Table 1.

Table 1: Prognostic score given by impact trial and also used in this study.

Predictors	Criteria	Score
Age (in years)	76-95	3
	56-75	2
	36-55	1
	15-35	0
Motor score	None	3
	Unstable	2
	Others	0
Pupil reactivity	No pupil reacted	6
	1 pupil reacted	2
	Other	0
Shock	Yes	2
	No	0
SAH	Severe deposits	1
	Others	0
Cisternal status	Compressed/absent	3
	Other	0
Epidural hematoma	No	2
	Yes	0

Cohort grouping

Two cohorts, one of death patients and the other one of the patients who were discharged with or without neurological deficit, were made.

Similarly, other two cohorts which were compared are one in which patients were managed conservatively and the other in which patients were operated.

Data and statistical analysis

All the data recorded was collated in master sheet and analyzed by Microsoft excel. Final scores, their correlation with the outcome and management done Microsoft excel, t- test for unequal variance was applied between death and discharged cohort in outcome and between conservative and surgical management.

RESULTS

Outcome analysis in correlation with midline shift

When we correlate the midline shift the management done to the individual patients, we find that 49 patients who were having no midline shift on CT scan, all managed conservatively, out of which 45 (92 %) patients have been discharged and 4 (8 %) patients have died. There is 8 % mortality. 3 patients having 1-5 mm of midline shift, all are managed conservatively and all discharged.

Table 2: Correlation of midline shift with the management done.

Midline shift (in mm)	Management		
	Conservative	Surgically	Grand total
No shift	49	0	49
01-05	3	0	3
05-09	9	8	17
>10	2	16	18
Grand total	63	24	87

In patients having >5 mm of midline shift, there are 35 patients, 11 (31 %) of them managed conservatively and 24 (61%) have been operated. A total of 18 (51%) patients died and 17 (34 %) patients have been discharged without any neurological deficit 14 % patients discharged with neurological deficit. Clearly there is a higher death rate in patients with midline shift >5 mm. This clearly suggests as the midline shift increases mortality rate increases.

Table 3: Correlation of midline shift with the final outcome of the disease.

Midline shift (mm)	Outcome		
	Death	Discharged	Grand total
No shift	4	45	49
01-05	0	3	3
05-09	5	12	17
>10	13	5	18
Grand total	22	65	87

Outcome analysis in correlation with total prognostic score

Patients with total prognostic score of 0-4 then there were 34 patients, 97% (33) patients discharged without deficit, 3 % discharged with deficit with no mortality. Among score of 5-9, total 19 patients are there. Out of which 79% (15) patients managed conservatively, 21%; 4 were operated. Among them 89% patients discharged without any neurological deficit and 11% discharged with deficit.

Table 4: Correlation of total prognostic score with the management done.

Total score	Management		
	Conservative	Surgically	Grand total
0-4	34	0	34
5-9	15	4	19
10-14	9	11	20
15-20	5	9	14
Grand total	63	24	87

Among score of 10-14, only 45% patients managed conservatively, 55% are operated. Out of these 50% died, 40 % discharged without neurological deficit, and 10% discharged with deficit. Among score of 15-20, only 36% patients managed conservatively while 36% managed conservatively, 64% operated. Out of which only 7 % can be discharged without deficit and 7% could be discharged without deficit, while 86 % patient died.

Table 5: Correlation of total prognostic score with the outcome.

Total score	Outcome		
	Death	Discharged with deficit	Discharged without deficit
0-4	0	1	33
5-9	0	2	17
10-14	10	2	8
15-20	12	1	1
Grand total	22	6	59

Statistical significance analysis

Two retrospective cohorts were made, one from conservatively managed patients and the other from operatively managed group. Then we compared the mean on of total prognostic score of two groups and applied the t-Test: two-sample assuming unequal variances. The P-value for which was <<0.005, and the difference of mean came out to be significant.

Table 6: T-test: two-sample assuming unequal variances between conservative and operative group.

	Conservative group	Operative group
Mean of total prognostic score	5.5	13.2
Variance	24.0	13.3
No. of patients	62	28
Standard deviation	4.9	3.7
Degree of freedom	69	
P value	0.00000000005	

P value $\ll 0.005$, hence the data is highly significant.

Table 7: T-test: two-sample assuming unequal variances between death and discharged group.

	Death group	Discharged group
Mean of total prognostic score	14.09	5.23
Variance	8.85	17.90
No. of patients	22	65
Standard deviation	2.97	4.23
Degree of freedom	52	
P value	0.0000000000000076	

P value $7.69905e-15 \ll 0.005$, hence data is highly significant.

We made two retrospective cohorts, one from death group and the other from discharged group, while comparing this we counted all the patients discharged as one group irrespective of its neurological deficit. Then we compared the mean on of total prognostic score of two groups and applied the t-Test: two-sample assuming unequal variances. The p value for which was $\ll 0.005$, and the difference of mean came out to be significant.

Three outcome variables shown in the graph, with the increasing score the no. of patients being discharged decreases drastically and mortality increases. No. of patients being discharged with neurological deficit depicted in figure as “deficit” also increases steadily. After the above analysis enables us to classify our patients in four risk categories on the basis of total prognostic score as shown in Table 8.

Table 8: Risk groups made on the basis of total prognostic score showing percentage risk of death and percentages of operated patients in each group.

Risk categories	Total score	Risk of death (%)	Operative intervention (%)
Low risk	0-4	0	0
Moderate risk	5-9	0	21
High risk	10-14	50	55
Very high risk	15-20	86	64

Table 9: Gomez in his study the scoring rule was used to create 4 risk categories 2:

Risk categories	Total score	Risk of early death (%)
Low risk	0-3	<1
Moderate risk	4-8	1-10
High risk	9-12	10-50
Very high risk	13-20	>50

DISCUSSION

Gómez et al in their study proposed that the principal application of the prognostic models should be to classify TBIs in a manner that is more accurate than that currently possible using the GCS or CT findings alone. They through this score demonstrated that early death can be predicted and can improve the methodological design of RCTs. They further concluded that using prognostic models may also improve trial design, although more studies of this type should be performed to determine their utility in the methodology of sharing patient data across different management-therapeutic settings in multi center, collaborative studies.² Gomez in his study expected that the effects of treatment and health care organization on outcome of individual patients change over time. This underlines the necessity of re-validation of these prognostic models in the future, to re-confirm generalizability or to update the models on more recent patient populations. This should become a continuing process, and highlights the need for a prospective high-quality observational study.² Pal in his study found that apart from GCS age and environmental factors are also responsible for mortality.⁶

Perel et al at Nutrition and Public Health Intervention Research Unit, Epidemiology and Population Health Department, London School of Hygiene and Tropical Medicine, Keppel Street, London reviewed total of 53 reports including 102 models and almost half (47%) were derived from adult patients. Three quarters of the models included less than 500 patients. Most of the models (93%) were from high income countries populations. Logistic regression was the most common analytical strategy to derived models (47%). In relation to the quality of the derivation models (n=66), only 15% reported less than 10% loss to follow-up, 68% did not justify the rationale to include the predictors, 11% conducted an external validation and only 19% of the logistic models presented the results in a clinically user-friendly way.⁵

When outcomes and management was compared with midline shift, we concluded that patients are also having mortality in patients with no midline shift. So, the midline shift can be a sensitive tool for assessing the TBI patients and planning management and predicting outcome of patients but not very specific.

On the other hand, when the outcome with total prognostic was compared, it was found that at low scores there is apparently no mortality and as the score increases, the mortality rises up to 86%. It seems to be more sensitive as well as specific. When the two cohorts of conservative group and operated groups were compared, the mean of total prognostic score of the conservative group was significantly lower than the mean score of operated group. The difference between means of total prognostic score of the two group have been found to be significant (p value <<0.005). Similarly, when the two cohorts of death group and discharged group were compared, the total prognostic score of discharged group was significantly lower than the mean score of patients in discharged group. The difference between means of total prognostic score of the two group have been found to be significant (p value <<0.005).

CONCLUSION

This prognostic model correlates well with the prognosis of the patients, and can be used to individually identify the patients who are more likely to succumb to death. Additionally, early identification of the need for surgical management can also be predicted.

Present study had some limitations. First, this study was observational and, thus, was accompanied by all problems inherent to this type of study, such as the lack of central committee evaluation. Second, the motor score was not always available because of early sedation or paralysis and ventilation. We preferred to use a separate category, untreatable, instead of using the motor score from the scene of the accident, but this choice remains under discussion. Third, is no. of patients in our study is very modest, so further trials need to be undertaken, from

different centers and a metanalysis of all can lead us in the positive side in management of TBI.

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