ORIGINAL RESEARCH PAPER

Neurosurgery

PROGNOSIS OF HEAD INJURY PATIENT ON THE BASIS OF MIDLINE SHIFT IN CT SCAN AND CONTRIBUTORY FACTORS

KEY WORDS: traumatic brain injury, midline shift in CT scan brain, Glasgow coma scale

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ABSTRACT

Background: Traumatic brain injury remains a global health problem with an approximate incidence of 0.2– 0.5% each year. CT classification scoring systems use Mid Line Shift as one of the most decisive features to score the amount of severity . Midline shift can be the result of heterogeneous morphologies consisting of hemorrhage, infarction, cerebral edema, and hydrocephalus, or a combination of these factors. Hence this study was conducted to analyze the correlation between degree of midline shift on ct brain and GCS score on admission in prediction of possible clinical outcome in head injury and to correlate ct scan finding of head injury patient with gcs of the patient and evaluate age site of injury, type of injury and pupillary reaction as contributory factors in predicting outcome. **Material and Methodology:** This Prospective Study was conducted on 150 Patients Admitted In Department Of Neurosurgery SMS Medical College, Jaipur .The Patient was enrolled In the study after obtaining an informed and written consent .neurological assessment will be done at the time of admission , 24 hours after the admission and at the time of discharge. Neurological assessment will be correlated with Midline shift in NCCT Brain. Other contributory factors such as pupillary reaction, age, sex, type and site of injury are assessed along with the neurological assessment at the above mentioned timing and correlated with outcome. **Results:** Among 150 patients with severe GCS, 41(27.3%) had midline shift >5 mm. Among 41 patients 34 patients had severe GCS Score and eventually resulted in poor outcome and it had a statistically significant determinant of outcome (p = 0.023). **Conclusion:.** By correlating CT scan finding with GCS score, we can predict the severity of head injury and a possible outcome of patient more accurately than considering both parameters as separate entities.

INTRODUCTION

One of the most frequent causes of mortality in motor vehicle accidents is traumatic brain injury. About 80% of them were classified as mild injuries, and 20% as moderate to severe. A brain injury accounts for around half of the 150,000 trauma deaths each year (1).

The Glasgow Coma Scale (GCS) score is a more popular metric for evaluating traumatic brain injury. The association between various computed tomography (CT) scan findings and prognosis is discussed by a number of authors in their work (2). Poor prognosis markers of severe head injury include lower GCS score and various CT findings, such as subarachnoid haemorrhage (SAH), hemorrhagic contusion, and subdural haemorrhage (SDH) (3).

The result of severe injury will be worse the more midline displacement there is on the CT image.

When the CT findings were related to increased intracranial pressure (ICP), one of the most common findings of the CT scan midline shift and others are compression or obliteration of basal cisterns, and the presence of subarachnoid haemorrhage, and subdural haemorrhage.

In many studies reported that presence of midline shift resulting ICP and poor prognosis (4). Many injuries have variable degree of brain swelling but about 1% will developed a significant intracranial clot, extradural or intracerebral, the early removal of which will reduce morbidity and may prevent mortality (5). Following injury, the primary damage will produce secondary brain swelling, either focal or generalized, and as there is a limit to the intracranial capacity, the increase in brain or blood volume will soon cause an increase in intracranial pressure causing cellular hypoxia, intracranial volume and inadequate or irregular respirations due to brain stem injury or brain stem compression (6). Head injury is leading cause of mortality and morbidity in developed and developing country.

Brain Injury From Trauma Results From Two Type Of Injury.

Primary Brain Injury- It occurs at time of trauma (cortical contusions, lacerations, bone fragmentation, diffuse axonal injury, and brainstem contusion) (7).

Secondary Injury- It develops subsequent to the initial injury. Includes injuries from intracranial hematomas, edema, hypoxemia, ischemia (primarily due to elevated ICP and/or shock), and vasospasm (8). Role of surgery is mainly required in these groups of the patients.

Clinicians treating patients often take decisions on the basis of their assessment of prognosis. As much as 80% of doctors believe that an assessment of prognosis in a head injury patient is important for taking therapeutic decisions such as barbiturates, hyperventilation, or mannitol. Assessment of prognosis could help communication with a patient and the family (9, 10). Major shortcoming of GCS is the limitation of its use among patients who are under sedation, under the influence of alcohol or psychoactive drugs, or are intubated (11-15). This hindrance has been compensated with the use of the morphological criteria based on radiological imaging. MRI studies are limited in terms of detecting white matter changes in the late phase (16, 17).

Hence, in the current scenario, scoring models based on CT imaging remains the valid option for prognostication of patients with TBI. CT scan characteristics such as status of basal cistern (18), midline shift (19-21), traumatic subarachnoid haemorrhage (tSAH) (22) and intraventricular haemorrhage (18) are useful indicators in predicting outcome in TBI. So, we planned a prospective study to analyze the correlation between degree of midline shift on CT scan of brain and GCS score on admission in prediction of possible clinical outcome in head injury, in order to correlate CT scan finding of head injury patient with GCS of the patient and evaluate age, site of injury, type of injury and pupillary reaction as contributory factors in predicting outcome.

MATERIALS AND METHODS

Permissions: Necessary permission was taken from the Ethical Committee and Research Review Board and after obtaining written consent.

Study Type: Hospital based study.

Study Design: Prospective study

Study Centre: Department of Neurosurgery, SMS Medical College and attached Hospital, Jaipur, Rajasthan.

Sample Size: Sample size in our study was 150 and it was taken on 1st come 1st basis.

Inclusion Criteria

All patients with recent traumatic head injury admitted to casualty section of trauma center in SMS hospital, Jaipur and have given consent for this study.

Exclusion Criteria

- Patients with deranged INR,
- Patients age ≥ 65 yrs,
- Patients with pre-existing intracranial lesions.

METHODOLOGY

This Prospective Study was conducted on the patients admitted in Department of Neurosurgery, SMS Medical College, Jaipur. The patients were enrolled in the study after obtaining an informed and written consent.

Neurological assessment was done at the time of admission, 24 hours after the admission and at the time of discharge. Neurological assessment was correlated with Midline Shift in NCCT Brain. Other contributory factors such as Pupillary reaction, Age, Sex, Type and Site of injury was assessed along with the neurological assessment at the above mentioned timing and correlated with outcome.

The sample size in our proposed study is 150 Cases. No extra-financial burden would be incurred to the patients.

Statistical Analysis

Nominal / categorical variables were summarized as frequency and percentage and were analyzed using Chi square test / Fischer's Exact test as applicable.

Continuous variables were summarized as mean and standard deviation and were analyzed using student t-test (for 2 group comparison) and ANOVA test for more than two group comparison.

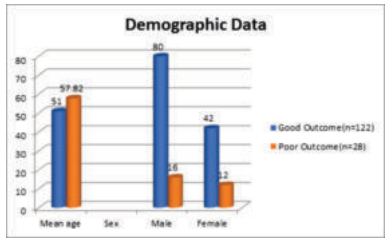
Correlation between two variables was analyzed using Pearson correlation coefficient. A 'p' value < 0.05 was taken as statistically significant.

All statistical analyses was done using Epi info version 7.2.1.0.

Table 1. Demographic Data Of Patients

	Demographic Data	Good Outcome (n=122)	Poor Outcome (n=28)	Chi square	p-value
	Mean age	51±28.07	57.82±47.31	2.71	0.31
Sex	Male	80	16	0.70	0.4
	Female	42	12		
Mode of injury	RTA	70	15	0.24	0.61
	Fall from height	52	13		

- In our study 28 patients' dead after TBI and 122 recovered.
- In our study there is no significant difference between demographic data of good and poor outcome.
- Mean age of patients who had good outcome was 51, while who had poor outcome had mean age of 57.82.
- Majority of patients were males, i.e. 80 males who had good outcome and 16 males who had poor outcome.
- The major mode of injury was RTA i.e. 85, followed by fall i.e. 65.



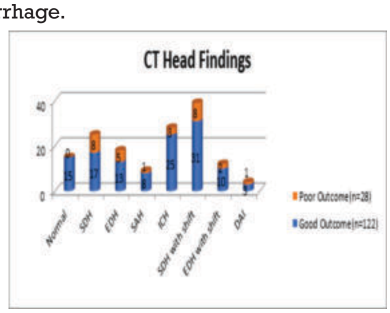
Graph 1-

Table 2. CT Head Findings And Outcomes

CT head findings	Good Outcome (n=122)	Poor Outcome (n=28)	Total	Chi square	p-value
Normal	15	0	15	52.7	0.001
SDH	23	2	25		
EDH	17	1	18		
SAH	8	1	9		
ICH	27	1	28		
SDH with shift	21	18	39		
EDH with shift	10	2	12		
DAI	1	3	4		
Total	122	28	150		

DAI, diffuse axonal injury; EDH, extradural hematoma; SAH, subarachnoid hematoma; ICH, intracerebral hematoma.

- A statistically significant association was observed in CT scan and outcome of patients.
- CT scan of brain showed multiple lesions in most patients, but for the purpose of classification of head injury in this study, the dominant lesion was considered.
- The present study showed no abnormality in 15 patients, while the common intracranial hemorrhage like subdural hemorrhage (n = 25), extradural hemorrhage (n = 18), intracerebral hemorrhage (n = 28), and subarachnoid hemorrhage (SAH) (n = 9).
- Five patients had diffuse axonal injury with no intracranial hemorrhage.

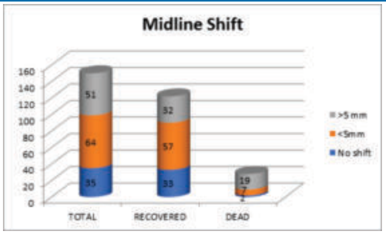


Graph 2

Table 3. Mid Line Shift In CT Scan

Midline shift	Total	Good outcome	Poor outcome	Chi square	P value
No shift	35	33	2	21.84	0.002
<5mm	64	57	7		
>5 mm	51	32	19		

- In this study midline shift in CT scan was observed in 115 patients, among whom 64 patients had <5mm midline shift (mls), while 51 had >5 mm shift.
- There was significant association of mid line shift in CT scan and outcome of patients.

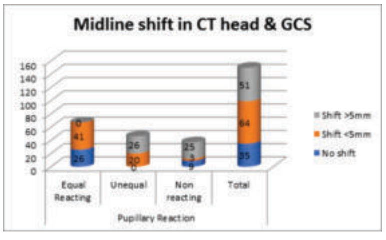


Graph 3-

Table 4. Midline Shift In CT Head And GCS (glasgow Coma Scale)

Midline shift in CT head	GCS			
	Mild	Moderate	Severe	Total
No shift	9	8	18	35
Shift <5mm	10	10	44	64
Shift >5mm	3	6	42	51
Total	22	24	104	150

- Chi square = 10.11, p value = 0.038
- Above table stated that majority of patients i.e. 104 had severe GCS score, 24 had moderate GCS score and 22 had mild GCS score.
- There is significant association of mid line shift in CT head and GCS score.

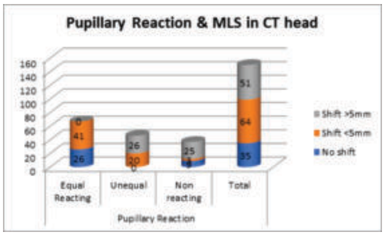


Graph 4-

Table 5. Pupillary Reaction And Midline Shift In CT Head

Midline shift in CT head	Pupillary reaction			Total
	Equal reacting	Unequal	Bilaterally Nonreacting	
No shift	26	0	9	35
Shift <5mm	41	20	3	64
Shift >5mm	0	26	25	51
Total	67	46	37	150

- chi square=10.11, p value=0.027
- Above Table states that maximum i.e. 67 patients had equally reacting pupil, 46 had unequal reacting pupil, and 37 had bilaterally non reacting pupil.
- There is significant association of mid line shift in CT head and Pupillary reaction.
- 26 out of 51 patients had Unequal Pupillary reaction while 25 out of 51 patients had Bilaterally non-reacting Pupillary reaction.

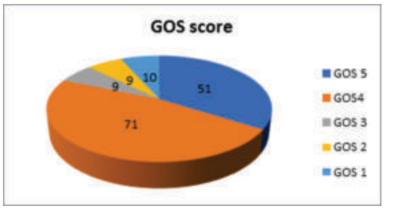


Graph 5-

Table 6. GOS Distribution

GOS score	No of patients
GOS 5	51
GOS4	71
Good Outcome	122
GOS 3	9
GOS 2	9
GOS 1	10
Poor Outcome	28

- In the present study, 122 patients had good outcome (GOS 4 and 5) after head injury according to GOS as compared with 28 patients who had poor outcome (GOS 1, 2 and 3).



Graph 6-

DISCUSSION

This prospective study was conducted on the patients admitted in Department of Neurosurgery SMS Medical College, Jaipur to assess neurological correlation with Midline shift in NCCT Brain after traumatic brain injury.

In our study there is no significant difference between demographic data of good and poor outcome. Mean age of patients who had good outcome was 51, while who had poor outcome had mean age of 57.82. Majority of patients were males, i.e. 80 males who had good outcome and 16 males who had poor outcome. Similar findings were observed by Kraus (23), who has shown that the most common group affected by head injuries are the young people between 20 years and 40 years and the incidence is lowest at extremes of age, that is, below 5 years and above 60 years. Further Similar findings were also observed in study of Shrikant (24).

In our study the major mode of injury was RTA i.e. 85, followed by fall i.e. 65. Similarly on analysis of mode of head injury by Shrikant (24), RTA was the most common cause for the same. The most common mechanisms leading to TBI are fall accidents, RTA, and assault-related incidents as observed by Gan et al (25). A study by Chiewvit et al (26) has also shown that the most common cause of head injury in age group of 0 to 20 years was motor accidents; highest incidence in group of 21 to 40 years was assault with a blunt object; and in group of 41–60 years, car accident was the most common cause while fall was the most common etiology in the group of > 60 years.

Our study has shown male preponderance (64%) and male female ratio was 1.7:1 indicating males are affected more than females, and this finding is similar to other studies. Age and sex are important predictors of outcome in head injury. Similarly in the study by Kraus (23), It was shown that the incidence is more in males as compared with females and most of the studies quote an incidence of 3:2 in favor of males. In the study by Slewa-Younan et al (27), although identical admission criteria were applied to both sexes, the levels of injury severity in males were greater than females.

In our study poor outcome was observed in elder patients, similarly other authors i.e. Mass and Shrikant state that the association was apparent only after the age of 40 years (3,24) and especially above 60 years (25).

In our study there is no significant association between age group and sex and outcome of patients. Similarly in study of Mass and Chiewvit there is no association between outcome in patients with head injury and age lower than 40 years (3, 26).

Comorbidities brought on by ageing other than intracranial damage, senile changes in the brain including greater flexibility and cortical atrophy, or variations in therapeutic care in the aged population may all be valid explanations.

Contrary to several accounts, Fabbri et al.26's investigation did not discover that age was a factor in the prognosis for patients with brain injuries. Age and sex did not significantly predict outcome in the current study ($p > 0.05$).

In this study midline shift in CT scan was observed in 115 patients, among whom 64 patients had <5mm midline shift (mls), while 51 had >5 mm shift. There was significant association of mid line shift in CT scan and outcome of patients. Strong evidence was found for the midline shift in study of Mass (3), Pillai (19), Murray (28) and Hiller (29) and increasing size of the shift was associated with poorer outcome (30). Jacobs et al, (31) Midline shift was found to be a significant predictor of prognosis in their analysis of 605 individuals with moderate-to-severe head injuries. The midline shift was a continuous variable; they did not discover a cutoff point. They also came to the conclusion that the type of lesion mattered in determining the outcome. Patients with extradural hematomas had a better prognosis than patients with acute subdural hematomas in patients with similar midline shift following intracranial trauma (12,27,32).

The present study concluded that the degree of midline shift in patients' brain injury was a statistically significant determinant of outcome ($p = 0.02$). Twenty six out of 115 patients with midline shift had poor outcome as compared with two out of 35 patients with no midline shift. similar findings were seen by Gennarelli et al (33) and Lobato et al (34) where they found that the degree of midline shift in CT head was a statistically significant determinant of outcome ($p = 0.023$). Seventeen out of 48 patients (35.4%) with midline shift had poor outcome as compared with 8 out of 60 patients (13.3%) with no midline shift.

In the present study, the type of injury was significantly associated with outcome of patients with head injury ($p = 0.001$). Diffuse axonal injury had the worst results with 75% patients having poor outcome while extradural hematoma patients had better results with 1 patients had poor outcome. Also, patients of subdural hematoma with midline shift had poorer outcome (46.1%) than patients having extradural hematoma with midline shift (16.7%). Similarly Gennarelli et al (33) and Lobato et al (34) in their study concluded that the type of intracranial lesion is an important factor in predicting outcome, as the severity of injury is assessed by GCS scores.

Our study stated that majority of patients i.e. 104 had severe GCS score, 24 had moderate GCS score and 22 had mild GCS score. There is significant association of mid line shift in CT head and GCS score. According to the various literature, there is strong evidence for the prognostic value of the GCS score on admission to hospital and the GCS motor score (25, 28, 35, 36). Lower admission GCS and lower GCS motor scores were associated with worse outcomes (26, 35, 36). The GCS showed a clear linear relation with mortality.

Our study also stated that maximum i.e. 67 patients had equally reacting upil, 46 had unequal reacting pupil, and 37 had bilaterally non reacting pupil. There is significant association of mid line shift in CT head and Pupillary reaction. Twenty six out of 51 patients had Unequal Pupillary reaction while 25 out of 51 patients had Bilaterally nonreacting Pupillary reaction.

There exists a relation between absence of or abnormal pupillary reactions and worse outcomes in TBI (28, 36). Pupil abnormalities were noted more frequently in patients with mass lesions, compressed cisterns, and shift, and more in patients with CT class III/IV than in patients with CT class I/II (37).

CONCLUSION

Hence in our study we can conclude that poor clinical outcomes were ultimately caused by the growing degree of midline shift on CT scans of the brain in patients with mass lesions following TBI, which was substantially correlated with the severity of the head injury (GCS = 3–12) and non reacting or unequal papillary reaction. The majority of patients (GCS 8) were found to have significant head injuries at the time of presentation. Patients' prognosis gets poorer when their GCS score drops and papillary reaction alters. The kind of head injury is very important in predicting the prognosis. We can more accurately forecast the severity of a head injury and a patient's potential result by connecting CT scan findings with GCS score and papillary reflex than by treating all variables independently.

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