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ORIGINAL ARTICLE

Outcome of severe head injury in Relation to basal cisterns on initial CT scan

Mohd Moshiur Rahman[1*], Muzahidul Islam[2], Mohammad Nahid Hasan[3], Shimul Bhattacharjee[4], Sheikh Mahmood Hasan[5]

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*Corresponding Author

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ABSTRACT

Background: *Traumatic brain injury is a serious public health issue. This injury is the leading cause of death in younger people especially in developing country. Severe head injury defined as Glasgow coma scale scores of less than 9, have a higher mortality rate and poorer outcome. Young males are the main victims. The purpose of this study was to determine prognostic value of the compressed basal cisterns on initial CT scan.* ***Materials & Methods:*** *Among them 22 patients with compressed basal cisterns considered as Group A and 22 patients with normal basal cisterns considered as Group B. Sample was selected purposively according to selection criteria. A pre-structured data collection sheet was used for recording patient's demographic, clinical and radiological data.* ***Results:*** *Most of the patients belonged to age 21-40 years and majority of the study patients are male. Road traffic accident is the major cause of trauma. Three fourth of the study population's GCS score are in 3-5 group. The most common findings in intracranial haematoma are acute Subdural Haematoma. Unfavorable outcome is seen in patients with compressed basal cisterns in Group A by GOS score. Unfavorable outcome is higher with compressed basal cisterns group in group A.* ***Conclusion:*** *Based on the result of this study Basal cisterns on the initial CT scan is a strong predictor of outcome in severe head injury and compressed basal cisterns are strongly related to unfavorable outcome and death.*

Keywords: *Severe traumatic brain injury, Basal cisterns, Computed tomography, Glasgow Outcome Scale, Prognostic factors.*

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1. *Assistant Professor, Department of Neurosurgery, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh (ORCID: 0009-0002-8905-2765)*
2. *Assistant Professor, Department of Neurosurgery, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh, (ORCID: 0009-0006-3785-1548)*
3. *Medical Officer, Department of Neurosurgery, National Institute of Neurosciences and hospital, Dhaka, Bangladesh, (ORCID: 0009-0003-3037-0176)*
4. *Assistant Registrar, Department of Neurosurgery, Kushtia Medical College, Kushtia, Bangladesh, (ORCID: 0009-0009-2178-9702)*
5. *Assistant Professor, Department of Neurosurgery, Dhaka Medical College and Hospital, Dhaka, Bangladesh, (ORCID: 0009-0005-2229-6468)*

INTRODUCTION

Head injury is the most common cause of death, among the young people, in the world. The incidence of head injury ranges from 56- 430 per 100,000 population per year. The overall incidence in USA is around 200 per 100,000 population per year [1]. Computed tomography of head has become the principal diagnostic tool in traumatic brain injury (TBI) since its introduction in 1971 [2]. Today, a head CT scan is performed routinely in TBI. It is used to identify traumatic cranial and intracranial abnormalities requiring immediate neurosurgical intervention or extensive monitoring. Further, it has been acknowledged that CT characteristics are associated with outcome after moderate to severe TBI, and it may therefore be used to predict outcome [3]. One of the most prominent CT characteristics that has emerged as a powerful predictor of outcome is the appearance of the basal cisterns. Compression or absence of the basal cisterns is strongly associated with adverse outcome in severe TBI, resulting in a two- to fourfold increase in mortality or unfavorable outcome compared to patients with normal basal cisterns [3-8]. Moreover, complete and partially obliterated basal cisterns are considered a sign of raised intracranial pressure (ICP).

The status of the perimesencephalic cisterns is also used to classify TBI. In the widely recognized Traumatic Coma Data Bank (TCDB) CT classification it is an essential classification criterion [9]. The TCDB CT classification categorizes TBI patients into six groups. The primary distinction is made between diffuse injury (category I–IV) and the presence of mass lesions (evacuated or non-evacuated). Within the diffuse injury category, patients are partially differentiated based on the presence, compression, or absence of the perimesencephalic cisterns. The TCDB CT classification is used to describe CT abnormalities and to stratify patients in research trials and prognostic studies [10-16].

A small number of studies have involved patients with GCS scores of less than 9 and have reported that, the admission GCS, the pupillary reaction to light, the presence of MLS disproportional to the space occupying lesion (SOL), and effacement of basal cisterns on the initial computed tomography all were significant predictors of outcome in severe head injury [17].

The current study aims to achieve a better understanding of the morbidity and mortality associated with severe traumatic brain injury and to determine the prognostic value of the appearance of the basal cisterns on initial CT scan, in early prediction of outcome in severe head injury.

MATERIALS & METHODS

This is a prospective cohort study. The study was carried out in Department of Neurosurgery, Dhaka Medical College and Hospital, Dhaka. The population size will roughly be estimated 44 Group A 22 and Group B 22 Patients with compressed basal cisterns. This study was done during the period of January 2016 to December 2017. Diagnosed case of severe traumatic head injury admitted in the department of Neurosurgery, Dhaka medical college hospital, Dhaka.

Inclusion criteria:

- Diagnosed case of Severe traumatic brain injury
- Age 16-65 yrs.
- Both genders.
- Glasgow Coma Scale (GCS) of 8 or below.

Exclusion criteria:

- Other TBI patient (Acute Subdural Haematoma due to other than traumatic cause e.g. bleeding disorder)
- Patient with penetrating mechanism of injury.
- Patients with concomitant spinal cord injury or other significant traumatic injury.

Study Procedure

Patients with severe head injury who had post-resuscitation GCS scores of 8 or less, according to inclusion and exclusion criteria and who got admitted in the Department of Neurosurgery, Dhaka Medical College Hospital, Dhaka within the study period was the study population. However, patients with penetrating mechanism and pediatric cases were excluded. All the cases were diagnosed with history, Clinical examination and radiologically by non-contrast CT scan of brain. After confirming diagnosis at admission center, thorough general and neurological examination was performed including vital signs, GCS score, pupillary status with documentation.

Data Collection procedure

A questionnaire was prepared considering variables like demographic data, presenting complaints, clinical findings, GCS and pupillary status on admission, CT scan of head findings, time interval between injury and diagnosis, subsequent clinical follow up at 30 days which was verified by the guide and the data were collected by the researcher himself. After selection of the patient, aims and objectives and procedures of the study explained with understandable language to the patient. The patients encouraged for voluntary participation and they were being free to withdraw themselves from the study. Patients were also assured that entire information and records kept confidentially. Then, informed written consent was taken from each patient.

Data Analysis

Statistical analyses will be carried out by using the Statistical Package for Social Sciences version 20.0 for Windows (SPSS). Continuous variables will be expressed as mean ± standard deviation, and categorical variables as frequencies and proportions. The differences between groups will be analyzed by chi-square test. A multivariate regression analysis will be performed. Statistical significance will be assumed when the probability value will be less than 0.05.

Ethical consideration

There is minimum physical, psychological, social and legal risk during taking history, physical examination and investigation. Proper safety measures were taken in every step of the study. Only researcher was allowed to access to the collected data. Ethical clearance was obtained from Ethical Review Committee (ERC) of DMCH to undertake the current study. According to Helsinki Declaration for Medical Research involving Human Subjects 1964, all the patients were informed about the study design, the underlying hypothesis and the right of the participants to withdraw themselves from the research at any time, for any reason. Informed written consent will be obtained from each subject who will voluntarily provide consent to participate in this study.

RESULTS

Table I shows Age distribution of the study patients, it was observed that 22.7% patients belonged to age range 21-40 years in Group-A and 18.2% patients belonged to 41-60 years age range in Group-B. The Mean was found 41.36±13.20years in Group-A and 38.18±14,80years in Group-B.

Table I: Distribution of the Study Population by Age: (*n*=44)

Age (Years)	Group A (n=22)	Group B (n=22)	P-value
16–20	2 (4.5%)	6 (13.6%)	0.74
21–40	10 (22.7%)	6 (13.6%)	
41–60	9 (20.5%)	8 (18.2%)	
61–65	1 (2.3%)	2 (4.5%)	
Mean ± SD	41.36 ± 13.20	38.18 ± 14.80	

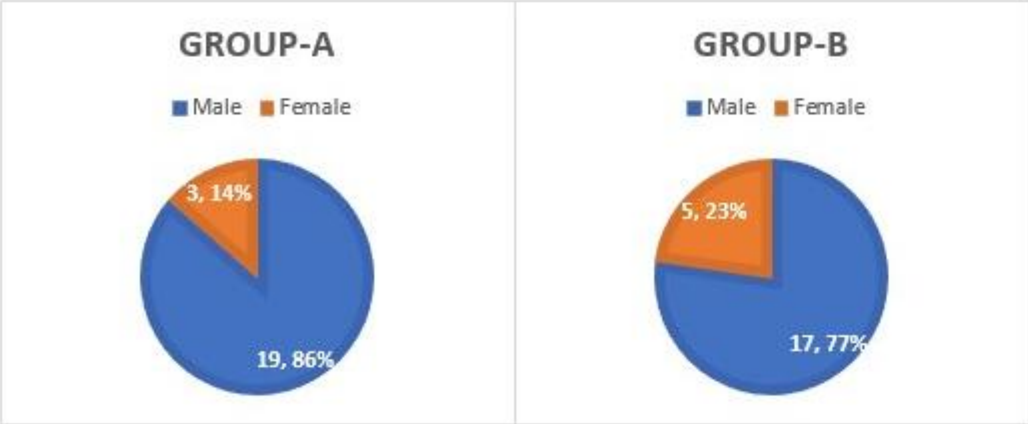

Figure 1: Distribution of the study patients by Gender

Figure 1 shows Gender distribution of the study patients; it was observed that 86% patients were male in Group-A and 77% in Group-B.

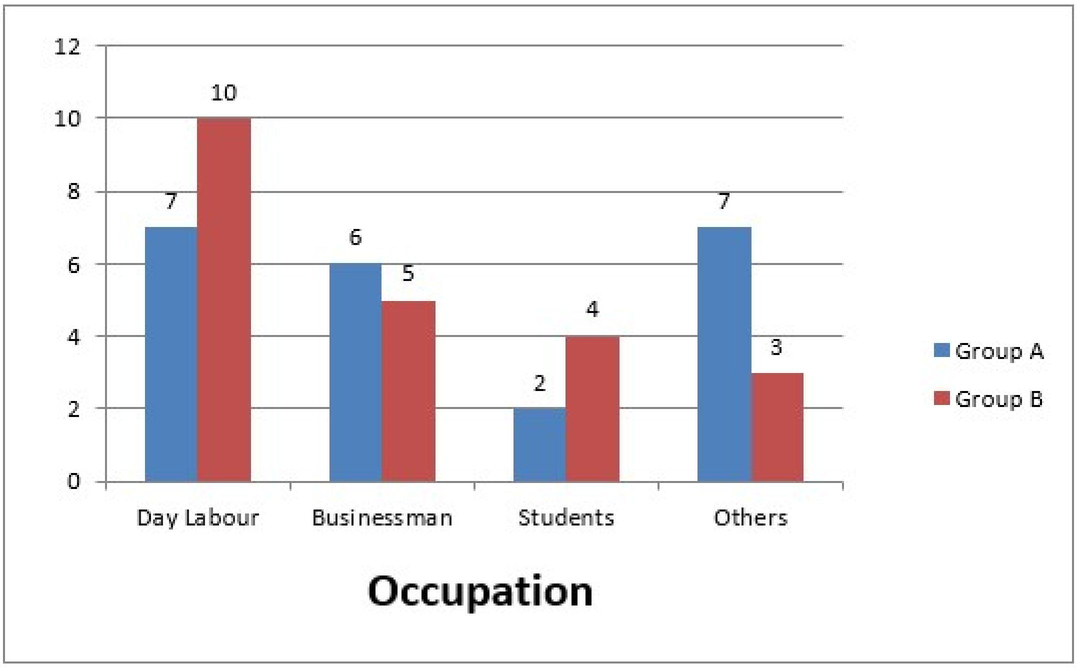

Figure 2: Distribution of Study Population by Occupation: (*n*=44)

Figure 2 shows Highest 17(38.6%) patients were Day laborer, followed by 11 (25%) patients were businessmen and 6 (13.6%) students and 10(22.7%) others (including housewife, farmer, rickshaw puller etc.) by profession.

Table II: Distribution of Study Population by Etiology of Trauma: (*n*=44)

Etiology of Trauma	Group A (n=22)	Group B (n=22)	P-value
Road traffic accident	19 (43.2%)	17 (38.6%)	
Physical assault	2 (4.5%)	3 (6.8%)	
Fall from height	1 (2.3%)	2 (4.5%)	0.946

Table II shows the distribution of study patient according to etiology of trauma. The difference between the group A and group B considering etiology of trauma found statistically not significant (p=0.946).

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Table III: Distribution of Study Population by Admission Glasgow Coma Scale (GCS) Score. (*n*=44)

Admission GCS Score	Group A (n=22)	Group B (n=22)	P-value
3–5	20 (45.5%)	14 (31.8%)	
6–8	2 (4.5%)	8 (18.2%)	0.04
Median (IQR)	4.00 (3.00–5.00)	5.00 (3.75–7.00)	0.05

Table III showed the distribution of the study population by admission Glasgow Coma Scale (GCS) score. The difference between Group A and Group B considering admission GCS score found statistically significant

Table IV shows the distribution of pupillary reaction to light among the study population. The difference between the group A and group B considering pupillary reaction to light were statistically not significant (p=0.21).

Table IV: Distribution of Study Population by Pupillary reaction to light: (*n*=44)

Pupillary Reaction	Group A (n=22)	Group B (n=22)	P-value
Reacting to light	4 (9.1%)	20 (45.5%)	
Non-reacting to light	18 (40.9%)	2 (4.5%)	0.21

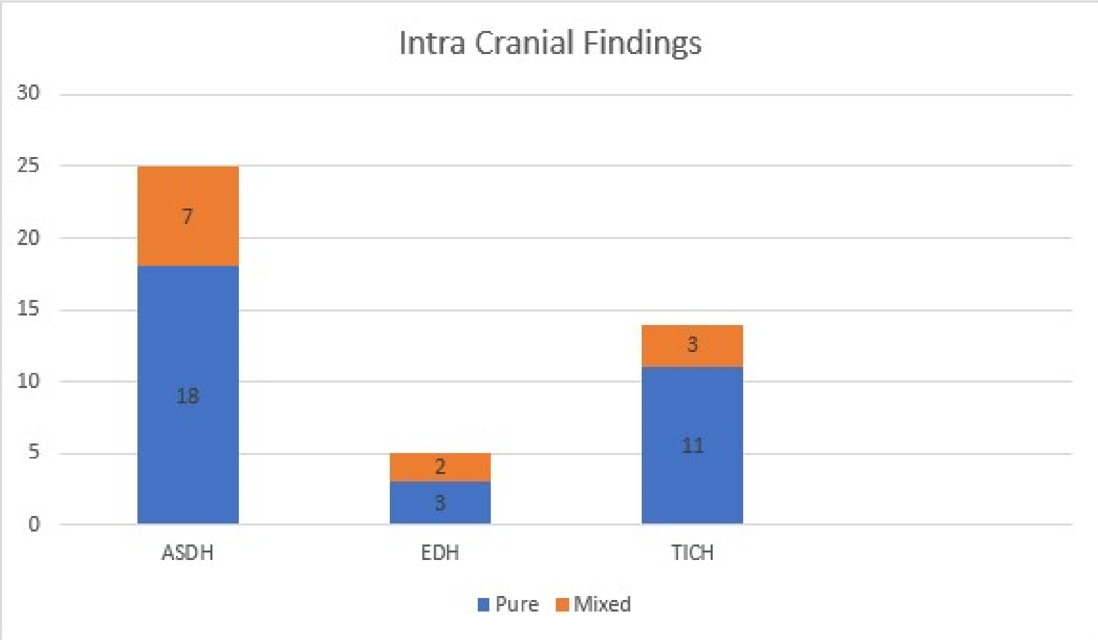

Figure 3: Distribution of the study patients by intracranial findings

Figure 3 showed the distribution of intracranial findings among the study population. Among the 25 cases of Acute subdural haemorrhage (ASDH) pure ASDH is 18 cases and mixed cases of ASDH (i.e. ASDH+TICH or ASDH + EDH) are 7 cases. Among the 05 cases of Acute Extradural haemorrhage Pure EDH are 03 cases and Mixed EDH (i.e. EDH+ASDH) are 02 in number. Among the 14 cases of Traumatic intracerebral haemorrhage (TICH) pure TICH are 11 cases and Mixed TICH (i.e. TICH+ASDH) are 3 cases.

Table V showed the distribution of mid line shift among the study population. The difference between the group A and group B considering midline shift found statistically significant (p=0.024).

Table V: Distribution of Study Population by Midline shift: (*n*=44)

Midline Shift	Group A (n=22)	Group B (n=22)	P-value
<5 mm	10 (22.7%)	20 (45.5%)	
≥5 mm	12 (27.3%)	2 (4.5%)	0.024

Table VI showed the distribution of Glasgow outcome scale score among the population at discharge. The difference between group A and group B considering GOS score at discharge found statistically significant.

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Table VI: Distribution of study population by Glasgow Outcome Scale (GOS) at discharge (*n*=44)

GOS Score	Group A (n=22)	Group B (n=22)	P-value
Death	15 (34.1%)	10 (22.7%)	
Persistent vegetative state	4 (9.1%)	2 (4.5%)	
Severe disability	2 (4.5%)	4 (9.1%)	
Moderate disability	1 (2.3%)	5 (13.6%)	
Good recovery	0 (0%)	1 (2.3%)	0.043
Mean ± SD	1.55 ± 1.01	2.27 ± 1.31	
Median (IQR)	1.00 (1.00–2.00)	2.00 (1.00–4.00)	0.047

Table VII showed the distribution of Glasgow outcome scale score among the population at 30th day of follow up. The difference between group A and group B considering GOS score at 30th day of follow up found statistically significant (p= .04)

Table VII: Distribution of study population by Glasgow Outcome Scale (GOS) at 30th day of follow up (*n*=44)

GOS Score	Group A (n=22)	Group B (n=22)	P-value
Death	15 (34.1%)	10 (22.7%)	
Persistent vegetative state	3 (6.8%)	1 (2.3%)	
Severe disability	2 (4.5%)	3 (6.8%)	
Moderate disability	1 (2.3%)	6 (13.6%)	
Good recovery	1 (2.3%)	2 (4.5%)	0.040
Mean ± SD	1.64 ± 1.13	2.50 ± 1.53	
Median (IQR)	1.00 (1.00–2.00)	2.50 (1.00–4.00)	0.041

Table VIII shows the relation of Basal cisterns among the study population with favorable and unfavorable outcome. The difference between the compressed basal cisterns and normal basal cisterns group considering 30 days outcome found statistically significant (p=0.01).

Table VIII: Relation of the basal cisterns with Glasgow Outcome scale at 30th day of Follow up: (*n*=44)

Basal Cisterns	Unfavorable	Favorable	P-value
Group A (Compressed)			
Unfavorable	20 (45.5%)	2 (4.5%)	
Group B (Normal)			
Favorable	14 (31.8%)	8 (18.2%)	0.010

Table IX shows the relation of pupillary reaction to light among the patient with favorable and unfavorable outcome. The difference between Reacting to light and non-reacting to light group considering 30th day outcome found statistically significant (p=0.031).

Table IX: Relation of Pupillary reaction to light with Glasgow Outcome scale at 30th day of Follow up: (*n*=44)

Pupillary Reaction	Unfavorable	Favorable	P-value
Group A			
Reacting to light	4 (9.1%)	0 (0%)	
Non-reacting to light	16 (36.4%)	2 (4.5%)	
Group B			
Reacting to light	14 (31.8%)	6 (13.6%)	
Non-reacting to light	0 (0%)	2 (4.5%)	0.031

Table X shows the relation of admission GCS score among the patient with favorable and unfavorable outcome. The difference between the 3-5 admission GCS group and 6-8 admission GCS group considering 30th day outcome found statistically significant (p=0.02).

Table X: Relation of Admission GCS score with Glasgow Outcome scale at 30th day of Follow up: (*n*=44)

Admission GCS	Unfavorable	Favorable	P-value
Group A			
3–5	18 (40.9%)	2 (4.5%)	
6–8	1 (2.3%)	1 (2.3%)	
Group B			
3–5	10 (22.7%)	4 (9.1%)	
6–8	5 (11.4%)	3 (6.8%)	0.020

Table XI shows the relation of Mid Line shift among the patient with favorable and unfavorable outcome. The difference between the <5mm midline shift and ≥ 5 mm midline shift group considering 30th day outcome found statistically significant (p=0.04).

Table XI: Relation of Midline Shift with Glasgow Outcome scale at 30th day of Follow up: (*n*=44)

Midline Shift	Unfavorable	Favorable	P-value
Group A			
<5 mm	4 (9.1%)	0 (0%)	
≥5 mm	16 (36.4%)	2 (4.5%)	
Group B			
<5 mm	14 (31.8%)	6 (13.6%)	
≥5 mm	0 (0%)	2 (4.5%)	0.040

DISCUSSION

The current prospective observational study was intended to find out some Clinico radiological parameters that may forecast deterioration in severely head injured patient in earliest possible time. Thus, a protocol may be developed through this study from the analysis of the risk factors which can guide a Neurosurgeon to manage such patients effectively, promptly, efficiently in our hospital facilities. In current study total 44 patients with severe head injury got admitted in Neurosurgery department of Dhaka Medical College Hospital. were included in the study. Present study findings are discussed here and simultaneously compared with previously published relevant studies.

In the present study, the highest incidence of severe traumatic head injury i.e. 16 (36.4%) was found in the 21-40 years of life followed by 17 (38.6%) in 41-60 years of life with a mean age of 41.36±13.20) years in group A and 38.18±14.80 years for group B. and age range were 16-65 years. Mean age and age range comparable with other studies such as [17,18,19]. Age range 21-40 were found to be the highest carrier of Severe head injury which may be due to higher incidence of fall and trivial injury. Most of the patients were male, where 86% and 77% patients were male in Group A and Group B respectively which is consistent with Jacobs et al., study, where they found 77% male in both groups [20]. Similar findings also observed by Vathanalaoha, Oearsakul and Tunthanathip [17].

Most of the patients in the current study were day laborer 17 (38.6%) followed by businessmen 11 (25%), students 6 (13.6%) and others (housewife, rickshaw puller, farmer etc.) 10 (22.7%). But no comparable or disagreeable data has been found from previous studies regarding severe traumatic head injury. The most common etiology of trauma was road traffic accident (RTA) and that was 43.2% and 38.6% in Group A and Group B respectively. Other significant etiologies were physical assault in 5 (11.4%) casesfollowed by fall from height 3 (6.8%).

As per the selection criteria, patients with GCS 3-8 were included in this study. In the current study it was found that, 34(77.3%) patients GCS score are within 3-5, and 10(22.7%) patients GCS score are within 6-8. Similar observation was found by Ogunlade et al [21]. He found that 37(74%) patients GCS are within 3-5 and 13(26%) patients GCS were within 6-8. But Teasdale and Jennett found different observation. He observed that at the time of admission GCS 3-5 were recorded in 14 patients and 6-8 were recorded in 23 patients [22]. Gennarelli et al reported that patients with GCS scores of 3-5 had higher mortality rate than patients with GCS scores of 6-8 [23]. The increased degree of midline shift in patients with severe head injury is significantly related to poor final clinical outcome [20].

Regarding the pupillary reaction to light it was observed that in compressed basal cisterns group 18(40.9%) patients have no pupillary reaction to light and 4(9.1%) patients have pupillary reaction to light. At 30th day of follow up, patient with non-reacting to light group 16(36.4%) have unfavorable outcome and 2(4.5%) patients have favorable outcome. In the normal basal cisterns group, patients with reaction to light, 14(31.8%) patients had unfavorable outcome and 6(13.6%) patients had favorable outcome. Sakas, Bullock and Teasdale, studied 40 trauma patients with BFDP [24]. Mortality was 100% if patients presented any of the following features: surgery 6 or more hours after bilateral loss of pupil reactivity, age more than 65 years, or absent motor response. Tien et al, compared trauma patients with a GCS of 3 and BFDP with patients with a GCS score of 3 and reactive pupils [25]. Mortality was 100% versus 42%; hemodynamic instability, midline shift, and herniation were observed in the BFDP patients. This observation is similar with the current study.

In this study it was observed that in compressed basal cisterns group patients with < 5mm midline shift, 4(9.1%) patients had unfavorable outcome and patients with > 5mm midline shift, 16(36.4%) patients had unfavorable outcome and 2(4.5%) patients had favorable outcome at 30th day of follow up. In the normal basal cisterns group, patients with < 5mm midline shift, 14(31.8%) patients had unfavorable outcome and 6(13.6%) patients had favorable outcome.

In this study we found that 15(34.1%) patients in compressed basal cisterns group and 10(22.7%) patients in normal basal cisterns group died during discharge. Total 25(56.8%) cases of severe head injured patient had died and 37(84.1%) patients had unfavorable outcome during discharge. And at 30th days of follow up no more patients had died and 34(77.3%) patients had unfavorable outcome and 10(22.7%) patients had favorable outcome. Among the study population in this present study, at 30th day of follow up, compressed basal cisterns group showed 20(45.5%) patients had unfavorable outcome and 2(4.5%) patients have favorable outcome. In normal basal cistern group 14(31.8%) patients showed unfavorable outcome and 8(18.2%) patients had favorable outcome which is statistically significant p =0.01, and this analysis is supported by Vathanalaoha, Oearsakul and Tunthanathip, [17]. He observed that in compressed basal cisterns group 49(66.2%) patients showed unfavorable outcome and 9 (32.1%) patients showed favorable outcome and in normal basal cisterns group 25(33.8%) patients showed unfavorable outcome and 19(67.9%) patients showed favorable outcome. This observation is more or less similar with the different studied by Ogunlade et al, Jacobs et al, Toutant et al [8,20,21].

In this study, the appearance of basal cisterns on brain CT scan, has been determined to correlate with survival and outcome. Absence of obliterated basal cistern had an independent association with survival and good outcome. This present study showed the powerful relationship between the compressed basal cisterns and the unfavorable outcome.

CONCLUSION

This comparative study of compressed vs normal basal cisterns was done in patients with severe traumatic brain injury. At 30th day post injury follows up; functional outcome was assessed by GOS score and found that patient with compressed basal cisterns on initial CT scan have unfavorable outcome. In this study patients, in whom the basal cisterns were normal, the outcome results are slightly better than those observed in patients with compressed basal cisterns. It is now apparent that, in addition to the clinical examination, we have one noninvasive highly significant radiological predictor of outcome. If the basal cisterns are compressed on first CT scan, the outcome is much more likely to be poor.

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CONFLICT OF INTEREST

None declared

ETHICAL CONSIDERATION

The study was approved by ethical review committee.

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