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Original Article

FACTORS ASSOCIATED WITH THE SURGICAL OUTCOME OF PATIENTS WITH TRAUMATIC ACUTE EXTRADURAL HAEMATOMA

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ABSTRACT

Aims:To determine the demographic, clinical, radiological, and surgical factors associated with the outcomes in study participants with traumatic acute extradural hematoma who were surgically managed in the Neurosurgery Department at a tertiary-level hospital in Bangladesh.

Materials and Methods:

This interventional study included 81 study participants of any age and sex with traumatic acute EDH who were surgically managed at the Department of Neurosurgery of Chittagong Medical College Hospital from September 2022 to February 2024. EDH was diagnosed by computed tomography (CT) scan of the head, and the surgical technique was craniotomy and evacuation of haematoma. Data regarding the demographic, clinical, radiological and surgical factors of these study participants were recorded and examined in relation to outcome at three months by Glasgow Outcome Scale (GOS). Good outcome was defined by GOS score 4 or 5 and poor outcome was defined by GOS score 1-3.

Results:

The median age of the study participants were 22 (range: 1.5-60.0) years. There was a male preponderance (87.7%) with a male-female ratio of 7.1:1. The most common mode of injury was road traffic accident (55.5%). Out of 81 study participants, 56.6% with good outcome had preoperative GCS of 9–13, and all 5 study participants with poor outcome had preoperative GCS between 3–8 (P<0.05). All study participants with poor outcome had unilateral mydriasis (p<0.05). The most frequent site of haematoma was the temporoparietal region (27.1%). All five study participants with poor outcome had haematoma volume >50ml (p<0.05). The mean midline shift (6.9 ± 0.4 mm) was higher in study participants with poor outcome than the study participants with good outcome (p<0.05). Basal cistern obliteration was found to have a significant association with poor surgical outcome (p<0.05). Out of 81 study participants 93.8% had good outcome and poor outcome or mortality rate was 6.2% at 3 months post-surgery.

Conclusions:

Majority of the study participants with traumatic acute EDH had good surgical outcome. Only five study participants had shown poor surgical outcomes with a preoperatively low GCS (<9), unilateral mydriasis, higher hematoma volume (>50ml), significant mid line shift, and basal cistern obliteration.

Keywords:

Extradural haematoma, Glasgow Outcome Score, Traumatic brain injury

Introduction:

Extradural haematoma (EDH) is a collection of blood within the potential space between the outer layer of the dura mater and the inner table of the skull. The incidence of acute extradural haematoma (EDH) among TBI is about 2.7-4%.1 In severe traumatic brain injury EDH occurs in up to 15% of patients. Males are four times more affected than females. Males are more prone to trauma due to their increased mobility and daily travel compared to females. Peak incidences of EDH are seen in 2nd decade of life and mean age of EDH patients is between 20-30 years. Extradural haematoma is rare in extremes of ages.2 About 85% of extradural cases occur due to rupture of the middle meningeal artery or its branches, and the remaining cases occur due to ruptured venous sinuses and fractured diploic bone. Overlying skull fracture is present in the majority of patients with EDH.3,4 The most common cause of acute EDH are road traffic accidents (RTAs),

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followed by fall from height, fall of heavy object over heads, and physical assaults. Temporoparietal and temporal regions are commonest sites for extradural haematoma.5 Extradural haematomas classically manifest as follows: i) a transient loss of consciousness following the trauma; ii) followed by a 'lucid interval'; iii) obtundation; contralateral hemiparesis; and ipsilateral pupillary dilatation as a result of the mass effect of the haematoma. This triad is observed in 30% of cases.6 Lucid interval is not a pathognomic feature for EDH. The symptoms of EDH are not well defined. The triad of head injury with lucid interval, ipsilateral mydriasis, and contralateral hemiparesis occurs in only 18% of cases when EDH is located in the temporoparietal region.7 Computed tomography (CT) scan of the head is the investigation of choice where a biconvex hyperdense lesion adjacent to the skull is seen. The best course of action for a substantial extradural haematoma (EDH) is prompt surgical intervention. Craniotomy and evacuation of the haematoma is the treatment of choice.8 The Brain Trauma Foundation has issued a guideline recommending surgical evacuation of patients with an acute EDH volume exceeding 30ml, regardless of the Glasgow Coma Scale (GCS).9 Mortality rate of EDH was 86% about 100 years ago, which has been reduced now to 5- 12% by introduction of computed tomography (CT) scan and timely surgical intervention.2 However, depending on the resources and standard of care available in various areas, the results of acute EDH fluctuate from centre to centre. Previous studies indicated that mortality from acute EDH ranges from 1.2% to 33%.10 In order to achieve optimal functional recovery and reduce morbidity and mortality, extradural hematomas must be diagnosed and treated as soon as possible.5 Several factors are responsible for the surgical outcome of acute EDH, including the initial motor response, the pupillary size and reaction, the location of the haematoma and, the time between trauma and surgery.11 Larger EDH (especially those >50ml), as well as EDHs with larger midline shifts are associated with significantly higher mortality rates than smaller EDHs with smaller mid line shifts.12 The present baseline study is thus aimed at documenting the determinants and surgical outcomes of study participants with traumatic acute EDH at a tertiary center hospital in Bangladesh.

Material and methods

Study design and settings

An interventional study was conducted in the Department of Neurosurgery, Chittagong Medical College Hospital, Chattogram, Bangladesh. The duration of study was 18 months, from September 2022 to February 2024. 81 patients included as per the selection criteria.

Sample size and technique

The sample size was 81 using 86.7% favorable outcome, 95% confidence level,5% margin of error. A consecutive sampling considering the inclusion and exclusion criteria.

Inclusion Criteria

Study participants had surgical intervention for the management of acute EDH following trauma of any age and sex.

Exclusion Criteria

1. Study participants with concomitant subdural haematoma (SDH), intracerebral haematoma (ICH), cerebral contusion, and subarachnoid haemorrhage (SAH).
2. Acute EDH with polytrauma (major chest trauma, blunt abdominal trauma, major trauma to limbs and pelvis).
3. Refusal to participate in the study.

Data Collection

A total of 81 male and female study participants who fulfilled the selection criteria were included in this study. Study participants who were admitted to the neurosurgery ward with suspected acute EDH following trauma, rapid resuscitation and evaluation were done simultaneously.

After confirmation of the diagnosis of acute EDH from CT scan of head, the guardian of the study participants who were thoroughly informed about the aims, objectives, and detailed procedure of the study. He or she was encouraged to participate with informed written consent and was allowed the freedom to withdraw from the study whenever he or she liked, even after participation.

The data of the study participants were collected by interviewing the study participants or their legal relatives.

The baseline data, including demographic data, clinical presentation, vital signs, neurological status, and findings of the initial non-contrast CT scan of the head, was recorded in a structured case record form. Outcomes were measured using the Glasgow Outcome Scale (GOS) during discharge, one month, and three months after surgery. After resuscitation and evaluation of the study participants, appropriate preoperative preparation was done.

Follow−up

During hospital stay: During immediate post-operative period, careful follow up was given to the study participants. Apart from vital signs, GCS score and pupillary status were monitored. Check CT was done within 48 hours postoperatively. GCS score was documented pre and post operatively. Surgical outcome was assessed by using Glasgow Outcome Scale (GOS). GOS was

recorded during discharge, 1 month, and 3 months after surgery in the Outpatient Department (OPD). For those patients who could not come on time, information was collected over the telephone with the study participants or the responsible attendant.

Data analysis

After completion of data collection, they were fed into SPSS version 23 for processing analysis. Continuous data were expressed as mean ± standard deviation (SD) for normally distributed data or median and 25%–75% interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as percentages (%) or proportions. The study participants were divided into 3- months good and poor outcomes by GOS. Between these groups, continuous and categorical variables were analyzed. Student's t-test was used to analyze normally distributed continuous variables, while Mann–Whitney U-test was used for non-normally distributed continuous variables. The Chi-square test or Fisher's exact test was used to compare categorical variables. Logistic regression analysis could not be done due to very few cases (only 5) with poor outcome. P ≤ 0.05 was considered statistically significant.

Results

A total of 99 study participants were screened and 81 of them were found to fulfill the eligibility criteria for the study. The final analysis included these 81 study participants, of which 76 (93.8%) study participants had good outcome and other 5 (6.2%) had poor outcome (expired within three months). Different demographic, clinical, and radiological findings were compared between patients with good and poor outcome in the following tables and charts.

Age ans sex distribution

Table 1 showed that median age of the study participants were 22 years and range were 1.5-60.0 years. Majority of the study participants with poor outcome within 11-20 years age group There was a male preponderance (87.7%) with a male-to-female ratio of 7.1:1. The proportion of male study participants was higher in poor outcome group than in the good outcome group. However, none of the differences reached statistical significance (P > 0.05).

Table 1: Association between demographic characteristics and surgical outcome

Characteristics	Total (N=81)	3-months outcome		P value
		Good (N=76)	Poor (N=05)	
Age, years				
Median (IQR)	22.0 (17.0-33.0)	22.0 (17.0-32.8)	18.0 (14.5-50.0)	0.917
1-10 years	6 (7.4)	6 (7.9)	0 (0)	
11-20 years	27 (33.3)	24 (31.6)	3 (60.0)	
21-30 years	25 (30.9)	25 (32.9)	0 (0)	
31-40 years	14 (17.3)	13 (17.1)	1 (20.0)	
41-50 years	6 (7.4)	6 (7.9)	0 (0)	
>50 years	3 (3.7)	2 (2.6)	1 (20.0)	
Sex				
Female	10 (12.3)	10 (13.2)	0 (0)	1.0
Male	71 (87.7)	66 (86.8)	5 (100.0)	

Mode of Injury

Road traffic accident (RTA) was the most common mode of injury (55.5%), followed by fall from height (23.5%), and physical assault (18.5%).

Table2: Association between mode of injury and surgical outcome

Mode of injury	Total (N=81)	Male	Female	3-months outcome		P value
				Good (N=76)	Poor (N=05)	
Road traffic accident	45 (55.5)	38 (84.4)	7 (15.6)	41 (53.9)	4 (80.0)	0.375
Fall from height	19 (23.5)	18 (94.7)	1 (5.3)	19 (25.0)	0 (0)	0.201
Physical assault	15 (18.5)	13 (86.7)	2 (13.3)	14 (18.5)	1 (20.0)	1.0
Others	2 (2.5)	2 (100)	0	2 (2.6)	0 (0)	1.0

Clinical presentation

Table 3 shows that, headache was the most frequent presenting feature (86.4%), followed by vomiting (50.6%), altered level of consciousness (46.9%), lucid interval (13.6%), and seizure (3.7%). Higher proportion of study participants with poor outcome had altered level of consciousness, lucid interval and seizure which was statistically significant (P<0.05).

Table 3: Association between clinical presentation and surgical outcome

Clinical presentation	Total (N=81)	3-months outcome		P value
		Good (N=76)	Poor (N=05)	
Headache	70 (86.4)	67 (88.2)	3 (60.0)	0.134
Vomiting	41 (50.6)	40 (52.6)	1 (20.0)	0.201
ALC	38 (46.9)	33 (43.4)	5 (100.0)	**0.020***
Lucid interval	11 (13.6)	8 (10.5)	3 (60.0)	**0.016***
Seizure	3 (3.7)	0 (0)	3 (60.0)	**<0.001***

Preoperative Pupillary Status

Table 4 shows that 66.7% of patient had equal and reactive pupil and 33.3% had unilateral mydriasis.

Table 4: Association between preoperative pupillary status and surgical outcome

Preoperative Pupillary Status	Total (N=81)
Equal and reactive	54(66.7)
Unilateral mydriasis	27(33.3)

Preoperative GCS

Table 5 shows that, 56.6% study participants with good outcome had preoperative GCS of 9-13. On the other hand, all five study participants with poor outcome had GCS level within 3-8 preoperatively (P<0.05).

Table 5: Association between preoperativeGCS and surgical outcome

GCS (3-15)	Total (N=81)	3-months outcome		P value
		Good (N=76)	Poor (N=05)	
Preoperative GCS				
3-8	6 (7.4)	1 (1.3)	5 (100.0)	
9-13	43 (53.1)	43 (56.6)	0 (0)	**<0.001***
14-15	32 (39.5)	32 (42.1)	0 (0)	

Haematoma location in CT

Table shows that most frequent site of haematoma was temporoparietal (27.2%), followed by parietal (22.2%), frontal (18.5%), and fronto-parietal (11.1%) region.

Table 6: Association between haematoma location in CT scan and surgical outcome

Haematoma location	Total (N=81)
Temporo-parietal	22 (27.2)
Parietal	18 (22.2)
Frontal	15 (18.5)
Fronto-parietal	9 (11.1)
Parieto-occipital	7 (8.6)
Fronto-temporal	3 (3.7)
Temporal	2 (2.5)
Fronto-temporo-parietal	2 (2.5)
Parieto- temporo-occipital	2 (2.5)
Posterior fossa	1 (1.2)

CT scan Characteristics:

Table 7 shows that, the most frequent site of haematoma was temporoparietal (27.2%), followed by parietal (22.2%), frontal (18.5%), and fronto-parietal (11.1%) region. However, the difference of haematoma location failed to reach any statistical significance (P > 0.05).

Table 7: Association between haematoma location in CT scan and surgical outcome

Haematoma location	Total (N=81)	3-months outcome		P value
		Good (N=76)	Poor (N=05)	
Temporo-parietal	22 (27.2)	20 (26.3)	2 (40.0)	1.0
Parietal	18 (22.2)	16 (21.1)	2 (40.0)	1.0
Frontal	15 (18.5)	14 (18.4)	1 (20.0)	1.0
Fronto-parietal	9 (11.1)	9 (11.8)	0 (0)	1.0
Parieto-occipital	7 (8.6)	7 (9.2)	0 (0)	1.0
Fronto-temporal	3 (3.7)	3 (3.9)	0 (0)	1.0
Temporal	2 (2.5)	2 (2.6)	0 (0)	1.0
Fronto-temporo-parietal	2 (2.5)	2 (2.6)	0 (0)	1.0
Parieto- temporo-occipital	2 (2.5)	2 (2.6)	0 (0)	1.0
Posterior fossa	1 (1.2)	1 (1.3)	0 (0)	1.0

Hematoma Volume in CT Scan

Table 8 shows that, all five of the study participants with poor outcome had preoperative haematoma volume of >50 ml (P<0.05).

Table 8: Association between hematoma volume in CT scan and surgical outcome

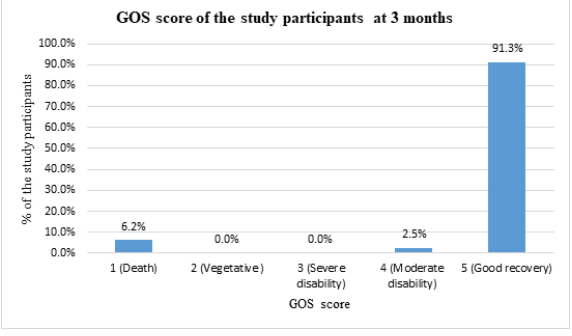
Haematoma volume (ml)	Total (N=81)	3-months outcome		P value
		Good (N=76)	Poor (N=05)	
30-50	34 (42.0)	34 (44.7)	0 (0)	
51-100	46 (56.8)	42 (55.3)	4 (80.0)	**0.001***
>100	1 (1.2)	0 (0)	1 (20.0)	

Outcomes

Mean time from trauma to surgery was 10.7±2.6 and 15.4±3.8 hours, respectively in study participants with good and poor outcome. Out of 81 study participants with traumatic acute EDH, 76 (93.8%) survived at least 3 months post-surgery. Other 5 cases expired, giving the 3-months mortality rate of 6.2%. All of the deceased study participants expired in-hospital.

At the final follow-up (3-months), 74 (91.3%) study participants had GOS score 5 (good recovery), 2 (2.5%) patients had GOS score 4 (indicating moderate disability) and other 5(6.2%) study participants had GOS score 1(Death). 93.8% of study participants had good outcome and 6.2% had poor outcome at 3 months post-surgery.

Figure 1: Distribution of the patients based on GOS score of the study participants at 3-months follow-up



Discussion

Present study investigated the parameters affecting the surgical outcome in study participants with traumatic acute EDH. A total of 81 patients of traumatic acute EDH were included in the study who found to fulfill the eligibility criteria.

In this study median age of the study participants were 22 years and range were 1.5-60.0 years. Highest number of study participants were in 11-20 years age group (33.33%), followed by 21-30 years (30.9%). Previous studies consistently reported that highest numbers of the victims of traumatic acute EDH were in the most active period of life i.e. peak incidence of EDH is in the second decade, and the mean age of patiev nts with EDH is between 20 and 30 years of age.13

There was a male predominant (87.7%) with a male-to-female ratio of 7.1:1 in the present study, which was agreed with the study of Chowdhury et al. (2008) where the male and female ratio was 6.27:1 Males are more prone to trauma due to their increased mobility and daily travel compared to females.

In this study RTA was the most common mode of injury (55.5%), followed by fall from height (23.5%), and physical assault (18.5%). Mode of injury failed to show any significant association with outcome in the present study. According to previous studies, TBI mostly occurred due to RTA.14, 15

In the present study, headache was the most frequent presenting feature (86.4%), followed by vomiting (50.6%), altered level of consciousness (46.9%), lucid interval (13.6%), and seizure (3.7%). Some presenting symptoms had an association with outcome significantly higher proportion of study participants with poor outcome had altered level of consciousness, lucid interval and seizure. The most common clinical presentation was headache/vomiting (63.61%), followed by altered sensorium (60.66%), in previous studies from Bangladesh.16

The GCS is the most commonly used scale for assessing the level of consciousness. Many studies have confirmed that low GCS scores (3–8) are highly predictive of a poor prognosis in patients with traumatic acute EDH.17, 18

In the present study, most of the study participants (56.6%) with good surgical outcome had preoperative GCS of 9-13, and in the 1st POD 80.3% of study participants with good surgical outcome had GCS between14-15. On the other hand, all five study participants with poor outcome had GCS level within 3-8 during preoperative and 1st POD which was statistically significant ($P<0.05$). Those who had a good GCS score (9-15) before surgery they were more likely to have good outcome compared to those who had a low GCS score (3-8) before surgery.19

Another predictive factor for poor outcome was preoperative pupillary status in the present study. All five study participants with poor outcome had unilateral mydriasis in the current study which was statistically significant ($P<0.05$).

In this study most frequent location of haematoma was temporoparietal (27.2%), followed by parietal (22.2%) and the location of hematoma was not statistically related to outcomes. In another large prospective study of 610 cases of EDH, the temporoparietal site was involved in 33.45%, followed by the frontal region in 23.28% and site of haematoma is not correlated with outcome.20

In the present study, it was found that the majority of the study participants (56.8%) had a volume of haematoma of 51-100 ml, followed by 42% within 30-50ml and 1.2% had a volume >100ml. All of the five study participants with poor outcome had a preoperative haematoma volume of >50 ml and which was statistically significant ($p<0.05$). Junior et al. (2015) found in their study that the worst prognosis was in patients with extradural haematoma of higher-volume (>50 mL). 12

Though the mean midline shift was higher in study participants with poor outcome than in with study participants good outcomes (6.9 vs. 5.9mm), the difference was marginally significant statistically ($p = 0.048$). 60% of the study participants with poor outcome had basal cisterns completely closed or obliterated, compared to 9.2% of the patients with good outcomes. In the study of Junior et al. (2015), midline shift greater than 5 mm, and obliterated basal cisterns had the worst prognosis. 12

In this study, associated skull fractures were present in 86.4% of study participants. Das et al. (2023) found that 85% of EDH patients had an associated skull fracture, which is almost similar to the current study. 3

In the present study, mean time from trauma to surgery was 10.7±2.6 and 15.4±3.8 hours in study participants with good and poor outcomes, respectively ($p <0.05$). Chowdhury et al. (2008) found that many factors affect the outcome of extradural haematoma surgery, and the most important one is the time interval from trauma to surgery; mortality can be close to 0% if this time interval can be minimized. 20

Out of 81, with traumatic acute EDH, 93.8% survived at least 3 months post-surgery, and the 3-month mortality rate was 6.2% in the current study. All deceased cases died in-hospital, while surviving study participants either had good recovery (GOS 5) or moderate disability (GOS 4), indicating good outcomes for the surviving. So, the 3-month outcome was good in 93.8% and poor in 6.2% in the current study. In the previous study, Gutowski et al. (2018) observed that the 3-month good outcome was 90%, the poor outcome was 10%, and the overall mortality rate was 6.8%. 6

The present study's findings were similar to the previous study's results. However, logistic regression analysis could not be done due to very few cases (only 5) with poor outcome. Nevertheless, the study findings would provide important reference values for evaluating outcomes in traumatic acute EDH in a public tertiary care setting in Bangladesh.

Conclusion:

In conclusion, most of the study participants with traumatic acute EDH had a good surgical outcome. Five study participants had shown poor surgical outcomes with a preoperatively low GCS (<9), unilateral mydriasis, and higher hematoma volume (>50 ml), significant mid line shift, and basal cistern obliteration.

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