Original article

Factors influencing the outcome of patients with acute extradural haematomas undergonig surgery

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Abstract

Background: Acute extradural haematoma (EDH) remains most common cause of mortality and disability resulting from traumatic brain injury. In the last three decades, improvements in rescue, neuromonitoring, diagnostic procedure and intensive care have led to better outcomes. The purpose of this study was to evaluate the factors influencing the outcome in patients with EDH undergoing surgery treated in a tertiary hospital in Bangladesh. ***Methods:*** In this retrospective study, 102 consecutive patients with acute EDH who underwent craniotomy were included. The study was carried out from July 2003 to December 2005. The diagnosis was made clinically and radiologically by CT scan. Patients were grouped on the basis of Glasgow Coma Scale (GCS) and operative outcomes were evaluated by Glasgow Outcome Scale (GOS) ***Results:*** More than half sampled respondents' (57%) age were more than 20 years while rests of the patients below 20 years with male predominance (Male: Female -12:1). About 7 in 10 respondents (70.6%) were working. Similarly, majority of the respondents (79.4%) had lost more than 30 ml blood. A notable proportion of the respondents (73.5%) had good GCS score (9-15 score) during admission. Similarly majority of the respondents (70.6%) had GCS score 9-15 and 29.4% had GCS score 3-8 before surgery. Road Traffic Accident (RTA) (65%) is the most common cause of EDH followed by assault (20%) and fall from height (12%). Temporal and temporo-parietal locations were the most common site of EDH (56%). Patients with good GCS before surgery had significantly better outcome (89%) compare to those who had bad GCS (10%). ***Conclusion:*** Level of consciousness before surgery is the most important factor affecting the outcome. Hence, early diagnosis and surgical intervention is very essential.

Key words: Acute Extradural Haematoma (EDH), Glasgow Coma Scale (GCS). Glasgow Outcome Scale (GOS).

Introduction

Head injury is one of the leading causes of severe disability and death in the modern world among individuals under 45[1]. Traumatic brain injury (TBI) accounts for approximately 70% of these traumatic deaths and most of the persisting disabilities in accident survivors[2]. Traumatic extradural hematomas (EDH) comprise 1 to 3% of all head trauma admissions[3].

The peak incidence of extradural haematoma (EDH) is in the second decade of life and mean age of patient with EDH in different series is between 20 and 30 years of age[4, 5.] Extradural haematoma is very rare in extremes of ages. Mortality rate vary from 10 – 40% and is an index of alertness and efficiency of health care and hospital setup in a country [6].

Risk factors for patients with EDH are advanced age, intradural lesions, temporal location, increased hematoma volume, rapid clinical progression, pupillary abnormalities, increased intracranial pressure (ICP) and low

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Glasgow coma scale (GCS) [7]. But others found the most significant factors associated with unfavorable outcome were higher age, lower GCS, and higher EDH volume [20].

Surgical mortality has rapidly decreased since Hutchinson described extradural heamorrhage as an emergency situation in 1867. 100 years ago, the mortality rate of EDH was as much as 86% and traumatic EDH remains a true neurosurgical emergency[8]. Until the late 1970s, when angiography was used for diagnosis (the era before computed tomography), the mortality rate was 30% or higher[9]. With the introduction and wide availability of cranial CT, early diagnosis and timely surgical intervention for EDH is an attainable gold standard[10]. Indeed, the treatable nature of EDH has led some authors to suggest that "toward zero mortality" is an achievable target with respect to this condition[11,12]. While zero mortality is common in non-comatose patients, 25% to 71% of comatose patients undergoing surgery have a fatal outcome[13]. Many reports on extradural hematoma have drawn attention to avoidable factors implicated in preoperative deterioration, such as delayed transportation to the hospital and delayed diagnosis, but less consideration has been given to the specific factors that influence the outcome of patients who arrive comatose in the operating room[13]. EDH remains even now a serious neurological condition [11]. The aim of this study was to evaluate the postoperative outcome in patients comatose after head injury with an extradural hematoma before surgery and to formulate recommendations for improvement of therapy and suggestions for the future research.

Methods

All patients of head injury from July, 2003 to December, 2005 admitted into the Department of Neurosurgery, Dhaka Medical College Hospital, with a CT confirmed diagnosis of EDH who subsequently underwent surgery, were reviewed. Patients with concomitant Subdural Haematoma (SDH) or Intracranial Haematoma (ICH), spinal, thoracic and abdominal trauma requiring surgical intervention were excluded from the study. Only patients with closed head trauma were included in the study. After initial resuscitation, each patient was examined in terms of age, sex and mechanism of head injury, localization of the hematoma, and neurological findings. Glasgow coma scale (GCS) scores of patients at the time of admission and before surgery were analyzed. Patients with GCS scores 9-15 were labeled as non-comatose and patients having GCS 8 or less were included in the category of comatose. CT scan head without contrast with bone windows was advised apart from base line investigations. Surgical intervention was done according to the size, site and mass effect of the hematoma in the form of craniotomy. Follow up was done every month for 3 months and then after 6 months. Functional assessment was done by measuring the GOS.

Variables

Dependent variable

Outcome of EDH: There were 5 types of outcome of EDH patients, good recovery, moderate disability, severe disability, vegetative state and death. The variable was recoded into two groups, good outcome=good recovery and moderate disability, and bad outcome= severe disability, vegetative state and death.

Independent variables

Socio-demographic characteristics, type of admission, blood loss and GCS score before surgery were included as independent variables.

Socio-demographic characteristics: Under socio-demographic characteristics age, sex and occupation was included. Age was grouped into 0-20 years and more than 20 years. Sex was categorized as male and female. Under occupation there were student, housewife, unemployed, bus/truck driver, service holder, business man, garments worker, day laborer, rickshaw puller and construction worker. The unemployed, student and housewife were grouped in to 'not working' and rest of the occupations were into 'working'.

Type of admission:
This variable was categorized in to 'direct' and 'referral'.

Volume of EDH: This was grouped in to two categories, less than 30 ml and more than 30 ml.

GCS score before surgery:
The total score was 3-15. It was categorized into two groups, bad GCS score=3-8 score, and good GCS score=9-15 score.

Analysis
Univariate, bivariate, and multivariate analysis were performed. Initially, univariate or descriptive analysis was used to describe the percentage of the respondents' socio-demographic characteristics. Bivariate analysis was done to identify associated factors to outcome of the EDH. A chi-square test was used to test the association between the variables. The variables (GCS score before surgery, age, occupation, type of admission and volume of blood) were further examined in the multivariate analysis (binary logistic regression) in order to identify the significant predictors of the likelihood of reporting bad outcome after EDH after controlling for other variables. During the process of analysis, multi-collinearity among the variables was assessed. There was high correlation between amount of blood volume and sex (0.751). During multivariate analysis sex variable was dropped from the logistic model. The data was analyzed using SPSS version 10.0.

Table I: Characteristics of the patients of EDH

		% of respondents	Outcome of disease process		N
			Good	Bad	
Age group***	0-20 years	42.2	37.2	62.8	43
	More than 20 years	57.8	86.4	13.6	59
Sex**	Male	92.2	70.2	29.8	94
	Female	7.8	12.5	87.5	8
Occupation***	Working	70.6	86.1	16.7	72
	Not working	29.4	16.7	83.3	30
Type of admission***	Direct admission	23.5	33.3	66.7	24
	Referral	76.5	75.6	24.4	78
Volume of EDH***	<30 ml	20.6	28.6	71.4	21
	>30 ml	79.4	75.3	24.7	81
GCS during admission***	Score 3-8	26.5	7.4	92.6	27
	Score 9-15	73.5	86.7	13.3	75
GCS before surgery***	Score 3-8	29.4	10.0	90.0	30
	Score 9-15	70.6	88.9	11.1	72
Total		100.0	65.7	34.3	102

**** = p<0.001, ** = p<0.01, * = p<0.05*

Results

More than half sampled respondents (57%) were more than 20 years of age while rests of the patients were below 20 years. Majority of respondents were male (92%). About one out of twelve respondents (7.8 %) was female. About 7 in 10 respondents (70.6%) were working. Similarly, a large majority of the respondents (79.4%) had lost more than 30 ml

blood. A notable proportion of the respondents (73.5%) had good GCS score (9-15 score). Similarly majority of the respondents (70.6%) had good GCS score before surgery (Table-I).

In bivariate analysis, it was found that EDH was associated with age, sex, occupation, type of admission, volume of blood loss, GCS score during admission and GCS score before surgery. A significantly higher proportion of respondents aged more than 20 years (86.4%) compared with only about one-third respondents (37.2%) aged less than 20 years had good outcome. A higher proportion of male respondents (70.2%)) than female (12.5%) had better out come. Similarly, a higher proportion of working patients (86.1%) than non-working patients (16.7%) had good outcome. Type of admission had a negative effect on outcome of EDH. For example, 33% of the participants who had direct admission had good outcome compared to 75.6% of those who had referral admission. A higher proportion of the patients (75.3%) had better outcome who had more than 30 ml blood loss compared to the patients who lost less than 30 ml blood (28.6%). A significantly higher proportion of patients (70.6%) (with GCS score 9-15) had good outcome compare to the patients (29.4%) who had bad GCS score (3-8 score) during admission. As expected, the percentage of those had good GCS score before surgery had significantly better outcome (89%) compare to those who had bad GCS score before surgery (10%) (Table-I).

The outcome of disease process had five options. Nearly half (49%) of the patients had good recovery and around 16% died (Figure 1). Out of ten patients six patients had EDH due to RTA (Figure 2). The frequency of EDH varied according to the location. Highest proportion (41%) of EDH occurred in the temporal region. One-fifth trauma occurred in the frontal site. Around 18% had injury in the parietal site and 15% had EDH in temporo-parietal region (Table-II).

Table II: Location of EDH of the patients

Location	Number	Percentage
Temporal	42	41.2
Frontal	22	21.6
Parietal	18	17.6
Temporo-parietal	15	14.7
Occipital	4	3.9
Posterior fossa	1	1.0
Total	102	100.0

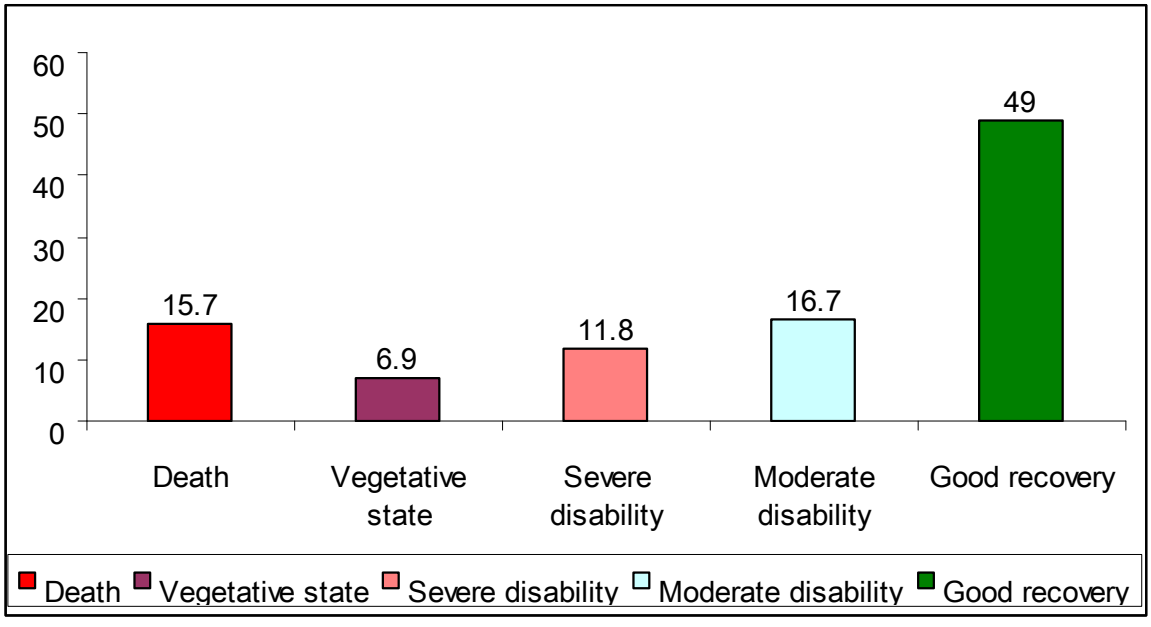

Figure.1: Outcome of the disease process of the patients of EDH

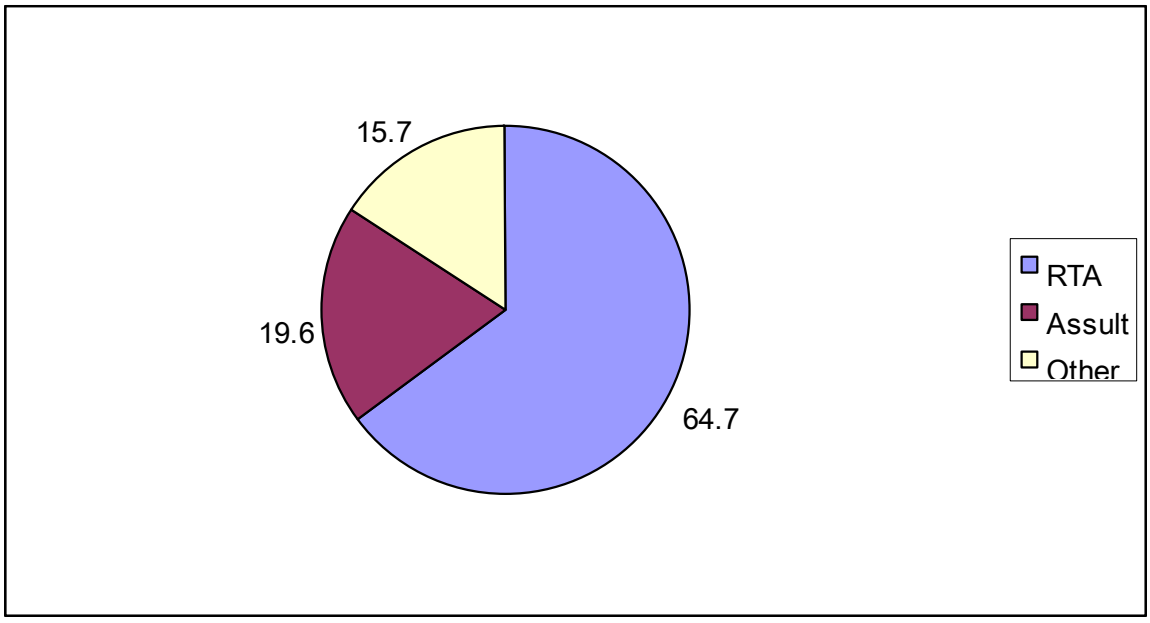

Figure 2: Causes of EDH of the patients

Logistic regression analysis was done to measure the strength of the association between outcome of the disease process and GCS score before surgery, age group, occupation, type of admission and volume of EDH. One model was developed in the analysis. GCS score before surgery was significant in the model but age, occupation, type of admission and volume of EDH was not significant. However, the GCS score was the only significant predictor of the outcome of EDH. Those had good GCS score (9-15 score) before surgery they were more likely to have good outcome (OR= 20.19) compare to those who had bad GCS score (3-8 score) before surgery (Table-III).

Table III: Adjusted odds ratio (OR) of surgical outcome status of the patients suffered from EDH with selected characteristics

		Odds Ratio
GCS score before surgery	3-8 score (ref)	1.00
	9-15 score	20.19**
Age group	0-20 years (ref.)	1.00
	>20 years	3.24
Occupation	Working (ref)	1.0
	Not working	2.24
Type of admission	Direct admission (ref)	1.00
	Referred	2.56
Volume of EDH	<30 ml (ref)	1.00
	>30 ml	1.43
Intercept		.004**
-2 Log likelihood		62.671
Cox & Snell R Square		0.489

*Note: *** = p < .001, ** = p < .01, * = p < .05*

Discussion

Acute EDHs are those lesions that develop immediately after trauma. As stated by Jacobson is mortality was found 86% in the last century, later declined to 16-48% in the pre-CT era, the introduction of CT accelerated the lowering of mortality to a great extent[14]. In our series, overall mortality rate is 16%. Survival of patients with EDH is limited by numerous factors; the age of the patient,10 (14) the speed of haematoma formation, the size and location of the clot, the interval between onset of papillary changes and surgery, the presence of associated intracranial lesions,4 and pre-operative GCS. The degree of primary brain injury, shown by a low GCS score on admission, seems to be one of the key factors in common with other studies [9]. Functional outcome showed a significant correlation with preoperative consciousness state, Glasgow Coma Scale score, pupillary size, and motor posturing [15]. Even in an urban environment with short pre-hospital times and rapid access to neurosurgery, outcome in patients having GCS 3 following EDH is likely to be poor [10]. EDH Mortality and morbidity from EDH could potentially approach zero if the patient is treated in a non-comatose condition [16].

There are reports on the effect of the age on the outcome of the patients with extradural haematoma. Some authors showed in their respective series that mortality and morbidity rates were lower in younger patients [17,18]. However, in our series, the effect of age was not significant.

Road traffic accident (RTA) is the most common cause of EDH in the literature followed by fall and other causes (e.g. assault) [9,19,20,21]. Chowdhury et al.[22] found that RTA (53%) and assault (28%) are the first and second predominate types of injury, followed by fall (15%). In the present study, RTA (65%) is the most common cause of extradural haematoma followed by assault (20%) and fall from height (12%).

In some series road traffic accidents and falls are the first and second predominant types of injury [12,21]. In another series, falls from height were the first type of injury in 66% of the patients and traffic accidents were the second frequent type of injury. In contrast, fall was determined as the most frequent mode of injury in many other series, as reported by Baykenar et al.[23], Ersahin et al. [24], and Kvarnes and Trumpy [25]. Falls were predominant in younger children, while traffic accidents were more frequent in adolescents [26].

Approximately 70-80% of the EDH is located in the temporo-parietal region, although extension to adjacent frontal and occipital areas is common [7].

Temporoparietal and temporal regions were predominant in terms of the location of EDHs, as reported in many series [12,25,27,28]. Although the most common site of EDHs has been reported as the temporal region [12,25], EDHs were localized in the temporo-parietal or parietal regions in some recent papers [13,29,37], as CT has enabled us to localize the haematoma precisely. Temporal and temporo-parietal locations were the most common site of EDHs in our patients. There was no statistically correlation between the site of EDH and mortality, although high mortality has been reported in association with EDH in the temporal region[8, 12]. In another study, temporoparietal location (33%) was the most common site followed by frontal region (23%) [22]. Posterior fossa EDHs comprise 3.4 to 13% of all EDHs and have an 11 to 22% mortality [24, 30, 31]. There were 12 patients with posterior fossa EDH (6.3%) [3]. There was 1 patient with posterior fossa EDH (01%). Because of the thinness of the temporal squamous bone and the close approximation of the middle meningeal artery and vein to the inner table, 70% of EDHs are located in the temporal region [32]. In rest of the cases, EDHs occur in the frontal, occipital and posterior fossa region. EDH contra lateral to impact site is extremely rare. One such case was reported by Mishra et al.[33] where there was a lower incidence of EDH in elderly due to adherent duramater with the cranium. Very young infants have a lower incidence presumably due to the pliable nature of the skull that resists fracturing. The

pathological effects of epidural haematoma are primarily due to compression of the underlying brain and later due to distortion and increased ICP. Clinical signs of these effects vary according to the location of the haematoma [34].

The neurological status in the time of intervention is the most significant factor affecting the outcome [12, 17, 18, 22 25, 27 ,35 ,36 ,37]. Kuday et al. showed in their series that the neurological status of patient (GCS) was found out to be the primary factor determining the result [14]. In some series, 35-40% of the patients were in the comatose group and 60-65% in non-comatose group [1,3]. The mortality rates have been reported 18-44% and 1%in comatose and non-comatose subjects, respectively [3,14,16,19]. 44.6% (29 out of 65) of the comatose patients died, whereas, only one death (0.8%) occurred among non-comatose patients. The level of consciousness significantly influenced the outcome [3].

Seeling et al. [35] reported 41% mortality in comatose patients with EDH. There were no deaths among patients with a GCS score of 8 or better in the series of Bricolo and Pasut [12] . Higher mortality rates have been reported in patients' unconscious at the time of surgery [15,28,29]. Özkan et al. found that all of the comatose patients died, whereas only two deaths occurred among non-comatose patients. The level of consciousness was significantly influenced the outcome. Level of consciousness just before surgery largely influence prognosis. Mortality is higher in comatose patients [26].

In our study, GCS scores found >8 in 72 (71%) patients and 30 (29%) were comatose. 46.6% of (14 out of 30) the comatose patients died, whereas, only 2 deaths (2.7%) occurred among non-comatose patients ($p<0.001$). The level of consciousness just before surgery largely influenced the outcome. Heinzelmann et al., Mohanty et al., and Kuday et al. have reported that lower GCS correlated with a more unfavorable outcome [14,38,39] . Rivas et al.[28] found that unfavorable outcome was determined by rapid clinical deterioration and EDHV of more than 150 ml. Lobato et al., Lee et al. and Servadei et al. have reported that outcome was influenced by GCS and EDHV among other factors [13,15,16]. In contrast, van den Brink et al. [40] found no correlation between EDHV and GCS, and outcome at six months. Paterniti et al.[11] reported that when an EDH was operated within six hours then EDHV did not correlate with outcome. The highest mortality (74%) was found in patients of EDH with subdural haemorrhage and a GCS between 3 and 5. Patient with an EDH and a GCS of 3 to 5 had a mortality of 36% and patients with an EDH and a GCS of 6 to 8 had a mortality of only 9% [4]. We observed that the GCS was the most important predictor of outcome. Factors like gender, and time from injury to management had no influence on outcome. Level of consciousness just before surgery largely influence prognosis. Mortality is higher in comatose patients.

Conclusion

Extradural haematoma is a neurosurgical emergency and timely surgical intervention provides rewarding results. Level of consciousness just before the surgery was the most important decisive factor in the management outcome of acute extra dural haematoma. Hence, the diagnosis should be made as soon as possible and the required measures should be taken immediately.

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