

Surgical Outcome of Extradural Hematoma Patients in Relation to Preoperative Neurological Status

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Abstract

Introduction: Epidural hematoma (EDH) is characterized by the acute onset of traumatic haemorrhage into potential space between the dura mater and skull following head injury. About 85% of the epidural cases are caused by skull fracture with rupture of the middle meningeal artery or its branches and rest of 1the time ruptured venous sinuses, fractured diploic bone. The BTF recommends that all patients with an EDH volume of greater than 30 cc should undergo surgical evacuation regardless of Glasgow Coma Scale (GCS). Aim of the Study: To assess the surgical outcome of extradural hematoma patients by using Glasgow Outcome Scale (GOS) postoperatively. Material & Methods: This prospective study was conducted in the Department of Neurosurgery, Dhaka Medical College and Hospital (DMCH), during the period of January 2016 to December 2017. A total of 98 patients of both sex and any age with EDH were selected purposively. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., IBM and New York, USA). Prior to commencement of this study, the "Research Review Committee" & the "Ethical Committee" of DMCH, Dhaka, approved the research protocol. Results: In this study, 98 patients were included; they were divided into 6 groups. Age range was 04 - 55 years. It was observed that majority, 30 (30.60%) patients were from 21 - 30 years of age. The mean age was found 25.24 ± 12.2 years. Other age related distributions were shown in the table. Male patients were 78 (78.55%) and 22 (22.44%) patients were female. A male predominance was observed. Among admitting GCS 3-8, 56.25% patients had unfavorable outcome and 43.25% had favorable outcome. Admitting GCS 9-13, 2.5% patients had unfavorable

outcome and 97.5% had favorable outcome. Admitting GCS 14-15, all patients (100.0%) had favorable outcome. Unfavorable outcome was observed in 9 (9.18%), 1 (1.00%) patients who belong 3-8, 9-13 GCS on admission. Mean GCS on admission was found 6.7 ± 2.44 score in unfavorable outcome group and 13.45 ± 2.30 score in favorable outcome group. **Conclusion:** This study revealed good surgical outcome in extradural hematoma patients. Preoperative GCS is an important predictor of outcome. Other preoperative neurological statuses like pupillary changes, neurological focal deficit, cranial nerve involvement, plantar reflexes and seizure also influence the surgical outcome.

Keywords

Epidural Hematoma, Surgical, Outcome, Traumatic, Postoperatively

1. Introduction

Epidural hematoma (EDH) is characterized by the acute onset of traumatic haemorrhage into potential space between the dura mater and skull following head injury [1]. About 85% of the epidural cases are caused by skull fracture with rupture of the middle meningeal artery or its branches and rest of 1 the time ruptured venous sinuses, fractured diploic bone [1] [2] [3] [4]. It is more common in male patients and usually occurs in the younger population because of the adherence of dura in the inner surface of the skull in the elder population [1]. 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 [2]. It is reported that one percent of all deaths and 15% of deaths occurring between 15 and 24 years are secondary to head injury [5]. Traumatic extradural hematoma (EDH) is a neurosurgical emergency and timely surgical intervention for significant EDH is the gold standard [6]. Craniotomy/craniectomy and evacuation of the hematoma is the treatment of choice [5]. Early identification and adequate management depending on the patient's clinical condition, especially in performing definitive surgery before irreversible cerebral damage occurs and the size of EDH is prerequisites for good outcome [7] [8]. The BTF recommends that all patients with an EDH volume of greater than 30 cc should undergo surgical evacuation regardless of Glasgow Coma Scale (GCS) [7] [9] [10]. It is strongly recommended that patients with an acute EDH and GCS < 9and anisocoria undergo surgical evacuation as soon as possible [3]. Jeong et al. [11] observed favorable outcome in 86.3%, 89.66% and unfavorable outcome in 13.69%, 10.34% in urban region, rural region respectively. Khan et al. [12] found that the mean Glasgow Coma Scale (GCS) score at presentation was 9.3 ± 4.4 . At 3 months, follow up 15 patients had a GOS score of five, four patients had a GOS score of four, two patients had a GOS score of 3, while 3 patients had a GOS score of 1. On univariate analysis, admitting GCS score, patient's age, the time from injury to admission and injury to surgery and anisocoric pupils at presentation were significantly associated with the outcome of GOS score. Jeong *et al.* [11] found older age (p = 0.0003), higher degree of brain injury (p < 0.0001), cases of surgical EDH (p < 0.0001), time interval from trauma to hospital before 6 hours, and the decreasing pattern of Glasgow Coma Scale (GCS) between and initial and final GCS were strongly associated with outcome.

2. Methodology and Materials

This prospective study was conducted in the Department of Neurosurgery, Dhaka Medical College and Hospital (DMCH), during the period of January 2016 to December 2017. A total of 98 patients of both sex and any age with EDH were selected purposively as inclusion and exclusion criteria. Preoperative computed tomography (CT) scan of brain was obtained for all patients where hyper-dense lentiform lesion under skull was identified as a case of extradural hematoma (EDH). After confirming diagnosis rapid thorough general and neurological examination was done and vital signs including GCS score, pupil status, BP, heart rate, O₂ saturation etc. were assessed and documented. CT scan finding including site of hematoma, thickness of hematoma, any midline shifting, underlying brain injury, overlying skull fracture also was assessed and documented. Then rapid resuscitation was done and patient was taken to OT for surgical intervention as early as possible in the form of craniectomy or craniotomy with evacuation of hematoma on the basis of the location of hematoma. Post operatively patient was kept in intensive care unit or post-operative ward. Patient follow-up was carried out for a total of 1 month post-operatively. Follow-up of the patients was done on indoor basis up to discharge and on OPD at 1 month. During follow up the patients were assessed using the post-operative GCS, check CT and Glasgow Outcome Scale (GOS) graded with a five-point score. The researcher himself collected the data. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., IBM and New York, USA). Prior to commencement of this study, the "Research Review Committee" & the "Ethical Committee" of DMCH, Dhaka, approved the research protocol.

- Inclusion Criteria
- Extradural hematoma patients who were admitted into DMCH of any age and sex.
- o Extradural hematoma patients who were treated surgically.
- Exclusion Criteria
- o Posterior fossa extradural hematoma patients.
- o Extradural hematoma patient treated conservatively.

3. Results

In this study, 98 patients were included; they were divided into 6 groups. Age range was 04 - 55 years. It was observed that majority, 30 (30.60%) patients were

from 21 - 30 years of age. The mean age was found 25.24 ± 12.2 years. Other age related distributions were shown in the table (**Table 1**). Male patients were 78 (78.55%) and 22 (22.44%) patients were female. A male predominance was observed (**Table 2**). Majority were suffering from motor vehicle accident 44 (44.90%), 29 (29.60%) were suffering from assault, 20 (20.40%) patients were fallen from height and other 04 (04.0%) patients had history of fall of heavy wt. overhead (**Table 3**). It was observed that majority 25 (25.50%) patients were had parietal lobe involvement. Other results were shown in the table (**Table 4**). It was observed that almost two third 65 (66.32%) patients underwent surgery within 6 - 24 hours and 25 (27.50%) patients were within 24 - 72 hrs (**Table 5**). GOS of the study patients, it was observed that majority had good recovery during discharge and 1 month after follow up (**Table 6**). The mean age was found 29.86 \pm 20.23 years unfavorable outcome group and 24.65 \pm 16.86 years in

Age in years	Frequency (n)	Percentage (%)			
≤10	18	18.36			
11 - 20	24	24.48			
21 - 30	30	30.60			
31 - 40	16	16.36			
41 - 50	8	8.16			
51 - 60	2	2.04			
Total	98	100.0			
Mean ± SD 25.24 ± 12.2					
	Min-Max (04-55))			

Tab	le 1. Distri	bution of	the s	tudy j	patients	by	age	(n =	98)).
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Table 2. Distribution of the study patients by sex (n = 98).

Sex	study patients ($n = 100$)				
	n	%			
Male	76	77.55			
Female	22	22.44			
Total	98	100.0			

Table 3. Distribution of the study patients by mode of injury (n = 98).

Mode of injury	Frequency (n)	Percentage (%)
Motor vehicle accident	44	44.90
Assault	29	29.60
Fall from height	20	20.40
Fall of heavy wt. over head	4	4.08
Unknown	1	1.01
Total	98	100.0

Location of hematoma	Frequency (n)	Percentage (%)
Frontal	23	23.46
Parietal	25	25.50
Temporal	5	5.10
Occipital	4	4.08
Temporo-parietal	24	24.48
Fronto-parietal	13	13.26
Parieto-occipital	4	4.08
Total	98	100.0

Table 4. Distribution of the study patients by location of hematoma (n = 98).

Table 5. Distribution of the study patients by timing of operation (n = 98).

Timing of execution	Frequency $(n = 98)$			
Timing of operation —	Ν	%		
within 6 hours	3	3.06		
within 6 - 24 hours	65	66.32		
within 24 - 72 hours	25	25.50		
>72 hour	5	5.10		
Total	98	100.0		

Table 6. Distribution of the study patients by GOS score (n = 98).

	Frequency (n = 98)			Outcome			
GOS score	N	%		Ν	%		
During discharge							
1	3	3.06	Unfavourable	13	13.26		
2	1	1.01	Favourable	85	86.73		
3	9	9.18					
4	30	30.60					
5	55	56.12					
At 01 month follow							
1	0	0.00	Unfavourable	10	10.20		
2	1	1.01	Favourable	86	87.75		
3	6	6.12	Lost F/U	2	2.04		
4	11	11.22					
5	75	76.53					

favorable outcome group (**Table 7**). Among male patients, 91.02% had favorable outcome, among female favorable outcome in 72.27% patients (**Table 8**). Unfavorable outcome was observed in 9 (9.18%), 1 (1.00%) patients who belong 3-8, 9-13 GCS on admission. Mean GCS on admission was found 6.9 ± 2.34 score in unfavorable outcome group and 13.23 ± 2.10 score in favorable outcome group (**Table 9(a)**). Among admitting GCS 3-8, 56.25% patients had unfavorable outcome 43.25% had favorable outcome. Admitting GCS 9-13, 2.5% patients had unfavorable outcome 97.5% had favorable outcome. Admitting GCS 14-15, all patients (100.0%) had favorable outcome (**Table 9(b**)). Unfavorable outcome

	Glasgow outcome					
Age (in years)	Unfavorable outcome (n = 10)		Favorable (n =	outcome 86)	P value	
	Ν	%	Ν	%	_	
0 - 10	2	2.04	17	17.34		
11 - 20	3	3.06	18	18.36		
21 - 30	3	3.06	27	27.54		
31 - 40	2	2.04	16	16.32	0.6800	
41 - 50	3	3.06	7	7.14	0.689	
51 - 60	1	1.01	2	2.04		
Mean ± SD	29.86	±20.23	24.65	±16.86		
Range (min, max)	48 (4.52)		51 (4.55)			
ns = not significant P value reached from unpaired t-test						

Table 7. Association between Glasgow outcome with age (n = 98).

Table 8. Association between Glasgow outcome with sex (n = 98).

Sex	Unfavorable outcome (n = 10)		Favorabl (n =	P value		
	N	%	Ν	%		
Male	6	8.97%	69	91.02	0 (11)	
Female	4	27.27%	17	72.72	0.611	
ns = not significant P value reached from unpaired t-test						

Table 9. Association between final Glasgow outcome with GCS on admission (n = 98).

			(a)				
			Outc	ome			
GCS on admission	Unfavorable	e outcome	(n = 10)	Favor	able outco	ome (n = 86)	P value
	Ν		%		Ν	%	=
3 - 8	9		9.18		7	7.14	
9 - 13	1		1.00		39	39.78	
14 - 15	0		0.00		40	42.80	0.044 ^s
Mean ± SD	6.9 ± 2.34	4		13.	23 ± 2.1		
			(b)				
					GCS or	n admission	
Outcome		3-8	9	-13	1	4-15	P value
	n	%	n	%	n	%	
Unfavorable outcom	e 9	56.25	1	2.5	0	0.00	0.044 ^s
Favorable outcome	7	43.75	39	97.5	40	100.00	

was observed in 9 (9.18%), 1 (1.00%) patients who belong 3-8, 9-13 GCS on admission. Mean GCS on admission was found 6.7 ± 2.44 score in unfavorable outcome group and 13.45 ± 2.30 score in favorable outcome group (Table 10(a)). Among preoperative GCS 3-8, 42.85% patients had unfavorable outcome 57.14% had favorable outcome. Admitting GCS 9-13, 2.56% patients had unfavorable outcome 97.44% had favorable outcome. Admitting GCS 14-15, all patients (100.0%) had favorable outcome (Table 10(b)). Headache in unfavorable outcome patients had 2 (3.27%) and 58 (96.73%) in favorable outcome. Patients had ALC/LOC in unfavorable outcome 12 (17.56%) and 60 (82.43%) in favorable outcome. Patients had focal neurological deficit in unfavorable outcome 4 (100.00%). Patients had convulsion in unfavorable outcome 3 (100.00%). Patients had pupillary changes in unfavorable outcome 9 (75.00%) and 3 (25.00%) in favorable outcome. Patients had cranial nerve involvement in unfavorable outcome 10 (76.92%) and 3 (23.08%) in favorable outcome and 11 (68.75%) patients had plantar extensor in unfavorable outcome and 5 (31.25%) in favorable outcome which were statistically significant (p < 0.05) but other clinical manifestation were not statistically significant (p > 0.05) between two groups (Table 11).

4. Discussion

In this present study it was observed that the incidence of EDH is highest (30.60%) in the third decade of life (21 to 30 years), followed by 2^{nd} decade of life (11 - 20 years) with a mean age of 25.24 ± 12.2 years and range from 4 to 55 years which is similarly observed by Khaled *et al.* [13]. In another study, Emejulu *et al.* [7] observed the peak age incidence was 21 to 30 years (42%), with a mean

Table 10. Association between Glasgow outcome with preoperative GCS (n = 98).

			(a)				
		Gl	asgow oi	utcome			
Preoperative GCS	Unfavorable outcome (n = 10)		ome	Favorable outcome $(n = 86)$			P value
_	Ν	9	6	Ν		%	
3-8	9	9.	18	10		10.10	
9-13	1	1.	00	38		38.76	0.0418
14-15	0	0 0.00		38		38.76	0.041
Mean ± SD	6.7 ± 2.44	7 ± 2.44		13.45 ± 2.3			
			(b)				
			Preope	rative GCS			
Outcome		3-8		9-13		4-15	P value
	n	%	n	%	n	%	
Unfavorable outcom	ne 9	42.85	1	2.56	0	0.00	0.041 ^s
Favorable outcome	10	57.14	38	97.44	38	100.00	

Clinical manifestation	Unfavorable outcome (n = 10)		Favorab (n	le outcome = 86)	P value	
	Ν	%	Ν	%		
Headache	2	3.27	58	96.73	0.03 ^s	
ALC/LOC	12	17.56	60	82.43	0.114 ^{ns}	
Vomiting	11	15.48	71	84.52	0.777 ^{ns}	
Lucid interval	0	0.00	19	100.00	0.436 ^{ns}	
Focal neurological deficit	4	100.00	0	0.00	<0.001 ^s	
Convulsion	3	100.00	0	0.00	<0.001 ^s	
Pupillary changes	9	75.00	3	25.00	0.001 ^s	
Cranial nerve involvement	10	76.92	3	23.08	0.001 ^s	
Plantar extensor	11	68.75	5	31.25	0.001 ^s	

Table 11. Association between Glasgow outcome with clinical manifestation (n = 98).

age of 23 years. In this current study, among the 98 patients, it was observed that majority, 76 (77.55%) patients were male and 22 (22.44%) patients were female. Male-female ratio was 3.45:1. A male predominance was observed which reflects male are more exposed to outside world. In one case series in Hong Kong Cheung et al. [6] observed male predominance (78.7%). Similar observations regarding the male predominant were also observed by Aurangzeb et al. [5], Cheung et al. [6], Emejulu et al. [7], Husain et al. [14], Khaled et al. [13] and Soon et al. [9]. Among the 98 patients it was observed that in majority cases the mode of injury was motor vehicle accident 44 (44.88%) followed by assault 29 (29.58%) and fall from height 20 (20.40%). In this study, motor vehicle accident was the commonest cause of injury comparable with many other published series Aurangzeb et al. [5]; Cheung et al. [6]; Emejulu et al. [7]; Gurer et al. [15]; Khaled et al. [13]. Location of hematoma was 25.50% in parietal, 23.46% in frontal, 24.48% in temporoparietal, 13.26% in frontoparietal region and only 2% in posterior fossa. Hematoma location was parietal in 49%, frontal in 36%, temporal in 10% and occipital in only 5% observed by Gerlach et al. [8]. In another study of 610 cases of EDH, temporo-parietal site was involved in 33.45% (n = 204) followed by frontal region in 23.28% (n = 142) and six patients (0.98%) had EDH in posterior fossa [13]. Almost two third 65 (66.310%) patients underwent surgery within 6 - 24 hours of trauma and 25 (25.50%) patients were within 24 -72 hours that was inconsistent with other previous studies. Gerlach et al. [8] found mean time to surgery 19.9 hours, however 53.8% patients underwent surgical evacuation of hematoma within 6 hours Khaled et al. [13] found that time interval between trauma and surgery was within 13 to 24 hours in maximum (54%) cases. In this present study it was observed that more than half (56.10%) of the patients were in Glasgow outcome scale 5 followed by 30.60% had Glasgow outcome score 4 scale, 9.18% with scale 3, 1% with GOS score 2 and 3% with GOS score 1 resulting in favorable outcome in 86.73% and unfavorable outcome in 13.26% patients during discharge. At one month two patients lost follow up, 76.5% patients had GOS 5, 11.22% patients had GOS 4, 5.10% patients had GOS 3, 1% patients had GOS 2 resulting in final favorable outcome in 87.75% and unfavorable outcome in 10.20%. Cheung et al. [6] observed 73.3% in GOS 5, 7.8% in GOS 4, 6.7% in GOS 3, 1.1% in GOS 2 and 10.1% in GOS 1. Gerlach et al. [8] observed excellent outcome (GOS 5) in 89.5% and good outcome (GOS 4) in 10.5% cases. In this study, it was observed that almost one-fourth (27.27.0 percentage) patients who had favorable outcome were belonged to age 21 - 30 years. The mean age was found 29.86 ± 20.23 years unfavorable outcome group and 24.65 ± 16.86 years in favorable outcome group. The mean age difference was not statistically significant (p = 0.689) between two groups. Similarly, Gurer B et al. [15] and Khan et al. [12] did not find significant difference between age and functional outcome. Among male patients, 91.02% had favorable outcome, among female favorable outcome in 72.27% patients. The sex difference was not statistically significant (p = 0.611) between two groups. Glasgow coma scale (GCS) score at presentation was found significant determinant of outcome. In this study unfavorable outcome was observed in 9 (9.18%), 1 (1.01%), 0.0% patients who belong 3-8, 9-13, 14-15 GCS during admission and preoperatively. Favorable outcome was found 7.14% in GCS 3-8, 39.78% in GCS in 9-13, 42.84% in GCS in 14-15 during admission and 10.2% in GCS 3-8, 38.76% in GCS 9-13, 38% in GCS 14-15 preoperatively. Among admitting GCS 3-8, 56.25% patients had unfavorable outcome 43.25% had favorable outcome. Admitting GCS 9-13, 2.5% patients had unfavorable outcome 97.5% had favorable outcome. Admitting GCS 14-15, all patients (100.0%) had favorable outcome. Mean GCS on admission was found 6.9 ± 2.34 score in unfavorable outcome group, 13.23 ± 2.10 score in favorable outcome group and 6.7 ± 2.44 score in unfavorable outcome group, 13.45 ± 2.30 score in favorable outcome group at preoperatively which were statistically significant (p = 0.044, 0.041))between two groups that indicate GCS (during admission and preoperatively) highly prognostic of outcome. Cheung et al. [6] observed unfavorable outcome 12.3%, 2.2%, 3.3% in GCS 3-8, 9-12, 13-15 and favorable outcome in 7.8%, 7.8%, 65.6% in GCS 3-8, 9-12, 13-15. Emejulu et al. [7] observed unfavorable outcome 10.6%, 2.1%, 2.1% in GCS 3-8, 9-12, 13-15 and favorable outcome in 10.6%, 29.8% and 44.7% in GCS 3-8, 9-12, 13-15 that was similar with this study. Gurer B et al. [15] observed that mortality and unfavorable outcome were highly correlated with admitting GCS (p < 0.001). Khan et al. [12], Pruthi et al. [16] and Kang et al. [17] found that admitting GCS was highly prognostic of outcome. In this study 2 (3.27%) patients had headache in unfavorable outcome and 58 (96.73%) in favorable outcome, 4 (100.00%) patients with focal neurological deficit had unfavorable outcome, 3 (100.00%) patients had convulsion in unfavorable outcome, 9 (75.00%) patients had pupillary changes in unfavorable outcome and 3 (25.00%) in favorable outcome. Clinical manifestations like vomiting,

ALC/LOC, lucid interval were not statistically significant (p > 0.05) between two groups. Gurer B *et al.* [15] observed that who had bilateral unreactive pupils before surgery had significantly higher mortality (p < 0.001) and unfavorable outcome (p = 0.009). Jones *et al.* [18] and Khan *et al.* [12] observed that anisocoric pupils at presentation were related to significantly worse outcome with no significant relation between lucid interval and outcome.

5. Limitations of the Study

The study population was selected from one selected hospital in Dhaka city, so that the results of the study may not reflect the exact picture of the country. The present study was conducted for a very short period. Small sample size was also a limitation of the present study. Therefore, in future further study should be undertaken with large sample size. Follow up after discharge was short

6. Conclusion and Recommendation

This study revealed good surgical outcome in extradural hematoma patients. Preoperative GCS is an important predictor of outcome. Other preoperative neurological statuses like pupillary changes, neurological focal deficit, cranial nerve involvement, plantar reflexes and seizure also influence the surgical outcome. A long follow up study should be done. Study should be done with large sample size. Study should be done at multiple centers.

Conflicts of Interest

None declared.

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