ORIGINAL ARTICLE

MORTALITY AND PROGNOSTIC FACTORS IN PATIENTS OPERATED FOR ACUTE EPIDURAL HEMATOMA

Shah Khalid[1], Shahbaz Ali Khan[2], Tariq Abbasi[3], Ahsan Aurangzeb[2], Faiza[4], Abdul Majid Khan[5]

[1]Neurosurgery Department Aga Khan University Hospital Karachi-Pakistan
[2]Department of Neurosurgery, [3]Department of Anaesthesia, [5]Department of Emergency, Ayub Medical College, Abbottabad-Pakistan
[4]Department of Obstetrics and Gynaecology, Benazir Bhutto Shaheed Teaching Hospital Abbottabad-Pakistan

Background: Epidural hematoma is one of the most common surgical emergencies encountered in neurosurgery. This study was conducted to determine the mortality and prognostic factors in patients operated for traumatic intracranial epidural hematoma in a resource-constrained setting from a developing country. **Methods:** This retrospective study was conducted in the Department of Neurosurgery at Ayub Teaching Hospital Abbottabad from 1st January 2019 to 31st Dec 2021. Inclusion and exclusion criteria were created. The medical record of 116 patients admitted and operated on for traumatic extradural hematoma was retrospectively reviewed. Information was recorded using a standardized structured questionnaire. The outcome was measured in terms of the Glasgow coma outcome score. **Results:** Out of 116 patients, 93 were male and 23 were female.19 (16.4%) patients were in the age range 0-5 years, 42 (36.2%) were in the age range 6-15, 35(31.0%) were in the age range 16-30, 11 (9.5%) were in the age range 31–45 years, 7 (6.0%) were in the age range 46-60 years while only one patient included in this study was above 60 years. Overall mortality was 4.3%. Mortality was higher in females and in those aged less than 5 years (3.4%). 4 out of 16 patients died with GCS less than 8, while none of the patients died when GCS was above 12. Mortality was significantly higher in the presence of associated lesions (4.4% vs. 0%) and anisocoria (2.6% vs.1.7%). Patients who operated within 6 hours of trauma resulted in better outcomes with a mortality rate of 0.0% and functional recovery of 57.8 % while for those who operated after 6 hours, mortality was significantly higher (4.3%) and functional recovery was significantly low (15.5%). **Conclusion:** Good surgical outcomes can be achieved with early operative intervention if indicated. Female gender, low preoperative GCS score, presence of pupillary dilatation, presence of associated lesions, delayed surgical intervention and age less than 5 years are significant predictors for poor outcomes.

Keywords: Epidural hematoma; Operative mortality; Prognostic Factors; Complications; Outcome; Extradural Hematoma

Citation: Khalid S, Khan SA, Tariq, Aurangzeb A, Faiza, Khan AM. Mortality and prognostic factors in patients operated for acute epidural hematoma. J Ayub Med Coll Abbottabad 2023;35(4 Suppl 1):769–73.

DOI: 10.55519/JAMC-S4-12780

INTRODUCTION

Epidural hematoma (EDH), first defined by Hutchinson in 1867 is a form of traumatic head injury characterized by the accumulation of blood between the inner table of the skull and the outer layer of Dura matter.[1] It accounts for about 1.5% of patients treated for head trauma.[2] Most of the cases result from road traffic accidents, falls from the height or direct head trauma.[3] Arterial injuries with the middle meningeal artery rupture is the most common underlying aetiology.[4] Injuries to Dural venous sinuses account for 9.7% of cases leading to poor prognosis and greater complications.[5] EDH with surgical indications is a neurosurgical emergency and requires urgent surgical decompression.[6] Mortality from isolated EDH ranges from 1.2–33%.[7] Many prognostic factors have been identified that can influence the outcome of patients with extradural hematoma.[8] Delay in diagnosing or treatment due to atypical presentation can increase mortality and morbidity.[9] Early diagnosis and timely intervention can reduce morbidity and mortality so healthcare professionals who deal with trauma patients must be aware of and competent to cope with this type of trauma.[10] There is a significant correlation between hematoma volume, density on CT, time interval from injury to surgery, motor score at presentation, mechanism of injury and outcome.[11] Glasgow Coma Score GCS score after resuscitation or before surgery is the solidest predictive indicator for outcome.[12] Mortality is significantly higher in patients having GCS 8 or below at the time of initial presentation (45.45%).[13] Age is one of the strongest prognostic factors with an increase in age being associated with worse outcomes.[14–16] Presence of associated lesions resulting from the same event such as subdural haematoma and or intraparenchymal lesion is associated with worse outcomes Rocchi *et al*.[17] Hematoma volume and neurologic grade have been described to affect outcome after evacuation of extradural hematoma.[18–20] Dubey *et al*[21] observed better outcomes in patients with hematoma volumes of smaller than 30ml

related to those with greater than 30 ml. Some studies institute that the volume of EDH does not affect outcome.[22,23] Other factors affecting the outcome include postoperative intracranial hypertension.[24,25] To date, only two studies in Pakistan have investigated the outcome and prognostic factors for intracranial epidural hematoma. Many international studies have explored head injury and acute subdural hematoma, but few studies focused on traumatic epidural hematoma. None of these studies have collectively assessed all the prognostic factors that can influence the outcome of the patient who underwent surgical intervention for traumatic intracranial epidural hematoma. Furthermore, the results of these limited previous studies are significantly different from each other. We aimed to determine the mortality and prognostic factors in patients operated for traumatic intracranial epidural hematoma.

MATERIAL AND METHODS

This retrospective study was conducted in the Department of Neurosurgery Ayub Teaching Hospital, Abbottabad from 1st January 2019 to 31st Dec 2021. Ethical permission was taken from the Hospital before initiating the study. Patients of either gender and any age, who were admitted and operated for traumatic intracranial extradural hematoma, were included in the study. Patients managed conservatively or those who were operated on for depressed skull fracture with underlying non-significant extradural hematoma were excluded from the study.

The medical record of 116 patients admitted and operated on for traumatic intracranial extradural hematoma was retrospectively reviewed. Information including age, gender, mechanism of trauma, associated lesions resulting from the same event (e.g., linear skull fracture, depressed skull fracture, cerebral contusions, acute subdural hematoma, long bone fracture etc.), GCS at presentation, presence of pupillary abnormalities, time interval from injury to surgical intervention and Glasgow outcome score at the time of discharge from hospital were recoded using a standardized structured questionnaire. The outcome was measured in terms of GOS score. Glasgow outcome score (GOS) 1 represents death, GOS 2 represents Neurovegetative condition (patients unresponsive or speechless for weeks or months), GOS 3 represents extreme debility (patients reliant on daily life support), GOS 4 represents modest disability (patients independent in daily needs) while GOS 5 designate good functional recovery (gaining of normal life with the minor neurological and psychological deficit). GOS 2-4 was used to indicate residual disabilities. Data was analysed using SPSS -23. The Chi-square test was used to determine the effect of categorical variables on the Glasgow coma outcome score. A *p*-value less than 0.05 was considered statistically significant.

RESULTS

Out of 116 patients operated for traumatic intracranial epidural hematoma, 93 were male and 23 were female. Nineteen (16.4%) patients were in the age range 0–5 years, 42 (36.2%) were in the age range 6-15, 35(31.0%) were in the age range 16–30, 11 (9.5%) were in the age range 31–45 years, 7 (6.0%) were in the age range 46–60 years while only one patient included in this study was above 60 years (figure-1). Fall from height was the most common mechanism (64.66%) followed by road traffic accidents (29.31%) and physical assault (6.03%). Five out of 116 patients died following surgical intervention with an overall mortality of 4.3%. The difference in residual disability, functional recovery and mortality between males and females was statistically significant (p=0.008). Mortality was higher in females (3.4%) while residual disability was higher in males (13%).77 (66.4%) male patients achieved good functional recovery. Mortality was significantly higher in patients under 5 years of age (3.4%). Residual disability was higher in patients 16-30 years of age (5.2%). Most of the patients who achieved good functional recovery were in the age range 6–15 years (34.4%). GCS on admission was one of the most significant predictors of outcome. Four out of 16 patients died with GCS less than 8 at the time of admission to hospital while none of the patients died when GCS was above 12. Functional recovery was significantly higher when GCS at the time of admission was greater than 12 (p<0.05). Mortality was significantly higher in those who had abnormal pupillary diameter or impaired response to light (dilated pupil and or absent light reflex) (2.6%), while functional recovery was higher in the absence of pupillary abnormalities (79.3%) (P<0.05). The effect of associated lesions on the Glasgow outcome score was statistically significant (p=0.007). Mortality was higher in the presence of associated lesions (4.4% vs. 0%). Patients who operated within 6 hours of trauma resulted in a better outcome with a mortality rate of 0.0% and functional recovery of 57.8% while for those who operated after 6 hours, the mortality was significantly higher (4.3%) and functional recovery was significantly low (15.5%) (table-1).

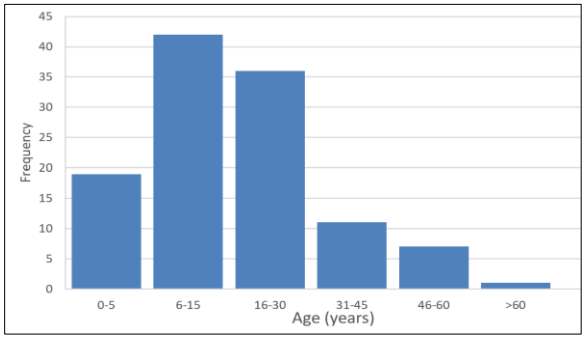

Figure-1: Age Distribution

Table-1: Effect of clinical variables on Glasgow coma outcome score.

Clinical Variables	No. Of Patients (N=116)	Mortality (N=5)	Residual Disability (N=17)	Functional Recovery (N=94)	*p*-value
Gender					
Male	93 (80.2%)	1 (0.9%)	15 (13%)	77 (66.4%)	0.008
Female	23 (19.2%)	4 (3.4%)	2 (1.7%)	17 (14.7%)	
Age (years)					
0-5	19 (16.4%)	4 (3.4%)	1 (0.9%)	14 (12.1%)	0.000
6-15	42 (36.2%)	0 (0%)	2 (1.7%)	40 (34.5%)	
16-30	36 (31.0%)	0 (0%)	6 (5.2%)	30 (25.9%)	
31-45	11 (9.5%)	1 (0.9%)	3 (2.6%)	7 (6.0%)	
46-60	7 (6.0%)	0 (0%)	4 (3.5%)	3 (2.6%)	
>60	1 (0.9%)	0 (0%)	1 (0.9%)	0 (0.0%)	
GCS on admission					
≤ 8	16 (13.8%)	4 (3.4%)	8 (6.9%)	4 (3.4%)	0.000
9-12	29 (25.0%)	1 (0.9%)	8 (6.9%)	20 (17.2%)	
>12	71 (61.2%)	0 (0.0%)	1 (0.9%)	70 (60.3%)	
Pupillary abnormalities					
Yes	9 (7.8%)	3 (2.6%)	4 (3.4%)	2 (1.7%)	0.000
No	107 (92.2%)	2 (1.7%)	13 (11.2%)	92 (79.3%)	
Associated lesions					
Yes	65 (56.3%)	5 (4.4%)	12 (9.7%)	48 (43.1%)	0.007
No	51 (43.7)	0 (0.0%)	5 (4.4%)	46 (39.7%)	
The time interval from injury to surgery					
<6 hours	75 (64.7%)	0 (0.0%)	8 (6.9%)	67 (57.8%)	0.00
7-12 hours	27 (23.3%)	5 (4.3%)	4 (3.5%)	18 (15.5%)	
12-24 hours	6 (5.2%)	0 (0.0%)	4 (3.5%)	2 (1.7%)	
>24 hours	8 (6.9%)	0 (0.0%)	1 (0.9%)	7 (6.0%)	

DISCUSSION

Epidural hematoma is a neurosurgical emergency with very low mortality if managed properly. Several factors may influence the outcome including GCS at presentation, presence of pupillary abnormalities, hematoma size, accompanying intracranial injuries and time interval from injury to surgery.[26,27] The objectives of this study were to determine the mortality and prognostic factors affecting the outcome of patients operated for traumatic intracranial epidural hematoma.

Males were the predominant victims in our study accounting for 80.2%. This may reflect our social culture where males are more exposed to outdoor activities and work. Another reason may be the higher incidence of motorbike accidents which is a main source of transport in Pakistan. Male predominance was also reported by previously done studies in Pakistan.[26,28] Most of the victims in this study were in the age range 6–15 years which is in contradiction with previously done national and international studies. Most of the previous studies reported a higher incidence after the age of 30 years.[26,29] In our series history of fall from height was the most frequent mechanism of trauma accounting for about 64.6% of cases. Rosyidi *et al*[3] reported road traffic accidents as a leading cause of traumatic extradural hematoma followed by falls from height and direct head trauma. We did not find other studies that reported the precipitating event for traumatic EDH. Overall mortality in our series was 4.3%. This is much lower than those reported by other series. Ruff *et al*[7] reported a mortality of 1.2–33% while Bullock *et al*[30] reported a mortality range from 9.4–33%. Low mortality in our series was because we received most patients with GCS greater than 12 which showed a direct relationship with Glasgow coma outcome score. Moreover, we operated on most patients within 6 hours of injury resulting in improved outcomes with a lower overall operative mortality rate.

The Glasgow coma scale score is an important tool to evaluate the level of consciousness in traumatic head injury patients. Head trauma patients can be graded into mild, moderate and severe head injury based on GCS score at presentation. GCS is an important prognostic factor in almost every Neurosurgical patient. In our study, we found a direct relationship between GCS score at the time of access to the hospital and GOS score at the time of discharge from the hospital. We noticed significantly higher mortality in those with GCS of less than 8. Mortality was significantly lower and functional recovery was significantly higher in patients admitted with GCS greater than 12. Similar results were observed by Emejulu *et al.*[31]

Age is also a critical prognostic factor for outcomes similar to Glasgow coma scale score. We observed higher mortality in patients less than 5 years of age. In our study, 4 out of 19 patients died following surgical intervention. Good functional recovery was

resumed when the age was greater than 6 years. 40 out of 42 patients in the age range 6–15 years and 30 out of 35 patients in the age range 16–30 years had achieved good functional recovery. Collaborators *et al*[32] reported high mortality after 40 years of age. Murray *et al*[16] also reported an inverse relationship between age and the Glasgow outcome scale. Epidural hematoma is a neurosurgical emergency and cases with absolute surgical indications require early surgical intervention.[6] Early surgical intervention once indicated can reduce morbidity and mortality.[10] Ozkan *et al*[32] reported lower mortality in those operated within 6 hours of injury (18.5%) compared to those operated after 6 hours of injury (23.5%). We observed a mortality rate of 0% when the patient was operated within 6 hours of injury. We also observed good function recovery and little residual disability with early operative intervention.

The presence of pupillary abnormalities and associated lesions can alter the outcome. We found a significant correlation between these clinical variables and Glasgow outcome scores. In our study 3 out 9 patients with pupillary abnormalities and 5 out of 65 patients with associated intra or extra cranial lesions died. Functional recovery was significantly lower in those with pupillary abnormalities. Only 2 out of 9 patients achieved good functional recovery. Patients with normal pupils had achieved significantly good functional recovery (79.3%). The difference in functional recovery in the absence or presence of associated lesions was not statistically significant (43.1% vs. 39.7%). Cohen *et al*[33] in their series of EDH patients reported 100 % mortality with dilated pupils for more than 70 minutes. Rocchi *et al*[17] also reported poor outcomes in those where EDH was accompanied by other associated lesions either intracranial or extracranial.

The main drawback of this study is its retrospective design. Hematoma volume is one of the most important prognostic factors but is not assessed by our study because of the retrospective design.

CONCLUSION

Age, preoperative GCS, pupillary abnormalities, associated lesions and time interval from injury to surgical intervention are significant prognostic factors that can alter the outcome of patients intended to be operated for traumatic extradural hematoma. Good surgical outcomes can be achieved with early operative intervention if indicated. Female gender, low preoperative GCS score, presence of pupillary dilation, presence of associated lesions, delayed surgical intervention and age less than 5 years are significant predictors for poor outcomes.

AUTHORS' CONTRIBUTION

SK, SAK: Conceived the idea, data collection, data analysis, and write-up. AZ, AN: Literature review, data collection. TA, F, AMK: Data analysis, proof reading, AA; supervised the study, proof reading, data analysis.

REFERENCES

1. Atci IB, Yilmaz H, Yaman M, Baran O, Türk O, Solmaz B. Incidence, hospital costs and in-hospital mortality rates of surgically treated patients with traumatic cranial epidural hematoma. Romanian Neurosurg 2018;XXXII (1):110–5.
2. Taussky P, Widmer HR, Takala J, Fandino J. Outcome after acute traumatic subdural and epidural haematoma in Switzerland: a single-centre experience. Swiss Med Wkly 2008;138(19-20):281–5.
3. Rosyidi RM, Priyanto B, Fauzi AL, Sutiono AB. Toward zero mortality in acute epidural hematoma: A review in 268 cases problems and challenges in the developing country. Interdiscip Neurosurg 2019;17:12–8.
4. Barbosa TG, Rodrigues LHDS, Xander PAW, Avelar TM, Costa GHFD, Batista AVDS, *et al*. Traumatic injury of dural venous sinus as cause of epidural hematoma: importance of recognition and adequate surgical planning. Rev Chil Neurocir 2021;47:40–3.
5. Yilmazlar S, Kocaeli H, Dogan S, Abas F, Aksoy K, Korfali, *et al*. Traumatic epidural haematomas of nonarterial origin: Analysis of 30 consecutive cases. Acta Neurochir (Wien) 2005;147(12):1241–8.
6. Cheung PS, Lam JM, Yeung JH, Graham CA, Rainer TH. Outcome of traumatic extradural haematoma in Hong Kong. Injury 2007;38(1):76–80.
7. Ruff LM, Mendelow AD, Lecky FE. Improving mortality after extradural haematoma in England and Wales. Br J Neurosurg 2013;27(1):19–23.
8. Ndoumbe A, Ekeme MVP, Jemea B, Simeu C, Takongmo S. Epidemiological Analysis of Surgically Treated Acute Traumatic Epidural Hematoma. Open J Modern Neurosurg 2016;6(3)89–97.
9. Sendilkumar A, Kannah E. Immediate prognostic outcome in traumatic epidural hematoma at a tertiary care centre. Int J Curr Res 2018;10(06):70085–90.
10. Bricolo AP, Pasut LM. Extradural hematoma: toward zero mortality. A prospective study. Neurosurgery 1984;14(1):8–12.
11. Lobato RD, Rivas JJ, Cordobes F, Alted E, Perez C, Sarabia R, *et al*. Acute epidural hematoma: an analysis of factors influencing the outcome of patients undergoing surgery in a coma. J Neurosurg 1988;68(1):48–57.
12. Stablein DM, Miller JD, Choi SC, Becker DP. Statistical methods for determining prognosis in severe head injury. Neurosurgery 1980;6(3):243–48.
13. Ndoumbe A, Ekeme MVP, Simeu C, Takongmo S. Outcome of Surgically Treated Acute Traumatic Epidural Hematomas Based on the Glasgow Coma Scale. Open J Mod Neurosurg 2008;8(1):109–18.
14. Krishna G, Beitchman JA, Bromberg CE, Currier Thomas T. Approaches to Monitor Circuit Disruption after Traumatic Brain Injury: Frontiers in Preclinical Research. Int J Mol Sci 2020;16;21(2):588.
15. Lingsma HF, Roozenbeek B, Steyerberg EW, Murray GD, Maas AI. Early prognosis in traumatic brain injury: from prophecies to predictions. Lancet Neurol 2010;9(5):543–54.
16. Murray GD, Butcher I, McHugh GS, Lu J, Mushkudiani NA, Mass AI, *et al*. Multivariable prognostic analysis in traumatic brain injury: results from the IMPACT study. J Neurotrauma 2007;24(2):329–37.

17. Rocchi G, Caroli E, Raco A, Salvati M, Delfini R. Traumatic epidural hematoma in children. J Child Neurol 2005;20(7):569–72.
18. Rivas JJ, Lobato RD, Sarabia R, Cordobes F, Cabrera A, Gomez P. Extradural hematoma: analysis of factors influencing the courses of 161 patients. Neurosurgery 1988;23(1):44–51.
19. Lobato RD, Rivas JJ, Cordobes F, Alted E, Perez C, Sarabia R, *et al*. Acute epidural hematoma: An analysis of factors influencing the outcome of patients undergoing surgery in coma. J Neurosurg 1988;68(1):48–57.
20. Heinzelmann M, Platz A, Imhof HG. Outcome after acute extradural haematoma, influence of additional injuries and neurological complications in the ICU. Injury 1996;27(5):345–9.
21. Dubey A, Pillai SV, Kollur SVR. Does volume of extradural hematoma influence management strategy and outcome? Neurol India 2004;52(4):443–5.
22. Paterniti S, Falcone MF, Fiore P, Levita A, La Camera A. Is the size of an epidural haematoma related to outcome? Acta Neurochir (Wien) 1998;140(9):953–5.
23. van den Brink WA, Zwienenberg M, Zandee SM, van der Meer L, Maas AI, Avezaat CJ. The prognostic importance of the volume of traumatic epidural and subdural haematomas revisited. Acta Neurochir (Wien) 1999;141(5):509–14
24. Jamjoom A. The influence of concomitant intradural pathology on the hematoma and outcome of patients with acute traumatic extradural hematomas. Acta Neurochir (Wein) 1992;115(3-4):86–9.
25. Ellenbogen RG, Abdulrauf SI, Sekhar LN. Closed Head Injury. Principles of Neurological Surgery 3rd ed. chapter 20(vol 1): 2012; p.346.
26. Niaz A, Nasir MH, Niraula K, Majeed S, Neupane J, Ghimire M, *et al*. Factors affecting the surgical outcome in extradural hematoma in Punjab Institute of Neurosciences, Lahore, Pakistan. Nepal J Neurosci 2017;14(3):13–8.
27. Lee EJ, Hung YC, Wang LC, Chung KC, Chen HH. Factors influencing the functional outcome of patients with acute epidural hematomas: Analysis of 200 patients undergoing surgery. J Trauma 1998;45(5):946–52.
28. Rehman L, Karachi NJ. Association of Outcome of Traumatic Extradural Hematoma with Glasgow Coma Scale and hematoma size. Ann Pak Inst Med Sci 2010;6(3):133–8.
29. Ayogu OM, Onobun DE, Igbokwe KK, Ugwuanyi CU, Mordi CO, Ibeneme SA. Factors Affecting the Outcome of Traumatic Brain Injured Patients with Acute Epidural Haematoma in National Hospital, Abuja. J West Afr Coll Surg 2022;11(1):1–4.
30. Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartl R, Newell DW, *et al*. Surgical Management of Traumatic Brain Injury Author Group. Surgical management of acute epidural hematomas. Neurosurgery 2006;58(3):S7–15.
31. Emejulu JKC, Shokunbi MT, Malomo AO. Determinants of outcome in operative treatment of traumatic extradural haematoma. West Afr J Med 2008;27(1):32–6.
32. Ozkan U, Kemaloglu S, Ozates M, Guzel A, That M. Analyzing Extradural Haematomas: A retrospective clinical investigation. Dicle Tip Dergis 2007;34(1):14–9.
33. Cohen JE, Montero A, Israel ZH. Prognosis and clinical relevance of anisocoria-craniotomy latency for epiduralhematoma in comatose patients. J Trauma Acute Care Surg 1996;41(1):120–2.

Submitted: September 26, 2023	*Revised: ---*	*Accepted: December 2, 2023*

Address for Correspondence:

Shahbaz Ali Khan, Department of Neurosurgery, Ayub Medical College, Abbottabad-Pakistan
Cell: +92 333 5031983
Email: shahbaz@ayubmed.edu.pk