DOI: http://dx.doi.org/10.3329/jninb.v4i1.38283
http://www.banglajol.info/index.php/JNINB

Original Article

Journal of National Institute of Neurosciences Bangladesh, January 2018, Vol. 4, No. 1

ISSN (Online) 2518-6612
ISSN (Print) 2410-8030

Comparison of Surgical Outcomes with Time Interval of Operation among extradural haematoma (EDH) Patients

MM Ehsanul Haque[1], Shamima Sultana[2], Md. Saiful Alam[3], Wahida Begum[4], Syeda Asfiya Ara[5]

[1]Professor, Department of Neurosurgery, Chittagong Medical College & Hospital, Chittagong, Bangladesh; [2]Assistant Professor, Department of Ophthalmology, National Institute of Ophthalmology & Hospital, Dhaka, Bangladesh; [3]Assistant Professor, Department of Neurosurgery, Chittagong Medical College & Hospital, Bangladesh; [4]Associate Professor, Department of Neuroradiology & Imaging, Natioanl Instittue of Neurosciences & Hospital, Dhaka, Bangladesh; [5]Lecturer, Department of Pathology, Chittagong medical College, Chittagong, Bangladesh

[**Received:** 21 July 2017; **Revised:** 6 October 2017; **Accepted:** 11 December 2017; **Published:** 1 January 2018]

Abstract

Background: Post-operative outcome of extradural haematoma (EDH) patients depends on the time interval of operation. **Objectives:** The purpose of the present study was to evaluate the role of time interval and surgical intervention in EDH. **Methodology:** This interventional study was carried out in the Department of Neurosurgery at Dhaka Medical College and Hospital, Dhaka, Bangladesh from July 2001 to July 2003 for a period of two (02) years. Patients with the history of head trauma admitted in Neurosurgery unit of Dhaka Medical College and Hospital which were being diagnosed as EDH both clinically and radiologically were included as study population. All patients were treated surgically and haematoma was evacuated. Outcome regarding neurological status, functional recovery, associated morbidity and mortality were assessed in each case as per Glasgow Outcome Scale and was compared between the two groups of patients who were treated surgically within 3rd day and 4th to 7th day after infliction of injury. The study population was devided into 4 groups on the basis of the consciousness level on admission of the patients. The EDH patietns who had GCS <5, 5 to 8, 9 to 12 and 13 to 15 were categorized as group I, II, III and IV respectively. On the basis of pre operative time interval, surgical intervention was done within 3 days of injury and from 4th to 7th day of injury. Craniotomy and craniectomy were done depending on patient's condition and situation of haematoma. **Result:** A total 63 patients were included. During admission out of 63 patients majority of the patients were in the group III which was 29(46%) cases. During pre-operqative period out of 63 patients majority of the patients were in the group III which was 30(47.6%) cases. Out of 63 cases a total number of 40 cases were performed the surgery within 72 hours and the rest 23 patients were from 4th day to 7th day of injury. In group I at 8th POD, 3 death cases were recorded at 3rd day operation group and 2 cases at 4th to 7th cases. In group IV at 8th POD follow up good recovery was reported in 6 cases at 3rd day and 3 cases at 4th to 7th day. In group I after 1 month, 3 death cases were recorded at 3rd day operation group and 2 cases at 4th to 7th cases. In group IV after 1 month follow up good recovery was reported in 6 cases at 3rd day and 3 cases at 4th to 7th day; however, moderate disability was reported in 2 cases at 4th to 7th day. **Conclusion:** In conclusion mortality rate is reduced in patients with EDH who are treated in the earliest possible time after head injury. *[Journal of National Institute of Neurosciences Bangladesh, 2018;4(1): 33-39]*

Keywords: epidural haemorrhage; extradural haematoma; extradural haemorrhage; cerebral epidural haematoma

Correspondence: Prof. MM Ehsanul Haque, Department of Neurosurgery, Chittagong Medical College & Hospital, Bangladesh, Email: muntaka26@gmail.com; Cell no.: +8801714133941

Conflict of Interest: There is no conflict of interest relevant to this paper to disclose.

Funding agency: This research project was not funded by any group or any institution.

Contribution to authors: Haque MME, Sultana S, Alam MS contributed from the protocol preparation up to report writing. Begum W, Ara SA involved in the manuscript writing and Khan AM, Hossain MA, Azam B, Hasanat A revised the paper.

How to cite this article: Haque MME, Sultana S, Alam MS, Begum W, Ara SA. Comparison of Surgical Outcomes with Time Interval of Operation among extradural haematoma (EDH) Patients. J Natl Inst Neurosci Bangladesh, 2018;4(1): 33-39

Introduction

Surgical technique for intracranial extracerebral haemorrage is one of the oldest techniques to decompress the brain[1]. The low mortality and morbidity

in current years have come about through the emergency services, modern neurological techniques, improved anaesthetic technique, widespread use of the CT-scan and adequate intensive care[2]. The treatment target in the case of head injuries is to provide the optimal milieu for recovery from the primary injury and to prevent secondary damage to the brain.

In a study Jamieson and Yelland[3] reported a mortality of 29.0% in patients undergoing operation within 12 hours of injury, 4% in those having surgery 3 to 4 days after injury and zero mortality in those operated after 5 days or more following. However, Bricolo and Pasut[4] have shown that by preventing delays in admission, investigations and necessary treatment the mortality in EDH cases could be reduced to 5% only. But such a low figure is difficult to achieve in developing country like Bangladesh where the situation is completely different. There is a neurosurgical network that is not sufficient enough to give proper facilities and treatment to all head injured patients. Most of the injured brought to the hospital do not even receive first aid at accident site. The causes of improper and delayed referral and management of patients are lack of awareness, quackery, lack of proper investigational facilities, lack of responsibility and accountability of the health service provider[5]. Even severely head injured patients requiring urgent intervention (diagnostic/ intensive therapeutic/ surgical) often come late. Less severely injured patients are probably more late. Therefore often no correlation exits between the operational time interval between the injury and operation and degree. This invariably affects the outcome of the patients. Moreover many of the patients cannot avail ICU facilities and above all the awareness of initial aggressive therapy to be rendered against hypoxia and hypotension is also questionable among the health personnel.

In this context, if there could be some clinical work to determine the state of the impact of the EDH and have a prognostic guideline to save time of the surgeons, resources of the patients and their families, would be a good and meaningful work. There are several treatment options for extradurals haematoma. Conservative treatment is considered if small less than 1 cm thick and minimal neurological signs or symptoms are found[6]. Furthermore patients should be observed and rescan in a week. Urgent surgery can be performed if there is deterioration. Surgery can be done if symptomatic with headache or decreased level of consciousness and more than 1 cm thickness of haematoma is found which will be difficult to resorb. There are several surgical treatment for extradural haematoma. These are evacuate clot, haemostasis, rule out coexistant subdural and tack up the dura to prevent reaccumulation[7]. Considering these situations the present study was done to find out the postoperative status of the head injured patients with EDH where surgical intervention was done at early possible but variable intervals after reaching the patient in Neurosurgery unit of DMCH from different corners of the country.

Methodology

This interventional study was carried out in the Department of Neurosurgery at Dhaka Medical College and Hospital, Dhaka, Bangladesh from July 2001 to July 2003 for a period of two (02) years. Patients with the history of head trauma admitted in Neurosurgery unit of Dhaka medical college and Hospital which were being diagnosed as EDH both clinically and radiologically were included as study population. Head injury patient with subdural haematoma, intracerebral haematoma, EDH associated with ASDH or ICH and patients not attending in the follow-up visit were excluded form this study. The diagnosis of EDH was made by clinically and by non contrast CT-scan in all patients. The details history, age, sex and cause of injury, the effect of injury and the level of consciousness among the patients were recorded; furthermore neurological status was also recorded. All patients were treated surgically and haematoma was evacuated. Outcome regarding neurological status, functional recovery, associated morbidity and mortality were assessed in each case as per Glasgow Outcome Scale and was compared between the two groups of patients who were treated surgically within 3rd day and 4th to 7th day after infliction of injury. The study population was devided into 4 groups on the basis of the consciousness level on admission of the patients. The EDH patietns who had GCS <5 were categorized as Group I. In group II EDH patients with GCS of 5 to 8 were included. In group III GCS of 9 to 12 were included. In group IV patients with GCS of 13 to 15 were included. On the basis of pre operative time interval, they were grouped as patients in whom surgical intervention was done within 3 days of injury. Surgical intervention was done from 4th to 7th day of injury. All the operations were done by the different surgeons having almost similar skill and in same place in neurosurgery department in DMCH. Two types of decompresive surgery were done depending on patient's condition and situation of haematoma. They were craniotomy and craniectomy. Parameters evaluated post operative outcome in respect to patient's neurological status, morbidity, mortality. Preoperative time interval and its relation to out come of the patients were

evaluated. All patients were examined thoroughly on admission, prior to surgical intervention, on 8th post operative day, (during the time of discharge) and follow up after one month. For the purpose of recording, a proforma was prepared. Data were collected on predesigned data collection sheet, compiled and appropriate statistical analysis was done using computer based software SPSS program. Postoperative out come was recorded and compared between two groups of patients who underwent surgical decompression with in two studied range of time. The relationship of time interval of surgical intervention and outcome of patients was analysed using multivariate analysis (Pearson Chi-Square test) and the conclusion drawn based on the 'p' value at the 5% level of significance. A semi-complete analysis table is attached with table (Computer based SPSS program).

Results

A total 63 patients were included. In this study maximum patients were in the age group 21 to 30 years which was 26(41.3%) cases followed by 31 to 40 years which was 18(28.6%) cases. Majority of cases were in their active period of life which was in the age group of 21 to 40 years and this was 44(69.8%) cases (Table 1).

Table 1: Age Distribution In Study Group (n=63)

Age Group	Frequency	Percent
Less than 30 Years	37	58.7
More than 30 Yars	26	41.3
Total	**63**	**100.0**

During admission out of 63 patients majority of the patients were in the group III which was 29(46%) cases followed by group II, IV and I which were 15(23.8%) cases, 14(22.2%) cases and 5(7.9%) cases respectively. During pre-operqative period out of 63 patients majority of the patients were in the group III which was 30(47.6%) cases followed by group II, IV and I which were 17(26.9%) cases, 11(17.5%) cases and 5(7.9%) cases respectively (Table 2).

Table 2: Distribution of Patients In Different Groups According To GCS level

Groups	During Admission	Pre-Operative
Group I	5(7.9%)	5(7.9%)
Group II	15(23.8%)	17(26.9%)
Group III	29(46%)	30(47.6%)
Group IV	14(22.2%)	11(17.5%)
Total	**63(100.0%)**	**63(100.0%)**

Group I= GCS<5; Group II= GCS 5-8; Group III= GCS 9-12; Group IV= GCS 13-15

Preoperative time interval was recorded from infliction of injury to surgical intervention among the study group. In group I, 3 cases were underwent surgical intervention within 72 hours and 2 cases were from 4th to 7th day of infliction of injury. In group II, 12 cases were underwent surgical intervention within 72 hours and 5 cases were from 4th to 7th day of infliction of injury. In group III, 19 cases were underwent surgical intervention within 72 hours and 11 cases were from 4th to 7th day of infliction of injury. In group IV, 6 cases were underwent surgical intervention within 72 hours and 5 cases were from 4th to 7th day of infliction of injury. Thus out of 63 cases a total number of 40 cases were performed the surgery within 72 hours and the rest 23 patients were from 4th day to 7th day of injury (Table 3).

Table 3: Patients In Different Groups Under Went Surgery At Different Interval Of Time

Groups	Preoperative Time Interval From Infliction of Injury to Surgical Intervention	
	Within 72 hours	From 4th to 7th day
Group I	3	2
Group II	12	5
Group III	19	11
Group IV	6	5
Total	**40**	**23**

Study population were followed up at 8th POD. In group I at 8th POD, 3 death cases were recorded at 3rd day operation group and 2 cases at 4th to 7th cases. No case of good recovery, moderate disability, severe disability and persistant vegitative state were recorded in group I patients. In group II at 8th POD, 5 death cases were recorded at 3rd day and 4 cases at 4th to 7th cases. No case of good recovery, moderate disability and persistant vegitative state were recorded in group II patients. However, severe disability was found in 7 cases and 1 case at 3rd day and in 4th to 7th a day. In group III at 8th POD follow up, good recovery was reported in 11 cases at 3rd day and 2 cases at 4th to 7th day; however, moderate disability was reported in 8 cases and 3 cses at 3rd and at 4th to 7th day respectively. Severe disability was found in 2 cases in 4th to 7th day and 4 death cases were recorded at 4th to 7th day. In group IV at 8th POD follow up good recovery was reported in 6 cases at 3rd day and 3 cases at 4th to 7th day; however, moderate disability was reported in 2 cases at 4th to 7th day (Table 4).

Table 4: Post-Operative Outcome In Different Groups Of Patients at 8th POD

Groups	Preoperative Time Interval	Good Recovery (5)	Moderate Disability (4)	Severe Disability (3)	Persistant vegitative state (2)	Death (1)
Group I	At 3rd days	-	-	-	-	3
	In 4th to 7th day	-	-	-	-	2
Group II	At 3rd days	-	-	**7**	-	5
	In 4th to 7th day	-	-	**1**	-	4
Group III	At 3rd days	11	8	-	-	-
	In 4th to 7th day	2	3	**2**	-	4
Group IV	At 3rd days	6	-	-	-	-
	In 4th to 7th day	3	2	-	-	-
Total		**22**	**13**	**10**	-	**18**

Table 5: Outcome in different groups of patients as per GOS at 1 month after operation

Groups	Preoperative Time Interval	Good Recovery (5)	Moderate Disability (4)	Severe Disability (3)	Persistant vegitative state (2)	Death (1)
Group I	At 3rd days	-	-	-	-	3
	In 4th to 7th day	-	-	-	-	2
Group II	At 3rd days	-	-	7	-	5
	In 4th to 7th day	-	-	-	-	5
Group III	At 3rd days	13	6	-	-	-
	In 4th to 7th day	2	3	2	-	4
Group IV	At 3rd days	6	-	-	-	-
	In 4th to 7th day	3	2	-	-	-
Total		**24**	**11**	**9**	**0**	**19**

Pearson Chi-Square test done. P< 0.000 which is highly significant

Study population were followed up after 1 month of operation. In group I after 1 month, 3 death cases were recorded at 3rd day operation group and 2 cases at 4th to 7th cases. No case of good recovery, moderate disability, severe disability and persistant vegitative state were recorded in group I patients. In group II after 1 month, 5 death cases were recorded at 3rd day and 5 cases at 4th to 7th cases. No case of good recovery, moderate disability and persistant vegitative state were recorded in group II patients. However, severe disability was found in 7 cases at 3rd day operation group. In group III after 1 month follow up, good recovery was reported in 13 cases at 3rd day and 2 cases at 4th to 7th day; however, moderate disability was reported in 6 cases and 3 cses at 3rd and at 4th to 7th day respectively. Severe disability was found in 2 cases in 4th to 7th day and 4 death cases were recorded at 4th to 7th day. In group IV after 1 month follow up good recovery was reported in 6 cases at 3rd day and 3 cases at 4th to 7th day; however, moderate disability was reported in 2 cases at 4th to 7th day (Table 5).

Discussion

Acute Extradural haematomas are one of the modes of presentation of head injury. Before introduction of CT-scan, tactics of haematoma treatment was simple; when diagnosed, it was removed as early as possible[8]. CT-scan and MRI have allowed to estimate parameters of haematoma, time of its formation, location, type, as well as degree of its impact on the brain. It became possible to exercise dynamic control of evolution of intracranial pathology in general & haematomas in particular[9]. However despite improved standard of hospital care and scanning methods, management of EDH is still inadequate and potentially avoidable deaths still occurs. So this study gave us the opportunity to observe on the various aspects of acute EDH.

At the beginning of this study, patients are selected with acute extradural haematoma randomly. The selected 63 cases were divided into 4 groups according to GCS status on admission and two groups according to preoperative time interval; those who were operated within 3 days (average 24.1 hrs) and those who were

operated with in 4th to 7th day (average 5.26 days). In this study majority of the patients belonged to the decades of most active and productive period of life. Highest percentage of patients belonged to 3rd decade 26(41.3%) cases and 44(69.8%) cases of patients were in their most active period of life which was between 20 to 40 years of ages. This is because, the working people avail themselves of traffic more than others and fall victim to RTA.

The age incidence which corresponds to the findings of Servadei et al[10] who found the peak incidence at 31 years in their study. GCS of the patients were recorded on admission and was found that 5(7.9%) patients belonged to scale range less than 5; 15(23.8%) patients to scale range 5 to 8; 29(46%) patients to 9 to 12 and 14(22.2%) patients to 13 to 15. But prior to operation we found 17(26.9%) patients in GCS 5 to 8; 30(47.6%) with GCS 9 to 12 and 11(17.5%) with GCS 13 to 15. This showed that consciousness level was deteriorating in 9.5% of patients without having decompressive surgery. This finding is consistent with the findings of Borovich and Braun[11] who demonstrated progression of EDH in 9.0% of patients during the first 24 hours with deterioration of consciousness level. On the otherhand Sullivan et al[12] found 23.0% of their patients who developed enlargement of EDH causing deterioration of LOC within 36 hours. Nearly similar study was done by Bezirecioglu et al[13] and they found that eighty patients with supratentorial EDH of less than 30 mL volume, while treated conservatively, under went surgical decompression because of enlargement of EDH with deterioration in the level of consciosness.

In this respect Grin et al[14] concluded that minor traumatic EDHs less than 50 ml usually does not always required surgical evacuation and upto 30ml may be treated conservatively if level of consciousness is in between 14 to 15. However, operation should be carried out when consciousness level is 11 or less operated all EDHs cases in this study irrespective of volume because of increasing headache in some cases and gradual deterioration of consciousness level.

In this study it is not found any difference in outcome among the patients in coma and GCS less than 8 between the two groups of patients where the mean interval between the injury and operation is significantly different; however, it has been found a significant difference in outcome in patients with GCS 9 to 12 and GCS 13 to 15 depending on the time of surgical intervention. This finding coralates to the finding of the Ono et al[15] who have concluded that in patients with mass lesion, the GCS score is the only significant prognostic factor for the epidural haematoma and GCS score can predict outcome in all age groups.

Many authors have worked on EDH at different places and in different time. They have found variation of mortality from 5.0 to 43.0% in developed countries. One interesting finding is elicited by DeNoronha et al[16]. They have reported a mortality of 29.0% in patients undergoing operation with in 12 hrs of injury, 4.0% in those having surgery between 3 to 4 days after injury and zero mortality in those operated 5 days or more following. This is just reversed the findings of Bricolo and Pasut[4]. They found the over all mortality in 5.0% of cases. They stated that this low mortality was achieved because 57.0% of patients under went surgery with in 6 hrs of injury and 60.0% was operated with a GCS score between 8 to 15. None of the patients with GCS level at or above 8 who under went surgery were dead. From this point they concluded that zero mortality from EDH may be a realistic goal for a modern well run care system for head injured patients[17].

On the otherhand Ortler et al[18] have retrospectively investigated outcome of EDH after 6 months. They have shown overall mortality 13.0%. Full recovery has been found in 52.0% patients when operated after 7 hours of injury and 20.0% when operated in between 7 to 14 hours of injury. Good outcome has been achieved in 55.0% in non comatose patients. But in comatose patients on admission good recovery has been achieved in only 15.0% and death is 25.0%. From their study they have concluded for emergency burr hole trepanation which can improve the outcome[18].

In this series overall mortality has been found in 19(30.1%) cases. All these deaths occur in patients with GCS less than 8 irrespective of time of surgical intervention. However, early intervention (mean time interval 24.1 hrs) gives a significant result. Good recovery occurs in 24(38.0%) cases. Among the patients who are not comatose on admission, a good recovery occurs in 24(38.0%) cases in total. Ortler et al[18] have found the good recovery in 52.0% cases. This discrepancy may be due to delay in surgical intervention in respect to their patients where interval is only 7 hrs. In this series among 30 patients with GCS 9 to 12, 19 cases are operated in mean interval of 24.1 hours and 11 patients operated at interval of 5.26 days. However, 13(20.6%) patients have achieved good recovery and 6(9.5%) cases achieved moderate disability.

On the other hand only 2(3.1%) cases among those 11 patients with GCS 9 to 12 who are operated at interval of 5.26 days have achieved good recovery; 3(4.7%) cases have achieved moderate disability; 2 cases have severe disability and 4(6.3%) are dead. Patients with GCS score 13 to 15, when operated earlier (mean interval of 24.1 hrs) achieved good recovery in 6(9.5%) cases and in 3(4.7%) cases when operated lately (5.26 days). Moderate disability is found in 11(17.4%) cases and severe disability is in 9(14.2%) cases in total. Severely head injured patients where GCS level was at or less than 8 obviously needed ICU support. All patients from group I and group II and only two cases from group III that is total 23(38.1%) patients of these series required ICU support but only 7(11.1%) cases are treated in ICU. Due to very limited number of beds in ICU it is very difficult to manage all the critical cases. If it can be done this study might show better result in respect to morbidity and mortality.

Despite a steady decline in mortality to 2.3% over the past years, the overall mortality is found in 30.1% cases. While zero percent mortality as proposed by Ammirati et al[20] is desirable, the difficulties of standardizing emergency services and the frequency of accompanying lesions make this goal difficult to achieve till today. Heiden et al[21] reported that 68.0% of the patients classified as severe disability at one month had improved to the category of moderate disability or a good recovery at 6 months and 72.0% had achieved this status at one year.

There are some limitation of this study. Timing of outcome assessment is very important, since premature assessment of outcome may under estimate the recovery. But outcome in this study was recorded at the end of one month. Though initially we started our study with the view to evaluate patients after six months but we did not found any patients in follow-up after one month. So we were compelled to limit our study with in month. If we could have follow-up at 6 months our study result might be improved as shown by Heiden et al[21]. Mortality rate was quite high in our study. But if we could have improved ICU facilities the mortality rate might be reduced. In our study as follow-up was limited with in one month , patients in vegetative stage could not be assessed properly. Different prognostic parameters like age , haematoma size and location , associated brain injury which could influence the ultimate outcome was not studied. If it could be included, result might be more precise and reliable. The delay which occurred for initiation of appropriate treatment was partly due to late presentation of patients and partly due to inadequate organization of emergency services and centralization of neurosurgical services. If this unwanted delay could be curtailed out come might be improved.

Conclusion

In conclusion preoperative time interval was inversely related to the out come of patients ie longer the time interval worse the prognosis. The number of patients achieved good recovery were significantly more among those who were treated within 3 days (mean 24.1 hours) than those who were treated after 3 days (mean 5.26 days). On the other hand, number of patients achieved severe disability ie GOS -3 were more among those who were treated lately (mean 5.26 days). Decompression techniques (craniotomy or craniectomy) should be adjusted according to the demand of the situation and timely evacuation is mandatory to reduce mortality as well as morbidity in EDH cases.

References

1. Sahuquillo J, Arikan F. Decompressive craniectomy for the treatment of refractory high intracranial pressure in traumatic brain injury. The Cochrane database of systematic reviews. 2006(1):CD003983

2. Ghajar J. Traumatic brain injury. The Lancet. 2000 Sep 9;356(9233):923-9

3. Jamieson KG, Yelland JD. Surgically treated traumatic subdural hematomas. Journal of neurosurgery. 1972 Aug;37(2):137-49

4. Bricolo AP, Pasut LM. Extradural hematoma: toward zero mortality: A prospective study. Neurosurgery. 1984 Jan 1;14(1):8-12

5. Gelabert-González M, Iglesias-Pais M, García-Allut A, Martínez-Rumbo R. Chronic subdural haematoma: surgical treatment and outcome in 1000 cases. Clinical neurology and neurosurgery. 2005 Apr 1;107(3):223-9

6. Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartl R, Newell DW, Servadei F, Walters BC, Wilberger JE. Surgical management of acute subdural hematomas. Neurosurgery. 2006 Mar 1;58(suppl_3):S2-16.

7. Warden DL, Gordon B, McAllister TW, Silver JM, Barth JT, Bruns J, Drake A, Gentry T, Jagoda A, Katz DI, Kraus J. Guidelines for the pharmacologic treatment of neurobehavioral sequelae of traumatic brain injury. Journal of neurotrauma. 2006 Oct 1;23(10):1468-501

8. Asghar M, Adhiyaman V, Greenway MW, Bhowmick BK, Bates A. Chronic subdural haematoma in the elderly—a North Wales experience. Journal of the royal society of medicine. 2002 Jun;95(6):290-2.

9. Orrison W.W, Gentry L.R, Stimac G.K, et al. Blinded comparison of cranial CT & MRI in closed head injury evaluation. Am. J. Neuroradiol 1994 . vol ,15 N2; 351-356

10. Servadei F, Vergoni G, Staffa G, Zappi D, Nasi MT, Donati R, Arista A. Extradural haematomas: how many deaths can be avoided? Protocol for early detection of haematoma in minor head injuries : Acta Neurochir (Wien) 1995;133(1-2):50-5

11. Borovich K, Braun J, Gilburd JN et all. Delayed onset of extradural hematomas. J Neuro surg 1985; 63;30-34

12. Sullivan T.P, Jarvik J.G, Cohen W.A: Follow-up of conservatively managed epidural hematomas: implications for timing of repeat CT. Am J Neuroradiol 1999 Jan;20(1):107-13
13. Bezircioglu H, Ersahin Y, Demircivi F, Yurf I, Donertas k, Tektas S: Non operative treatment of acute extradural haematomas: analysis of 80 cases. J. Trauma 1996, Vol 41, N.4 696-698
14. Grin A.A. Ioffe Yu.S., Krylov V.V. : Minor traumatic intracranial dural hematomas (up to 50 cm3) of suptratentorial localization: In the book: Selected problems of Neurology and Neurosurgery. Stupino. 1997. 39-40
15. Ono J, Yamaura A, Horie T, Makino H, Nakamura T, Isobe K, Shinohara Y, Watanabe Y, Ariga N: CT scan in severe head injury with special reference to Glasgow coma scale. [Article in Japanese]: No Shinkei Geka 1983 Apr;11(4):379-87
16. DeNoronha RJ, Sharrack B, Hadjivassiliou M, Romanowski CA. Subdural haematoma: a potentially serious consequence of spontaneous intracranial hypotension. Journal of Neurology, Neurosurgery & Psychiatry. 2003 Jun 1;74(6):752-5
17. Ahmed R, Hossain MA. Craniocerebral Trauma; Epidemiology and Aetiology. Bangladesh Journal of neuroscience 1989, 5: 66-75
18. Ortler M , Lang Mayr JJ, Stockinger A, Golser K, Russegger L, Resch H. Post operative outcome of traumatic bain injury. Surg Neurol 1997;48(2):193-196
19. Daniel D.P, Sharon R.W. 2001: Epidural Haematoma: Instant Access to the mind of medicine ; Feb, 2001.41-42
20. Ammirati M, Tomita T. Epidural hematomas in infancy and childhood. J Pediatric Neuroscience 1985;(1):123-238
21. Heiden JS , Small R , Calon W et al. Severe head injury, Cliniacl assessment and outcome. Phys Ther 1992;63:1951-64