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Original Research Article

Management and Factors Predicting Outcome of Traumatic Epidural Hematoma in Pediatric Population in North East India

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Abstract

Introduction: childhood morbidity and mortality is highly attributed by Traumatic Brain Injury (TBI). Near about 3% of all head trauma. Haemorrhage due to physical trauma commonly occurs in the epidural space which results from the active bleeding from the epidural venous plexus. The fracture of the temporal bone also damages the Middle Meningeal Artery (MMA) located just underneath the temporal bone. It has been shown that posterior fossa is less frequent as compared to supratentorial hematoma. Often the clinical symptoms are of slow onset and develop silently but they can become fatal if not treated in time. The prognosis of the patients of an epidural hematoma should be analyzed by considering the factors like age, sex, Glasglow Coma Scale (GCS) mainly. A CT scan results in an epidural hematoma is characterized by a uniform hyperdense lesion that is biconvex shaped.

Materials and Methods: This is a retrospective study conducted in Gauhati Medical College and Hospital, Guwahati, India. The study sample is taken from the mentioned hospital and includes pediatric age groups ranging from 0-12 years old. The pediatric population from 0-12 years old between May 2017 and May 2021 is considered. The raw data is collected from the above-mentioned hospital and then each patient is systematically studied during the admission and outcome after management. The patient's analysis is made by considering clinical characteristics, radiological evaluation, employing Glasglow Coma Scale (GCS), Glasgow Outcome Scale (GOS) and Modified Rankin Scale (mRS) which is determined at the time of discharge. The primary objective of the study was to analyse and compare the management of Epidural Hematoma and its respective outcome. The parameters that were considered in this study for comparison are Mechanism of Injury, the characteristics of the trauma for each patient, severity and the outcome of the management.

Results: the study also considered the Glasglow Coma Scale (GCS) measured at the time of admission of these patients. The study found that 30 patients had GCS between 14 and 15, 11 patients were found to be between 9 and 13 and 4 patients were found to have GCS between 3 and 8. There was no seizure reported during the immediate or follow-up treatment period. Out of 22 patients who received Conservative treatment, 15 patients showed good recovery during the discharge from the hospital followed by 5 patients and 2 patients who showed moderate disability and severe disability respectively. In total, 21 patients (46.6%) showed Good Recovery at the time of hospital discharge. During the follow-up, the number of patients who showed Good Recovery went up from 21 to 29 (46.6% to 64.44%) followed by moderate

disability (12 patients; 26.66%) and severe disability (3 patients; 6.66%). The most common location of hematoma in this study was found to be in Parietal region (n = 12; 26.66%) and Frontal region (n = 12; 26.66%). The number of patients with mRS "0" increased from the time of discharge to the time of follow-up, increasing from 55.55% to 73.33%. The improvement is quite significantly observed among the patients who have undergone Conservative management as compared to Surgical Management.

Conclusion: our findings has strongly concluded that the location of hematoma, volume of hematoma and GCS at the time of admission has significant influence on the prognosis of the Epidural Hematoma. This study has also concluded that only poor clinical statuses like lower GCS, higher Injury Severity should be managed in surgery. Otherwise, higher GCS and lower Injury Severity can be easily managed by Conservative treatment.

Keywords: GCS, mRS, GOS

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Introduction

Childhood morbidity and mortality is highly attributed by Traumatic Brain Injury (TBI). Near about 3% of all head trauma. Haemorrhage due to physical trauma commonly occurs in the epidural space which results from the active bleeding from the epidural venous plexus. In an epidural hematoma, bleeding occurs in the sinal neuraxis leading to neuraxial block [1]. The classical presentation of Epidural hematoma occurs after a blow to the temporal aspect of the skull resulting in the fracture of the temporal bone. The fracture of the temporal bone also damages the Middle Meningeal Artery (MMA) located just underneath the temporal bone. Generally, there is a brief episode of loss of consciousness post-traumatic event followed by a conscious episode. The period of this consciousness till the onset of coma is referred to as "lucid interval" [2]. One of the leading aetiology of mortality in children is Traumatic Brain Injury (TBI). Several studies have shown that the older pediatric population experience severe TBI as compared to younger. It has been reported that 7% of mortality is attributable to TBI in older children while 9-25% of mortality is attributable to severe pediatric TBI. Although the mortality rate varies according to the age groups, recent studies have confirmed that children less than 2 years is one of the good predictors of severe traumatic patients [3].

Studies have shown that posterior fossa is less frequent as compared to supratentorial hematoma. Often the clinical symptoms are of slow onset and develop silently but they can become fatal if not treated in time. With the introduction of Computerized Tomography (CT) scan, the diagnosis of hematomas has become easier, thus, providing earlier management leading to the increased good prognosis of traumatic brain injury among the pediatric patients [4-7]. As of now, a CT scan is routinely conducted in any case of head injury. At the time of admission, the assessment of the patients with traumatic brain injury is done by employing Glasglow Coma Scale (GCS) [8]. The prognosis of the patients of an epidural hematoma should be analyzed by considering the factors like age, sex, Glasglow Coma Scale (GCS), the size of hematoma during admission. However, the fracture of skull bone along with damage to the Middle Meningeal Artery (MMA), meningeal vein or major sinus, within 6

hours of trauma may contribute to the bad prognosis [9].

Further diagnostic tests should be carried out to determine the prognosis of the head injury. This may include an X-Ray for assessing the skull bone fracture and Magnetic Resonance Imaging (MRI) for determination of any change in brain tissue [10]. However, it has been well documented those primary injuries are often not a considerable factor to assess the degeneration later. Instead, secondary injuries due to a chain of biochemical reactions generally contribute to swelling, insufficient oxygenation to the brain tissue and inadequate blood supply may occur from the compression attributed to the increasing size of the hematoma [11]. An epidural hematoma, injury or blow to the skull results in the collection of blood between the skull and dura. Although, the epidural hematoma is found to be a little less occurring post head injury. In many cases, the late onset of hematoma has been found, however, epidural hematoma has been reported both at the time of admission and during hospital stay (delayed formation). 75% of epidural hematoma in children have been found associated with a skull fracture. The hematoma occurs as a result of dural arteries and sometimes venous sinuses. A CT scan results in an epidural hematoma is characterized by a uniform hyperdense lesion that is biconvex shaped. The outcome of the patients may vary according to the time of surgery and the neurological status during the surgery [12]. In India, one of the most important public health problems is Traumatic Brain Injury. Among all the TBIs, Road Traffic Accident (RTA) accounts for 60%, falling down accounts for 25% and 10% cases occur due to assault. The mortality in India due to Epidural Hemorrhage ranges from 5% to 50% [13-15].

Materials and Methods

1. Data Collection and Study Design

This is a retrospective study conducted in Gauhati Medical College and Hospital, Guwahati, India. The study sample is taken from the mentioned hospital and includes pediatric age groups ranging from 0-12 years old. The pediatric population from 0-12 years old between May 2017 and May 2021 is considered. The raw data is collected from the above-mentioned hospital and then each patient is systematically studied during the admission and outcome after management.

As the study is retrospective, 61 patients were primarily inspected. Based on inclusion and exclusion criteria, 45 patients were selected for the study finally.

Inclusion Criteria

Ø Hemorrhage volume is more than 10 ml

Ø The age of the patient < 12 years

Ø The treatment is given in this institution

Exclusion Criteria

Ø The treatment is given outside the mentioned institution

Ø The patients who were brought dead

Ø The patients who were referred or got referred in his own will.

2. Patient’s analysis

The patient’s analysis is made by considering clinical characteristics, radiological evaluation, employing Glasglow Coma Scale (GCS), Glasgow Outcome Scale (GOS) and Modified Rankin Scale (mRS). GCS scoring was determined during the time of admission. The clinical features of each patient are noted down and the frequency of each clinical feature is listed. The pupil examination of each patient is also considered as bilateral NSRL (No Significant Risk Level), unilateral Fixed Pupil and bilateral Fixed Pupil. CT scan of each patient was analysed and the intracranial lesions were determined including contusion, subarachnoid haemorrhage, sub-occipital haemorrhage,

skull fracture and its nature. The location of Epidural Hematoma (EDH) was considered for each of the patients. The management procedure was classified, and the type of management is marked against each patient and further details have been elaborated in section 2.3. Modified Rankin Scale (mRS) was determined at the time of discharge.

3. Management Procedures

The management procedures applied to the patients can broadly be divided into 2 groups, namely, conservative management and surgical management. The surgical management was given to the patients only if they fulfill the criteria of surgical treatment mentioned below. The surgery was performed based on GCS including group of patients who had surgery within 4 hours from the time of admission (Early Surgery group) and those patients who had surgery 12 hours after admission (Delayed Surgery group). The patients underwent craniotomy or craniectomy followed by evacuation of the hematoma. 10 patients were immediately operated while 13 were such who were under observation followed by surgery.

The criteria for surgical treatment that are followed in this institution are the volume of the haemorrhage is more than 30 ml (CT finding), the thickness of EDH is more than 15 mm (CT finding), the midline shift is more than 0.5 mm with conscious deterioration and decreased GCS score ≧ 2 points.

4. Data analysis

The primary objective of the study was to analyse and compare the management of Epidural Hematoma and its respective outcome. Patients were assigned to surgery according to the criteria, otherwise, they were assigned to the conservative management group. The various parameters between the groups (namely, Conservative group, Early Surgery group and Delayed Surgery group) were compared. The parameters that were considered in this study for comparison are Mechanism of Injury, the characteristics of the trauma for each patient, severity and the outcome of the management.

Results

The study is based on Gauhati Medical College and Hospital, Guwahati, India. The demographic characteristics are given in detail in Table 1. The study has classified the patients into 3 categories, namely, patients receiving Conservative Management, Delayed Surgery and Early Surgery. In total, the study considered 45 pediatric patients ranging from 0 years to 12 years old. Out of 45 patients, 29 patients are male while 16 are female. The ratio of males to females is 1.81. The median age of the patients receiving conservative management, Delayed Surgery and Early Surgery are 4.5, 5 and 6 years respectively. The mechanism by which the patient's experienced injury is domestic fall less than 1-meter, domestic fall more than 1 meter, sports injury, assault and Road Traffic Accident (RTA). The characteristics of the patients in this institution had shown that the highest number of patients had domestic fall less than 1 meter and sports injury followed by domestic fall more than 1 meter and road traffic accident which is followed by assault. The patients who were given conservative management mostly had domestic falls. The patients who had sports injuries and road traffic accidents were given mostly delayed surgery and early surgery was the treatment of choice mostly for a road traffic accident, assault and few cases of sports injury. The details of demographic characteristics and mechanism of injury are summarized in Table 1.

Table 1: Demographic characteristics and the mechanism of injury

Parameter	Conservative Management	Delayed Surgery	Early Surgery	Total
Total, n (%)	22 (48.88%)	13 (28.88%)	10 (22.22%)	45
Age (Median, IQR)	4.5 (0-11)	5 (1-11)	6 (1-9)	4 (0-12)
Gender (male 64.44%)	15 (33.33%)	8 (17.77%)	6 (13.33%)	29 (100%)
Gender (female 35.5%)	7 (15.55%)	5 (11.11%)	4 (8.88%)	16 (100%)
Mechanism of Injury				
Domestic fall (≦ 1 m)	9	2	0	11 (24.44%)
Domestic fall (≧1 m)	7	3	0	10 (22.22%)
Sports Injury	3	5	3	11 (24.44%)
Assault	1	0	2	3 (6.66%)
Road Traffic Accident	2	3	5	10 (22.22%)

The study considered several symptoms indicating Traumatic Brain Injury (TBI) including swellings at external sites, nausea, vomiting, unconsciousness, neurological status (Normal, somnolent and comatose), pupillary reactions and Injury Severity Score. The study also considered the Glasglow Coma Scale (GCS) measured at the time of admission of these patients. The study found that 30 patients had GCS between 14 and 15, 11 patients were found to be between 9 and 13 and 4 patients were found to have GCS between 3 and 8. There was no seizure reported during the immediate or follow-up treatment period. For CT scoring, we used the Rotterdam CT score to determine the severity. The study found that the Rotterdam CT score was mostly 1 or 2 in these patients. The detailed findings are summarised in Table 2.

Table 2: Clinical and Radiological (CT scan) features among the patients

Parameter	Conservative Management	Delayed Surgery	Early Surgery	Total
Total, n (%)	22 (48.88%)	13 (28.88%)	10 (22.22%)	45
Symptoms indicating TBI				
External swelling	13 (28.88%)	9 (20 %)	5 (11.11%)	27 (60%)
Nausea	10 (22.22%)	5 (11.11%)	3 (6.66%)	18 (40%)
Vomiting	9 (20%)	6 (13.33%)	5 (11.11%)	20 (44.44%)
Unconsciousness	2	10	12	24 (53.33%)
Neurological Status				
Normal	18	2	0	20 (44.44%)
Somnolent	4	7	5	16 (35.5%)
Comatose	1	4	5	10 (22.22%)
Pupils reactivitiy				
Both the eyes	22	10	4	36 (80%)
One eye	0	2	4	6 (13.33%)
None of the eye	0	1	2	3 (6.67%)
Injury Severity Score	11.5	24	28	21 (46.66%)
GCS at admission				

14-15	18	7	5	30 (66.67%)
9-13	4	4	3	11 (24.44%)
3-8	0	2	2	4 (8.88%)
Rotterdam CT score				
1	16	3	4	23
2	3	1	3	10
3	2	4	2	8
4	1	2	1	4
5	0	1	0	1
6	0	1	0	1

Table 3 presents the detailed outcomes of the treatment given to the patients in each category. The outcomes of the patients are determined by The Glasgow Outcome Scale (GOS), measured once at the time of hospital discharge and at the time of follow up after 6 months. Out of 22 patients who received Conservative treatment, 15 patients showed good recovery during the discharge from the hospital followed by 5 patients and 2 patients who showed moderate disability and severe disability respectively. At the time of discharge, Good Recovery is 4 and 2 respectively in the case of the Delayed Surgery group and Early Surgery group. In total, 21 patients (46.6%) showed Good Recovery at the time of hospital discharge. During the follow-up, the number of patients who showed Good Recovery went up from 21 to 29 (46.6% to 64.44%) followed by moderate disability (12 patients; 26.66%) and severe disability (3 patients; 6.66%). At the time of follow up, 1 death is also registered who was given Early Surgery. There was no report of death registered within 24 hours of surgery.

Table 3: The outcome of the treatment in terms of Glasglow Outcome Scale (GOS)

Parameter	**Conservative Management**	**Delayed Surgery**	**Early Surgery**	**Total**
Total, n	22	13	10	45
GOS - hospital discharge				
Good Recovery	15	4	2	21 (46.6%)
Disability (moderate)	5	5	4	14 (31.11%)
disability (severe)	2	3	3	8 (17.77%)
vegetative	0	1	1	2 (4.44%)
death	0	0	0	0
GOS - follow up				
Good Recovery	18	6	5	29 (64.44%)
disability (moderate)	4	6	2	12 (26.66%)
disability (severe)	0	1	2	3 (6.66%)
vegetative	0	0		0 (0%)
death	0	0	1	1 (2.22%)
Death within 24 hours	0	0	0	0 (0%)

The study found the location and volume of hematoma and compared that with the duration of hospital stays. This finding can put an efficient conclusion of factors that can influence the prognosis of Epidural Hematoma. The most common location of hematoma in this study was found to be in Parietal region (n = 12; 26.66%) and Frontal region (n = 12; 26.66%). This is followed by Temporo-parietal (n = 6;

13.33%) and Temporal region (n = 6; 13.33%). The volume of hematoma was highest (> 50 ml) was in the Frontal region (11.11%) followed by the Parietal and Temporal region (6.66%). The duration of hospital stay was highest in the cases for Frontal hematoma (6 cases staying more than 7 days) whereas 4 Parietal hematoma cases stayed in the hospital for more than 7 days. In this study, 29 cases (64.44%) were found to have 30-50 ml of hematoma while 16 cases (35.55%) were found to have more than 50 ml of hematoma. The location of hematoma and duration of hospital stays is correlated in the chart (Figure 1) below and the whole summary of the location of hematoma, a corresponding volume of the hematoma and duration of hospital stays are summarized below (Table 4). The source of hematoma was mainly arterial blood in 32 patients (71.11%) while in 4 patients (8.88%), the hematoma was contributed by venous sinuses in the dura. In 9 patients, as the bleeding was stopped before 24 hours, it cannot be identified.

Table 4: Location of the hematoma correlating with volume of the hematoma, duration of hospital stays

Location of hematoma	Volume of hematoma (ml) and corresponding duration of Hospital Stays (days) in each category					
	30-50	Duration of Hospital Stay		More than 50	Duration of Hospital Stay	
		< 7 days	> 7 days		< 7 days	> 7 days
Parietal	9	8	1	3	0	3
Frontal	7	5	2	5	1	4
Temporo-parietal	4	3	1	2	0	2
Temporal	3	3	0	3	0	3
Bifrontal	3	2	1	2	0	2
Fronto-temporal	2	1	1	1	0	1
Posterior fossa	1	1	0	0	0	0
Age (in years) < 6 years 7 to 12 years	 14 8			 13 10		

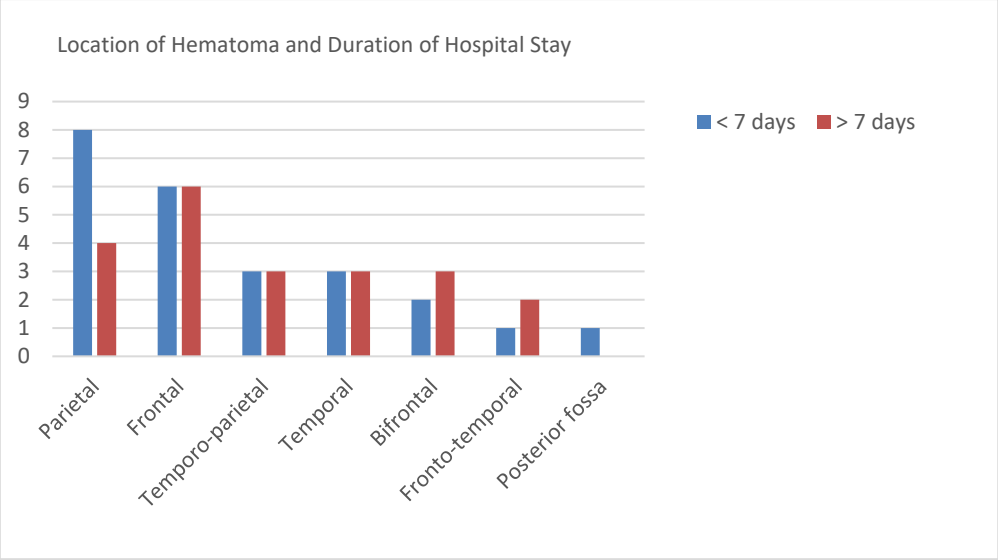

Figure 1: Chart showing location of hematoma and its respective duration of hospital stays

Table 5 shows the Modified Rankin Scale (mRS) of the patients at the time of discharge and at the time of follow-up after 6 months. The number of patients with *mRS* "0" increased from the time of discharge to the time of follow-up, increasing from 55.55% to 73.33%. The improvement is quite significantly observed among the patients who have undergone Conservative management as compared to Surgical Management. And from the criteria of the treatments in this institution, we know Conservative Management was given to the patients who fulfilled the criteria for surgery and consequently higher GCS. Modified Rankin Scale shows the outcome of the patients based on the treatments given to them.

Table 5: The result of Modified Rankin Scale among the patients at the time of discharge and after 6 months

Parameter	**Conservative Management**	**Delayed Surgery**	**Early Surgery**	**Total** (%)
Total, n	22	13	10	45 (100)
mRS at discharge				
0	15	8	2	25 (55.55)
1-2	14	3	1	18 (40%)
3-5	0	1	6	7 (15.55)
mRS at follow up (6 months)				
0	21	11	2	33 (73.33)
1-2	8	1	1	10 (22.22)
3-5	0	0	6	6 (13.33)

Discussion

This study collected and analyzed the important factors and treatments provided to patients of traumatic epidural hematoma and correlated with their outcomes after the treatment. The patients with poor Rotterdam CT scores, higher scores for Injury Severity and the presence of neurological deficits, were given operative treatment mostly. And the patients who showed lesser scores for Injury Severity and absence of neurological deficits were given conservative management. The patients who received operative management and the patients who received conservative management have shown comparable outcomes. Over the years, Conservative Management has gained popularity in asymptomatic Epidural Hematoma cases and increased above 60% [16]. The scoring of CT scan is considered as a significant prognostic factor as considered by most of the studies [17]. Studies confirmed that post-traumatic epidural hematoma with an approximate volume of 30 ml can be efficiently managed by conservative treatments [18]. It has been suggested that a large volume of epidural hematoma which is more than 30 cm3 should be manageable by conservative treatment in higher GCS [19]. This study shows the mRS results of the patients who had Conservative Management is improved as compared to Surgery group of patients. This shows, higher GCS at the time of admission is more likely to results in good prognosis.

Another study confirms that conservative management for epidural hematoma should be applied in small-sized hematomas and

those with higher GCS or unchanged neurological status. Although spontaneous resolution is observed in many mild cases, however, conservative management in unchanged neurological status had shown good outcomes in terms of higher Glasglow Outcome Score (GOS) [20].

Conclusion

Our findings have strongly concluded that the location of hematoma, volume of hematoma and GCS at the time of admission has significant influence on the prognosis of the Epidural Hematoma. The study has correlated the status of patients including their Glasglow Coma Scale at the time of their admission, their neurological status and the type of management given (conservative, early surgery or delayed surgery) with the outcome of the patients in terms of Glasglow Outcome Scale (GOS). This study has also concluded that only poor clinical statuses like lower GCS, higher Injury Severity should be managed in surgery. Otherwise, higher GCS and lower Injury Severity can be easily managed by Conservative treatment. A similar outcome can be achieved in both the cases mentioned above. However, the study recommends formulating guidelines in the future for the efficient management of pediatric Epidural Hematoma.

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