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ORIGINAL RESEARCH

Paediatric Traumatic Extradural Hematoma: Clinico-Radiological Profile and Outcomes from a Single Centre

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ABSTRACT

Background: Paediatric traumatic extradural hematoma (EDH) is a neurosurgical emergency requiring timely diagnosis and intervention. This study evaluates the clinico-radiological profile and outcomes of paediatric EDH cases from a single centre.**Methods:**A retrospective study was conducted on 32 paediatric patients with EDH. Data on demographics, mode of injury, clinical features, radiological findings, management, and outcomes were analysed. Glasgow Coma Scale (GCS) was used to assess prognosis.**Results:**Falls, including from heights, bicycles, and stairs, were the leading cause (78%), with males (84%) and the 11–18 years age group (66%) most affected. Vomiting (66%) and loss of consciousness (47%) were common symptoms. CT revealed fractures in 53% of cases, with the frontal and parietal regions being the most frequent EDH sites. While frontal and parietal EDHs had better outcomes, combined EDHs showed higher risks of moderate and poor outcomes. Conservative management was the primary approach (75%), while 22% required surgery. ICU admission (3%) was linked to the worst prognosis. Larger hematoma volumes (>40 mL) correlated with poorer outcomes.**Conclusion:**Paediatric EDH predominantly results from falls, with older children and males most affected. Early clinical and radiological evaluation is crucial for management. Conservative treatment is effective in most cases, whereas surgical intervention is needed for severe cases. Hematoma volume and location significantly influence prognosis.

Keywords: Paediatric extradural hematoma, traumatic brain injury, Glasgow Coma Scale, clinico-radiological profile, neurosurgical management, head trauma, hematoma volume, paediatric head injury.

INTRODUCTION

Extradural hematoma (EDH) is a significant cause of morbidity in paediatric trauma, characterized by the accumulation of blood between the dura mater and the skull, most commonly caused from the rupture of the middle meningeal artery post-head trauma.[1-3], Due to the distinct anatomical and physiological features of the paediatric skull, such as its increased elasticity and open sutures, EDH commonly results from blunt head injuries and poses unique challenges in children, which can influence the presentation and management.[4,5]

Using computed tomography (CT), several markers associated with hematoma expansion in intracerebral haemorrhage (ICH) patients have been identified. CT also plays a crucial role in the rapid diagnosis of epidural hematoma (EDH), offering detailed information about its size, location, and related cranial fractures.[6]

Clinical features such as loss of consciousness, vomiting, seizures, and other neurological symptoms further guide the evaluation and management of these cases. The extent of the hematoma, the type of injury,

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and management time are some of the variables that affect the outcome of EDH.[7]

The clinico-radiological features and results of paediatric EDH cases treated at a single tertiary institution are examined in this study. This study intends to provide significant information into the management of paediatric EDH in clinical settings by examining changes in clinical presentation, imaging findings, and outcomes.

MATERIALS AND METHOD

This was a a retrospective observational study carried out at a tertiary care facility in Kanchipuram, Tamilnadu, Over the course of 1 year. In this study total 32 paediatric patients (ages 0–18 years) who had been diagnosed with extradural hematoma (EDH) based on CT and clinical symptoms were recruited. Patients with inadequate data or serious comorbidities were not included.

Data were collected includes demographics (age, gender), the mechanism of injury, clinical characteristics (e.g., vomiting, loss of consciousness), CT results (e.g., location and amount of hematoma), management strategies, and results were taken from the hospital's medical records.

Clinical and Radiological Assessment: Seizures, headaches, vomiting, and loss of consciousness were among the clinical characteristics that were noted. EDH volume was recorded in millilitres, and patients were evaluated using non-contrast CT imaging, neurological deficit assessment, and the Glasgow Coma Scale (GCS) or the Paediatric Glasgow Coma Scale, depending on age. The location, volume, and related fractures of EDH were examined in CT scans. At two weeks, and then at 1, 2, and 6 months, follow-up assessments were carried out. Patients received a thorough neurological examination and a GCS evaluation at every follow-up visit.

Outcome measures were determined using the Glasgow Outcome Score (GOS), with assessments performed at the 2-week, 1-month, 2-month, and 6-month follow-up intervals.

Management: ICU management, surgery (burr hole or craniotomy), and conservative management were the methods used for treatment. The size of the hematoma, the clinical state, and the neurological status were taken into consideration when choosing a treatment.

Statistical Analysis: The data were presented using descriptive statistics. For categorical variables including clinical features, mode of injury, and demographic traits, frequencies and percentages were computed. Tables showing the distribution of results according to clinical characteristics, CT results, and management techniques were displayed. MS Excel was used to analyse all of the data, and the results were shown in the proper tables and figures.

OBSERVATION AND RESULTS

Demographics and Mode of Injury

In this study 32 paediatric patients with EDH, falls—including falls from heights, bicycles, and stairs—were the most common cause of injury, accounting for 78% of the cases. Male patients, who made up 84% of the total, were noticeably more impacted. With 66% of the cases occurring in the 11–18 years, this age group was the most impacted, indicating a higher occurrence in older children than in younger ones. [**Table 1]**

Table 1: Demographics and Mode of Injury

Mode of Injury	Female	Male	0-5 years	6-10 years	11-18 years	Total
Assault	0	2	0	0	2	2
Bike Vs Bike	0	4	0	0	4	4
Fall From Bicycle	0	1	0	1	0	1
Fall From Bike	1	12	0	0	13	13
Fall From Height	3	5	4	3	1	8
Fall From Stairs	1	2	1	1	1	3
Pedestrian Vs Bike	0	1	0	1	0	1
Total	5	27	5	6	21	32

ClinicalFeatures and Outcomes

Loss of consciousness [LOC] (47%) and vomiting (66%) were the most prevalent clinical symptoms among the 32 paediatric patients. With only 9% of subjects experiencing seizures, they were less common. Most patients with clinical symptoms, such as vomiting and LOC, notably had positive results (GCS >12). Only a tiny percentage had bad outcomes (GCS <8), and LOC and vomiting were less likely to be associated with poor outcomes. Even if they were uncommon, seizures did not correspond with serious consequences. [**Table 2]**

Table 2: ClinicalFeatures and Outcomes

Clinical Feature	Frequency	Poor Outcome (GCS<8)	Moderate Outcome (GCS= 9-12)	Good Outcome (GCS >12)
Loss of Consciousness (LOC)	15 (47%)	1	4	10
Vomiting	21 (66%)	1	5	15

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ENT Bleeding	4 (12.5%)	1	1	2
Headache	9 (28.1%)	0	0	9
Seizure	3 (9%)	0	0	3

CT Findings and Outcomes

53% of the patients in the 32 cases had fractures, and most of them had EDHs in the frontal and parietal areas. In 38% of the cases, combined EDH was seen. While combined EDHs demonstrated a higher incidence of moderate and poor outcomes, frontal and parietal EDHs were associated to consistently positive outcomes. Despite being less frequent, temporal EDHs typically produced positive results, showing the significance of fracture location and EDH type in predicting recovery. [**Table 3]**

Table 3: CT Findings and Outcomes

CT Finding	Frequency	Poor Outcome (GCS<8)	Moderate Outcome (GCS= 9-12)	Good Outcome (GCS >12)
Fracture Present	17	1	2	14
EDH Location - Frontal	7	0	0	7
EDH Location - Parietal	7	0	0	7
EDH Location - Temporal	6	0	1	5
Combined EDH	12	1	5	6

Management and Outcomes

22% of patients had surgery, whereas the majority (75%) received conservative care. The mean GCS score for both conservative and surgical therapy was 5, indicating comparable results. However, with a far lower mean GCS score of 1, patients who needed intensive care unit (ICU) treatment (3%) had the worse results. [**Table 4]**

Table 4: Management and Outcomes

Management	Count	Mean Outcome
Conservative	24	5
Surgery	7	5
ICU Management	1	1

EDH Volume and Outcomes

Of the patients in the study, 34.4% had EDH values between 21 and 40 mL, and 62.5% had volumes between 0 and 20 mL. With a mean GCS score of 5, the results for both groups were comparable. However, as was the case in one instance with a volume of 41–60 mL and a mean GCS score of 1, a bigger EDH volume (>40 mL) was linked to a noticeably worse outcome. Better results were often associated with smaller quantities. **[Fig.1]**

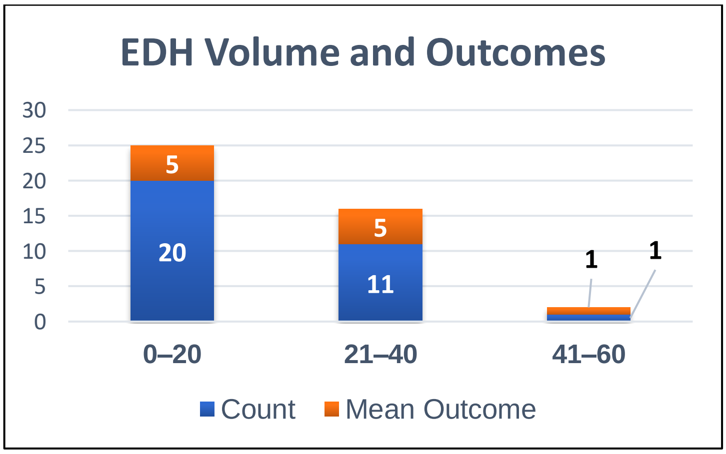

Figure 1: EDH Volume and Outcomes

DISCUSSION

The clinical characteristics, radiological findings, therapy, and outcomes of paediatric patients with extradural hematomas (EDH) were the focus of this investigation, which was carried out at a single tertiary care facility. Most of the patients in the study were male, and children between the ages of 11 and 18 had a higher prevalence. In line with previous research, this demographic trend shows that older children are more likely to be involved in traffic accidents, which are the main cause of EDH in this age range.[8] The most common symptoms were

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vomiting and unconsciousness, according to main clinical observations. These findings highlight the importance of recognizing non-specific symptoms, as they often serve as early indicators of intracranial pathology.[9]
Radiologically, the frontal and parietal regions were the most common sites of hematoma. They are often associated with underlying skull fractures, and act as a conduit for arterial or venous disruption thereby EDH formation. Therefore neuroimaging (particularly CT scan) not only serves in giving a timely accurate diagnosis but also guides to plan the surgery to achieve favourable outcomes.[10,11]
The mechanisms of injury and demographic findings of our study are consistent with earlier studies on paediatric extradural hematomas (EDH). The male preponderance (65%) is like that of **Gajbhare SV et al. (2023),** who discovered 55.32% male cases, and **Sobti S. et al. (2022),** who reported a male-to-female ratio of 21:17. This is presumably because men tend to take greater risks which lead to injuries. [12,13]
According to **Sobti S. et al. (2022) and Gajbhare SV et al. (2023),** where more than 55% of cases were in this age range, our group's peak age group of 1–5 years is consistent with their findings. [12,13] Anatomical characteristics such as larger heads and weaker neck muscles make younger children more susceptible to falls. [14]
According to the findings of **Sobti S. et al. (2022) and Gajbhare SV et al. (2023)**, most patients in our study had symptoms including headache (47.37%) and vomiting (52.63%), which is consistent with previous studies on the clinical presentation of paediatric EDH. [12,13,15,16]. Neurological deficiencies such as focal neurological signs (26.32%) and altered consciousness (36.84%) were also common, which is consistent with findings from **Kumar B et al. (2023)** showing that 35% of children had focal neurological symptoms.[17] In accord with the 19% seizure rate reported by **Gajbhare SV et al. (2023),** seizures were reported in 21.05% of cases.[12]
Only 15.79% of our cases had a lucid interval, which is consistent with findings by **Sobti S. et al. (2022) and Gajbhare SV et al. (2023),** who also noted similar findings. [12, 13]
Studies emphasized the usefulness of NCCT as the imaging modality of choice for identifying EDH, the radiological presentation of paediatric extradural hematoma (EDH) mostly involved CT scans. EDH in children is confirmed by Non-contrast CT scans, which usually show the distinctive hyperdense biconvex lens-shaped lesion. [18,19]. This is consistent with the pattern outlined by **Al-Hajj S (2021),** who highlighted the diagnostic precision of CT in determining the position and amount of the hematoma, even in situations including mild neurological impairments.[20]
Akdağ R (2021) has pointed out that MRI is more sensitive when it comes to identifying tiny lesions or when CT results are unclear, MRI may show further information in paediatric EDH patients, such as brain contusions or surrounding oedema, which were less noticeable in our study.[21]
The findings of **Kumar B et al. (2023),** who discovered that these regions were mainly involved in paediatric EDH, are comparable with the location of EDH in our group, which is primarily parieto-occipital as shown in 45% of patients.[22] A higher incidence of frontal EDH was identified in other investigations, such as those by **Chakradhar R et al. (2024),** which may be due to variations in patterns of injury.[23]
Furthermore, the results of **Sharma M (2022)** shows that larger EDHs were frequently linked to worse outcomes—especially when there was a major midline shift or compression of nearby brain structures, correspond with the severity of the hematoma seen in our study.[24]

Outcome Analysis
Most patients in our study recovered well from surgery, and the results of paediatric EDH were generally positive. This result is consistent with the study by **Al-Hajj S (2021),** which found that most paediatric EDH patients had a favourable prognosis, especially if they received an early diagnosis and the right surgical care.[20]
The results of **Akdağ R (2021),** who reported a complication rate of about 10% in surgically managed paediatric EDH patients, were supported by the comparatively low prevalence of postoperative problems such as infection, hematoma recurrence, or seizures. [21]
Patients in our group who had larger hematomas, particularly those with considerable brain swelling, or who had delayed surgical intervention responded worse. Large hematomas and delayed intervention were also linked to worse functional results and increased morbidity, especially when the neurological condition was deteriorated at the time of surgery, according to **Gajbhare SV et al. (2023), Al-Hajj S (2021)** and **Sharma M(2022).**[12,20.24]. Although the majority of patients demonstrated some level of functional improvement after rehabilitation, neurological abnormalities such as hemiparesis, cognitive impairments, or seizures were observed in these situations.
According to **Chakradhar R et al. (2024),** who stressed that the lack of early indicators of deterioration does not ensure a benign course, the occurrence of a lucid interval in a minority of patients did not predict a uniformly excellent outcome in our group.[23] Similarly, **Kumar B et al. (2023)** emphasized that continual monitoring is necessary to discover late problems, even while clear periods may indicate a less serious injury. [22]

CONCLUSION
This study highlights how important it is to diagnose children extradural hematomas early and treat them

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quickly to achieve positive results. The prevalence of frontal and parietal hematomas, which are frequently linked to skull fractures, emphasizes how crucial imaging is for directing surgical treatment.These findings help to understanding the pattern of injuries and management in a vulnerable paediatric population.

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Conflict of Interest: None

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