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Pediatric Extradural Hematoma: Clinical Characteristics, Management, and Prognosis

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Abstract: ***This article explores the clinical characteristics, management strategies, and prognosis of pediatric patients with extradural hematoma EDH resulting from traumatic brain injuries TBIs. EDH, a collection of blood between the dura and skull bone, poses significant morbidity and mortality risks among the pediatric population. The study, conducted at a neurosurgery department, retrospectively analyzes 118 patients aged 2 to 14 years who underwent surgical treatment for traumatic EDH. The study investigates demographic distribution, mode of injury, presenting complaints, site of EDH, associated lesions, and outcomes. Key findings highlight the prevalence of male patients, a range of presenting complaints including altered sensorium and vomiting, and the significance of prompt diagnosis and timely surgical intervention in achieving favorable outcomes. The study underscores the importance of maintaining a high index of suspicion, utilizing neuroimaging techniques, and adopting appropriate surgical strategies for managing pediatric EDH cases.***

Keywords: Pediatric, extradural hematoma, traumatic brain injuries, clinical characteristics, management, prognosis

1. Introduction

Traumatic brain injuries (TBI) are leading cause of mortality and morbidity in paediatric age group. Extradural hematoma (EDH), collection of blood between dura and skull bone, is a fatal entity if left untreated. [1, 2, 3].1 - 6% of total TBIs presents with EDH. Overall 0 - 12% mortality has been reported among patients presented with EDH [2, 4]. Paediatric patients with EDH presents with very nonspecific symptomology which makes it difficult to diagnose promptly. Computed tomography remains linchpin of diagnosing EDH which also gives information about severity of injury and associated lesions like intradural hematoma, fractures, scalp hematoma which have prognostic significance [1, 2, 3, 4, 5]. Developing countries like India where primary care infrastructure and emergency transportation facilities are poor, it can lead to significant delay in reaching to diagnosis and appropriate management.

2. Material and Methods

The study design was retrospective descriptive study conducted in Department of Neurosurgery, Institute of Medical Sciences, BHU, Varanasi. Time period of study was January 2021 to December 2022. Consecutive 118patients of both sexes irrespective of other injuries, who were operated for traumatic EDH in the age group 2 - 14 years were included in the study. NCCT head was done for all patients at the time of arrival. Patients below 2 years, conservatively managed irrespective of age and who didn't give consent for surgery were excluded.

Descriptive analysis was done using different variables, i. e. age, sex, mode of injury, site of EDH, GCS at arrival, GCS at post operative day 1 and 10, volume of EDH, presenting complaints, associated lesions (like scalp hematoma, skull fractures, intradurallesions), injury to surgery time, duration of hospital stay.

Surgical technique used was craniotomy/ craniectomy with evacuation of EDH with dural tenting sutures. Patients were observed in ward/ ICU in postoperative period appropriately.

Outcome was determined by Glasgow outcome scale at discharge/ death.

Descriptive analysis and comparison was also done by dividing the patients into three age based groups: 2 - 5 year, 6 - 10 year and 11 - 14 year.

We also divided patients according to site of EDH i. e., Temporal bone dominant EDH, Parietal bone dominant EDH, Frontal bone dominant EDH, Occipital bone dominant EDH and Post fossa EDH and analysis was done using different variables. Images (1 - 4).

Data was collected retrospectively by analyzing medical, surgical and radiological records submitted in medical record department in IMS BHU, Varanasi between 1 January 2021 to 31 December 2022.

Statistical tests were done using SPSS version 20 software. Test of Significance was done using Pearson chi square test and one way Anova test. P value less than 0.05 was taken significant.

Volume was measured using Peterson and Esperson equation:

ABC/2; A, B, C represents diameters of hematoma in sagittal, axial and coronal planes

3. Results

Among 118 patients, 70.3% (n=83) were males and 29.7% (n=35) were females.

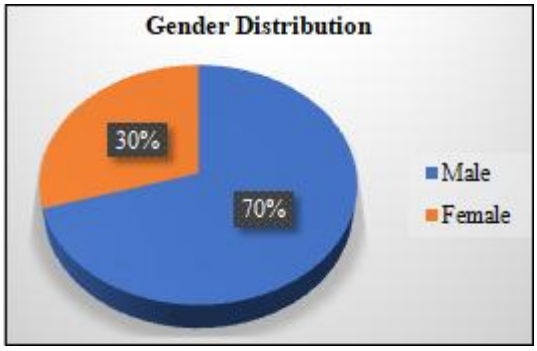


Table 1: Demographical analysis

n =118	Min value	Max value	Mean	Standard deviation
Age	2	14	9.19	3.267
GCS at presentation	3	15	12.73	2.905
GCS at POD1	3	15	14.39	2.298
GCS at POD10	3	15	14.49	2.428
Injury to surgery time (hours)	1	36	12.29	6.353
Hospital stay	6	26	9.25	2.840

Table 2: Demographical analysis (Site of EDH)

n =118	
Frontal bone dominant EDH	25 (21.2%)
Parietal bone dominant EDH	71 (60.2%)
Occipital bone dominant EDH	5 (4.2%)
Posterior fossa EDH	3 (2.5%)
Temporal bone dominant EDH	14 (11.9%)

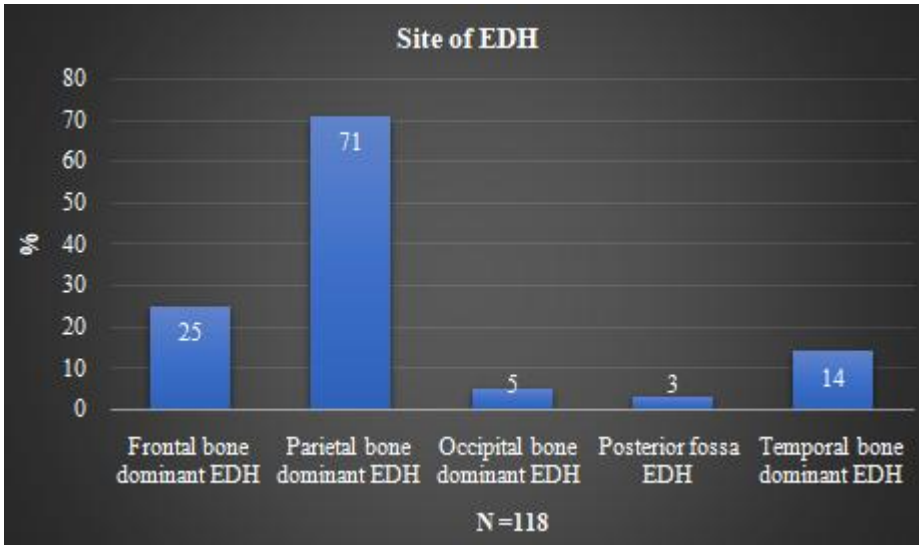


Table 3: Demographical analysis (Presenting complaints)

n =118	
Headache	24
Vomiting	14
Unconsciousness	19
Altered sensorium	52
Headache and vomiting both	9

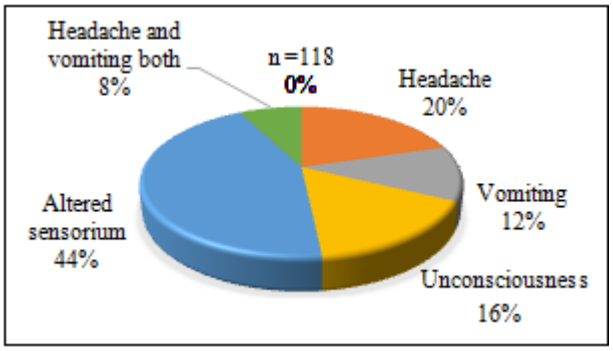


Table 4: Demographical analysis (Mode of injury)

n =118	
Fall from height	46
Road - traffic accidents	68
Others	4

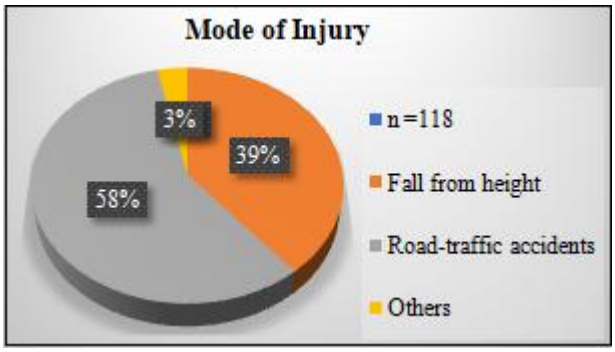


Table 5: Demographical analysis: (Based on division of age groups)

	2 - 5 years (n=18)	6 - 10 years (n=49)	11 - 14 years (n=51)
Males Females	6 (33.3%) 12 (66.7%)	37 (75.5%) 12 (24.5%)	40 (78.4%) 11 (21.6%)
Scalp hematoma + Scalp hematoma -	2 (11.1%) 16 (88.9%)	33 (67.3%) 16 (32.7%)	45 (88.2%) 6 (11.8%)
Fall from height Road - traffic accidents Others	17 (94.4%) 1 (5.6%) 0	22 (44.9%) 26 (53.1%) 1 (2%)	7 (13.7%) 41 (80.7%) 3 (5.9%)
Volume of EDH (meanin ml)	33.61	37.73	43.55
Skull fractures + Skull fractures -	10 (55.6%) 8 (44.4%)	26 (53.1%) 23 (46.9%)	7 (13.7%)
Mortality	1	1	3
Hospital stay (mean in days)	9.39	8.63	9.25

In our study we found scalp hematoma in 68% (n=80) patients. We also found that in 56.8% (n=67) patients there was associated intradural lesion like subdural hematoma, parenchymal contusion etc. In 56.8% (n=67) patients there was also associated skull bone fractures.

Overall there was 4% (n=5) mortalities among all patients.

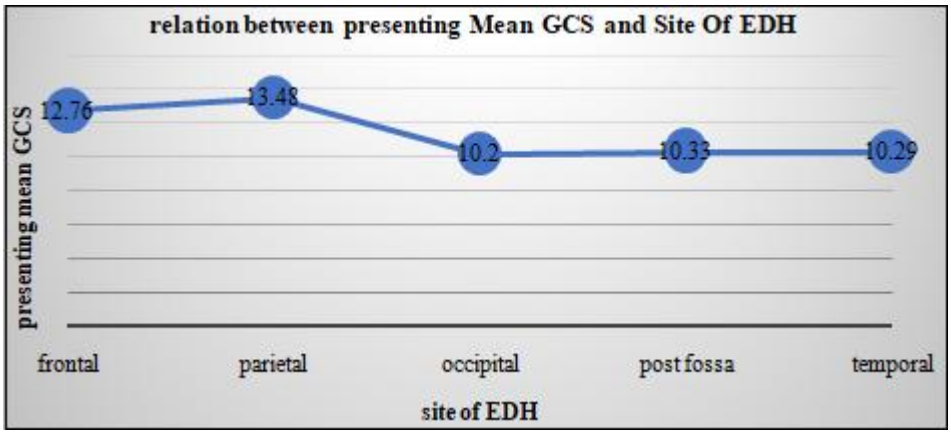
4. Observations

Site of EDH and its association

Most patients were diagnosed with parietal bone dominant EDH 60.2% (n=71, Table 2) but mean EDH volume was highest (42.50 ml) in patients with temporal bone dominant EDH although it was non - significant. Scalp hematoma and skull bone fractures were predominantly found in patients with parietal bone dominant EDH, 38.9% (n=46, non - significant) and 35.6% (n=42, significant, Pearson's chi square test, $p<0.026$) respectively. Other intradural lesions (like subdural hematoma, intraparenchymal) were also significantly associated with patients with parietal bone dominant EDH.

Site of EDH had no significant impact on hospital stay or outcome.

Mean GCS at presentation was lowest (10.20) in patients with Occipital bone dominant EDH (Anova, $p<0.0001$). Mean GCS at postop day 1 was lowest (12.67) in patients with posterior fossa EDH and at post op day 10 was lowest in patients with Occipital bone dominant EDH although both were non - significant.



Age specific analysis:

Most patients (43.2%, n=51) were in age group 11 - 14 years. In age group 2 - 5 years, 66.7% (12/18) were females. Statistically age - group wise sex distribution was significant (Pearson chi square test<0.001). There was also statistical significance of age groups on volume of EDH (Anova, $p<0.00001$) and scalp hematoma (Pearson chi square test, $p<0.0001$) We found that there was no statistical significant effect of different age groups on site of EDH, presenting complaints, skull fractures and other intradural lesions, GCS or hospital stay.

Outcome (GOS) was not dependent on age wise distribution.

5. Discussion

Extradural hematoma is collection of blood in the potential space between outer layer of duramater and inner table of skull bone. Itcan be caused by injury of middle meningeal vessels, venous sinus bleeds or fracture bleeds etc. It can expand rapidly in very small time and can lead to life threatening morbidity or mortality. Being a potentially life threatening neurosurgical emergency, mostly requires surgical evacuation of EDH. [1]

Paediatric EDH is more common in males as in culture of our country males are exposed to active life for outdoor activities earlier than females. It was consistent with our study as there was male predominance (70.3%, n=83). in age group 2 - 5years there was female predominance (12/18, 66.7%), may be attributed to gender discrimination towards

female child as mode of injury was fall from height/lap due to lack of care. [1]

In our study commonest mode of injury was Road - traffic accidents (57.6%, n=68) followed by falls. In literature there is controversy towards commonest mode of injury, since we had most of the patients in elderly age group 11 - 14 years (43.2%, n=51), specially males, uncontrolled biking and traffic might be a cause. [1, 2]

In our study most of the patient landed in altered sensorium (44.1%, n=52) in emergency room, others presentations were headache, vomiting and loss of consciousness. In most of the literature, although vomiting and headache are most common presenting complaints in paediatric age group. It may be attributed to delayed arrival of patients at tertiary centres due poor referral system and transportation facilities as it was shown by larger injury to surgery time ranging from 1 to 36 hours (mean - 12.26 hours) [3].

In our study most of the patients had parietal bone dominant EDH (60.2%, n=71). which was consistent with numerous other studies. Others were frontal, temporal, Occipital bone dominant and posterior fossa region EDH. Although there was large number of patients had skull bone fractures (56.8%, n=67) which was supported by different studies, butit was not contributory towards diagnosing EDH [1, 4, 5]. We also found a greater occurrence of scalp hematoma (68%, n=80) as EDH can be suspected an underlying pathology in children with TBIs having scalp hematoma. We also found in 56.8% (n=68) patients associated intradural lesion [2].

Mean GCS was improved from 12.73 at the time of arrival to 14.49 at the time of discharge which denotes prompt diagnosis and timely intervention leads to good recovery [1, 2, 6].

Mean volume of EDH was lowest in 2 - 5 years age group probably due to tight adherence of dura to overlying bone although data regarding it sparse [1, 7].

Mean hospital stay was 9.25 days ranging from 6 to 26 days which was explained by the fact that since all patients went under surgical intervention and most of the patients were discharged after stitch removal within hospital stay.

Mortality in our study was 4% (n=5) which was relatable to various other studies [8, 9, 10].2 out of 5 patients has associated parenchymal lesion and 2 patients have underlying infraction of brain (image 4). One patient died of septicaemia in ICU after 26 days.

6. Conclusion

Pediatric extradural hematoma is a critical concern in cases of traumatic brain injuries, demanding prompt diagnosis and intervention. The study is comprehensive analysis of demographic, clinical, and outcome data offers insights into the challenges and strategies in managing these cases. Effective utilization of neuroimaging techniques, coupled with timely surgical approaches, is pivotal in achieving positive patient outcomes. Through enhanced awareness, diagnostic acumen, and appropriate management, clinicians can contribute to reducing the morbidity and mortality associated with pediatric EDH

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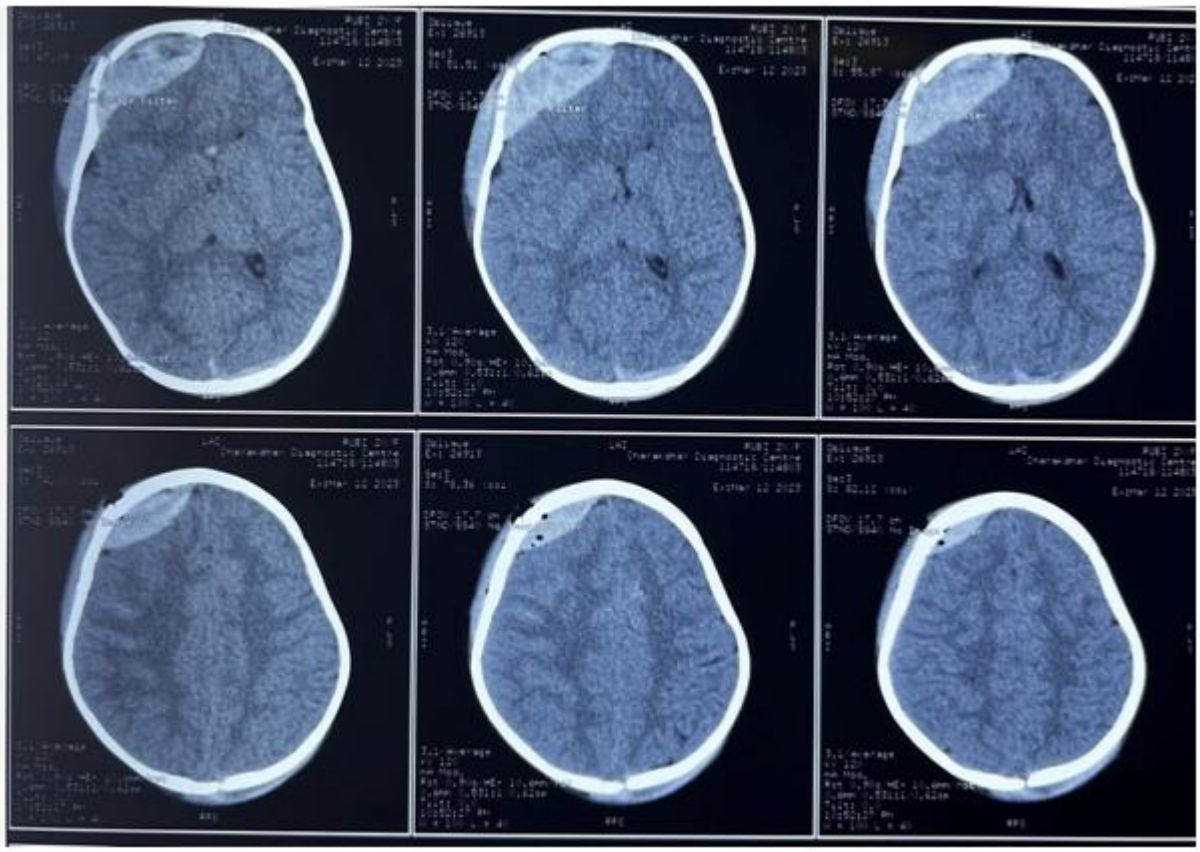

Image 1: Frontal bone dominant EDH in a 2 year old child showing fractured frontal bone with underlying EDH and overlying scalp hematoma

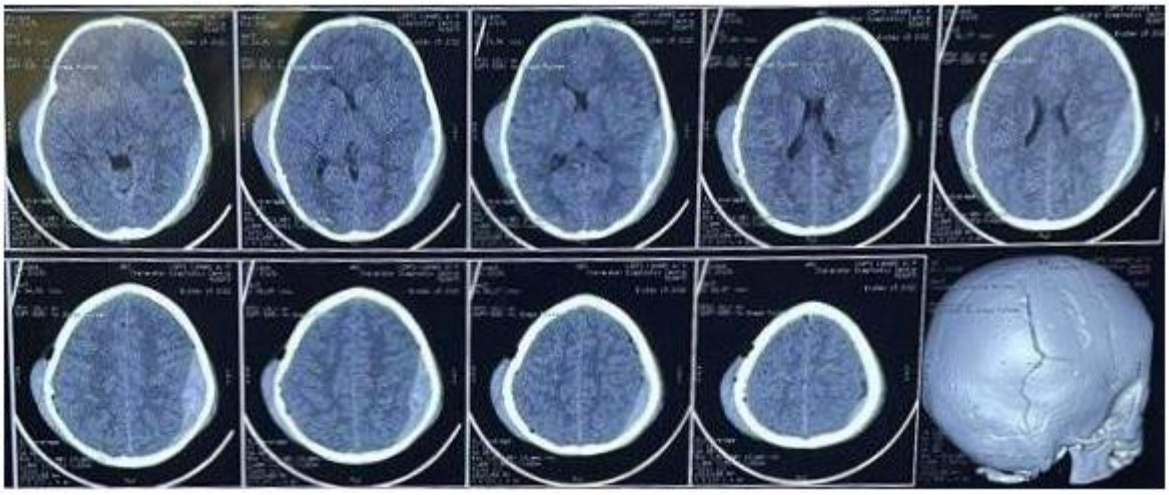

Image 2: Parietal bone dominant EDH in a 7 year old child with overlying scalp hematoma

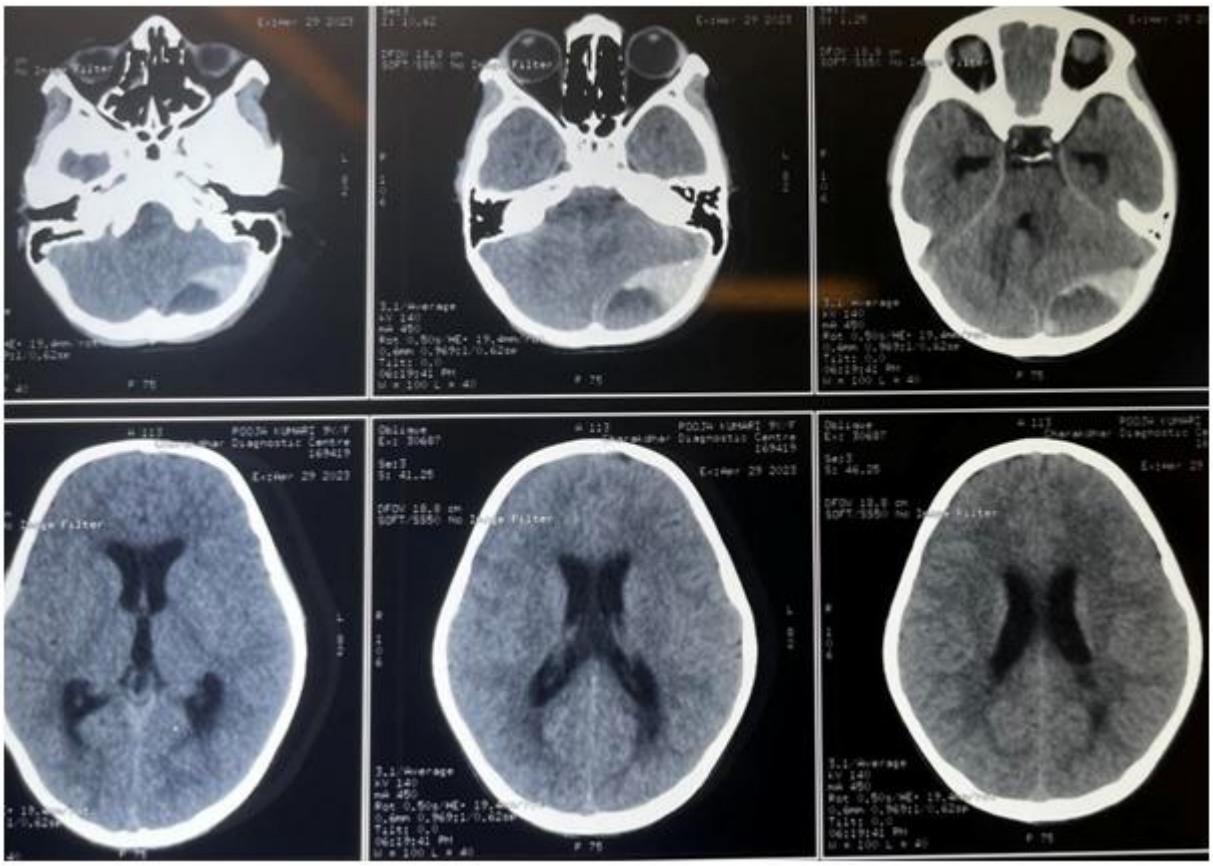

Image 3: Posterior Fossa EDH in a 9 year old child

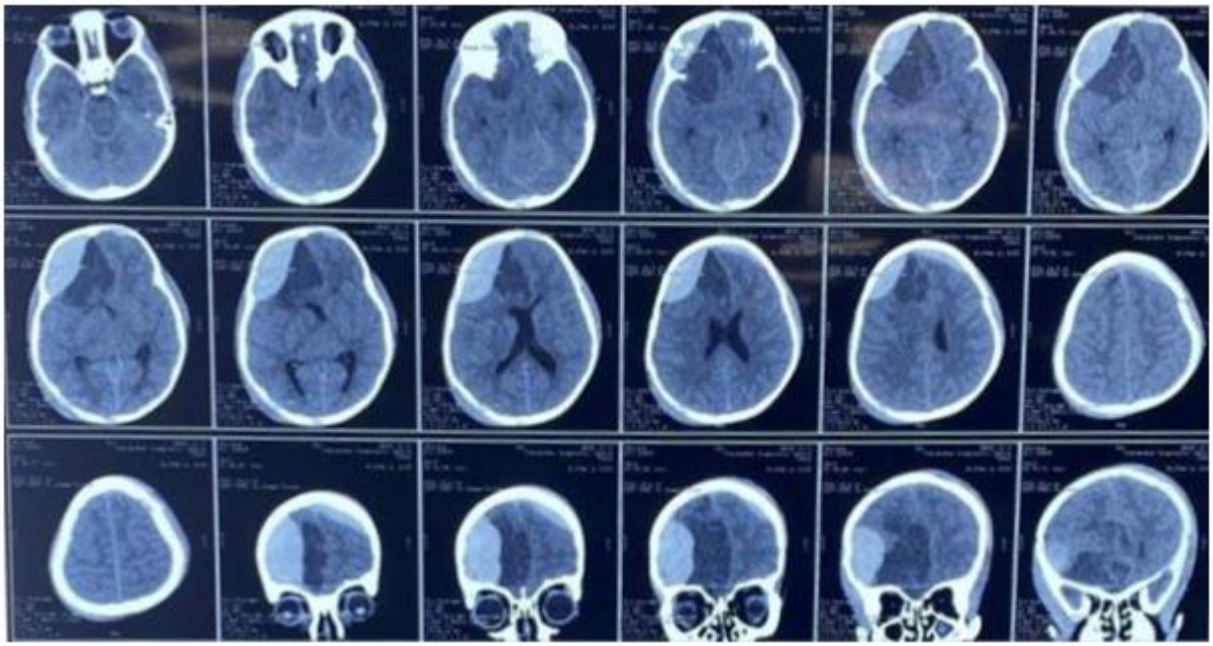

Image 4: Frontal bone dominant giant EDH with underlying infarct