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ORIGINAL RESEARCH

Multidetector Computed Tomography Evaluation in Traumatic Extradural Hemorrhage with Neurological Correlation and Follow Up

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Abstract

Introduction: Trauma is the major health problem and is a leading cause of death. Extradural hematomas occur in approximately 2% of all patients of head injuries and 5-15% of fatal head injuries. CT is the single most informative diagnostic modality in the evaluation of a patient with a head injury. Follow-up assessment is frequently necessary to detect progression and stability and evidence of delayed complications and sequelae of cerebral injury which can determine whether surgical intervention is necessary. Hence the present study assess the role of computed tomography in patients with traumatic extradural hemorrhage with neurological correlation and follow up.

Objectives of the study: The objectives of the study were to evaluate the imaging findings of extradural hemorrhage on Multidetector Computed Tomography. To correlate the thickness of extradural hemorrhage and midline shift with neurological symptoms of patient. To evaluate the prognosis of patients with neurological deficits on follow up.

Material and methods: This was a prospective study involving subjects with traumatic extradural hemorrhage. CT scan Brain was performed in all study participants and neurological correlation and follow-up was done in all subjects. Chi-square used to test significance for qualitative data and an independent *t*-test was used as a test of significance for quantitative data. p value < 0.05 will be considered as statistically significant.

Results: A total of 62 patients were enrolled in the study, majority were in the age group 21 to 30 years. Male predominance 55 (88.7%) was observed. Based on clinical history, clinical diagnosis and mode of injury was due to RTA. Majority of them, 17 (27.4%) of patients had right temporal EDH followed by l3 (21.0%) left temporal EDH and the commonest site of EDH was right temporal region. 26 (41.9%) of patients had mild category of GCS score followed by 22 (35.5%) moderate and 14 (22.6%) had severe category of GCS. The mean size of EDH among study patients was 8.25 ± 3.917 mm with minimum of 3mm to maximum of 18.2mm. Among 36 patients with midline shift, majority, 19 (52.7%) had it on left side and 17 (47.3%) had on right side. The commonest symptom among the patients was loss of consciousness 38 (61.3%). Majority 57 (92.0%) of patients had good recovery followed by 5 (8.0%) had moderate recovery. The size of EDH was significantly larger among patients with midline shift and patients with moderate recovery had significantly larger EDH compared to those with good recovery.

Conclusion: Multidetector Computed Tomography (MDCT) was found to be a useful and adequate diagnostic tool in the evaluation of patients presenting with head injury.
Keywords: Road Traffic Accidents, Head Trauma, Epidural Hemorrhage.

Introduction

In a rapidly developing country like India steady increase in urbanization and industrialization has resulted in an exponential growth of road transportation and subsequently there is a steady increase in road traffic accidents (RTA) and has been referred to as “silent epidemic RTA’s” has become a daily occurrence taking an increased toll on human lives and limbs. Most of these patients are in their prime (2nd and 3rd decade of life) and therefore have a direct social and economic effect besides the emotional burden of suffering a lifelong debilitating loss of function. The incidence of traumatic brain injuries is common among the 21 - 40 years of age group followed by 41 - 60 years age group and below 20 years age group. The incidence among the above 61 years age group is comparatively less.[1]

The advent of CT & the recent influx of newer generations of MDCT have revolutionized the understanding of traumatic brain injury.[2] Neuroimaging plays a vital role in optimal management of these patients which depends on early and correct diagnosis.[3]

In head injury, Computed Tomography is the single most informative diagnostic modality in the evaluation of a patient. Besides facilitating rapid implementation, it can demonstrate significant primary traumatic injuries including extradural, subdural, intracerebral hematomas, subarachnoid and intraventricular hemorrhages, skull fractures, cerebral edema, contusions and cerebral herniations. CT is currently the procedure of choice over MRI because it is faster and more readily available and it more easily accommodates emergency equipment and can easily enable, the detection of blood during the acute phase.[4]

CT is a quick, cost effective, non-invasive method to assess time and the extent of cerebral injury and is an essential aid to triage patients to observation, medical or surgical management.[5,6] Role of CT in Diagnosis and management of traumatic brain injury (TBI) is crucial to improve patient outcomes. Since very few structured studies have been conducted till date, we conducted this study to evaluate and assess the role of computed tomography in patients with traumatic extradural hemorrhage with neurological correlation and follow up.

Objectives of the study

The objectives of the study were to evaluate the imaging findings of extradural hemorrhage on Multidetector Computed Tomography, to correlate the thickness of extradural hemorrhage and midline shift with neurological symptoms of patient, to evaluate the prognosis of patients with neurological deficits on follow up.

Materials and methods

Source of data

The study was conducted in the Department of Radio-Diagnosis at” R.L. Jalappa Hospital and Research Center attached to Sri Devaraj Urs Medical College, Tamaka Kolar.

Method of collection of data

A cross-sectional descriptive study was done at Department of Radio-Diagnosis at R.L. Jalappa Hospital and Research Center attached to SDUMC, Kolar. A total of 62 patients of adult age group with extradural hemorrhage due to craniocerebral injury were included in the study. All the patients satisfying the inclusion criteria underwent CT evaluation after giving

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consent. All the CT scans in this study was performed using SIEMENS® SOMATOM EMOTION 16 CT machine.

CT Protocol consisted of the following

- Non contrast axial 16 slice helical series
- Beam collimation 4.8 mm.
- Detector configuration 16x0.625
- Pitch 0.8:1
- Tube current 270 mAs
- Voltage 130 kV

Along with axial images, coronal and sagittal images will be obtained and compared. The hemorrhage detected on CT examination were classified according to the region involved. The image findings of extradural hemorrhage on MDCT, correlation of the size of extramural hemorrhage and midline shift with neurological features and the prognosis of patients with the neurological deficits on follow up were evaluated.

Inclusion criteria

Patients of adult age group with extradural hemorrhage due to craniocerebral injury.

Exclusion criteria

- Patients with no extradural hemorrhage on CT.
- Patients who cannot be followed up.

Statistical Methods

Traumatic extradural hemorrhage was considered as the primary outcome variable. Study group considered as Primary explanatory variable. Age, gender, right side and left side were considered as other study relevant variables. Descriptive statistics were used to analyze data in accordance with the study's objectives. Data was also represented using appropriate diagrams like Error bar diagram, bar diagram, staked bar diagram and box plots. All Quantitative variables were checked for normal distribution. Continuous variables were analyzed by independent-sample T-tests and expressed as the mean and standard deviation. Data was entered into Microsoft excel data sheet and analyzed using Stata version 12 software. Chi-square was used as test of significance for qualitative data and independent t test was used as test of significance for quantitative data. P value < 0.05 was considered statistically significant

Results and observations

A cross-sectional descriptive study was done at Department of Radio-Diagnosis at R.L. Jalappa Hospital and Research Center attached to SDUMC, Kolar. The study aimed to evaluate the traumatic extradural hemorrhage patients by multidetector computed tomography with neurological correlation and follow up. A total of 62 patients of adult age group with extradural hemorrhage due to craniocerebral injury were included in the study.

In the present study, out of 62 (100%), majority (27 (43.6%)) of patients were in the age group of 20 to 29 years followed by 30 to 39 years, 14 (22.6 %). (Table 1)

Table 1: Age wise distribution of patients

Age group	Frequency	Percent
20-29	27	43.6
30-39	14	22.6
40-49	11	17.7

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

50 and above	10	16.1
Total	62	100.0

Out of 62 (100%) patients, about 55 (88.7%) of patients were males and 7 (11.3%) were females showing male predominance. (Figure 1)

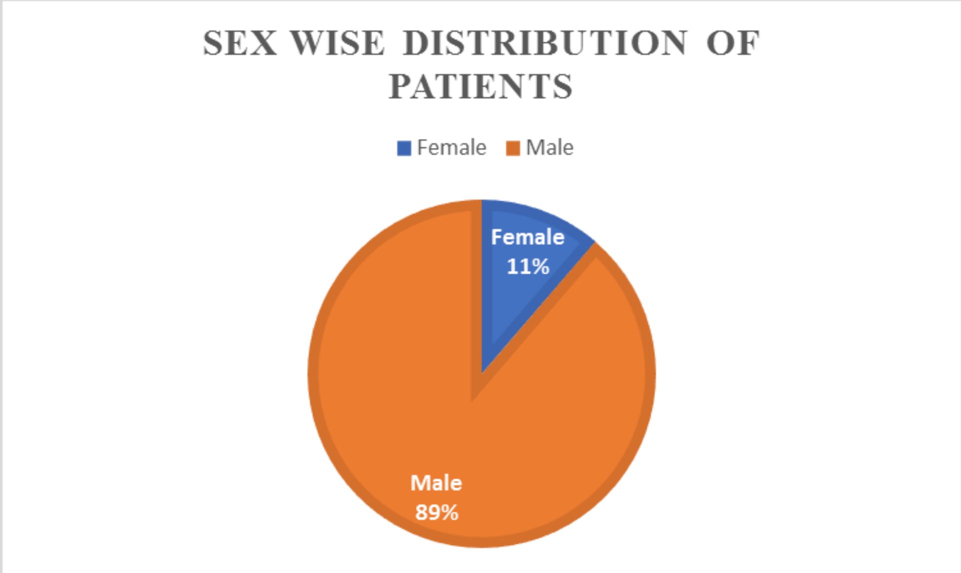

Figure 1: Pie chart of sex wise distribution of patients (N=62)

The clinical history of all 62 (100%) patients showed that all had history of head injury and the mode of injury for all patients was RTA. Even all were clinically diagnosed as head injury following RTA.

On radiological examination, out of 62 (100%) patients, majority of them, 17 (27.4%) patients had right temporal EDH followed by l3 (21.0%) left temporal EDH. (Table 2)

Table 2: Distribution of patients based on their radiological diagnosis

Radiological diagnosis	Frequency	Percent
Left frontal edh	5	8.1
Left occipital edh	1	1.6
Left parietal edh	7	11.3
Left temporal edh	13	21.0
Right frontal edh	11	17.7
Right parietal edh	6	9.7
Right occipital edh	2	3.2
Right temporal edh	17	27.4
Total	62	100.0

Among all 62 (100%) patients, the commonest site of EDH was right temporal region, 17 (27.4%) followed by l3 (21.0%) left temporal region. (Figure 2)

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

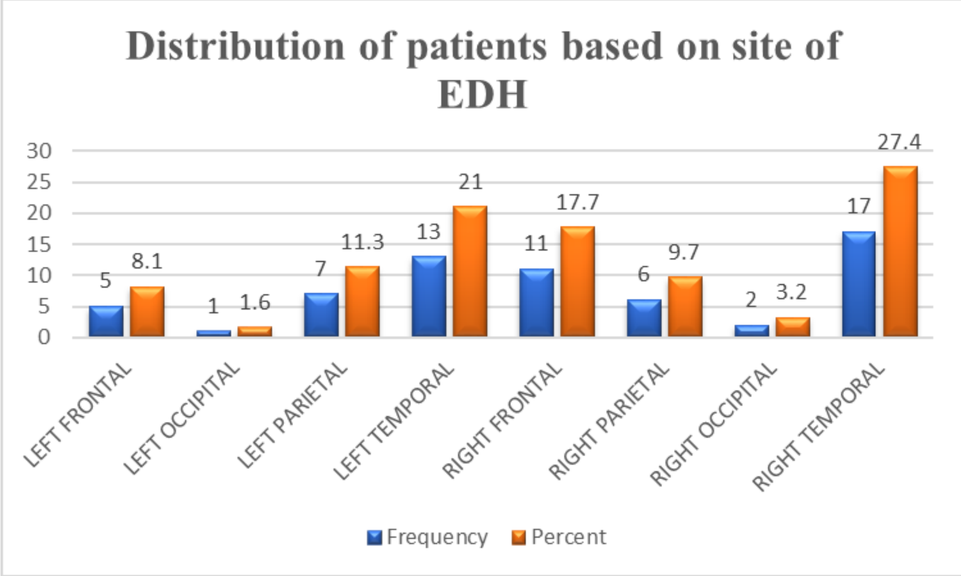

Figure 2: Staked bar chart of distribution of patients based on site of EDH (N=62)

Majority of the patients out of 62 (100%), had mild category of GCS score i.e., 26 (41.9%) of patients followed by 22 (35.5%) moderate and 14 (22.6%) had severe category of GCS. (Table 3)

Table 3: Distribution of patients based on GCS score

GCS category	Frequency	Percent
Mild	26	41.9
Moderate	22	35.5
Severe	14	22.6
Total	62	100.0

The mean size of EDH among study patients was 8.25 ± 3.917 mm with minimum of 3mm to maximum of 18.2mm. (Table 4)

Table 4: Descriptive analysis of size of EDH

Measure	Size in mm
Minimum	3
Maximum	18.2
Mean	8.25
Std. Deviation	3.917

About 36 (58.0%) of study patients presented with midline shift out of 62 (100%) patients. (Table 5)

Table 5: Distribution of patients based on presence of Midline shift

Midline shift	Frequency	Percent
Present	36	58.0
Absent	26	42.0
Total	62	100.0

Among 36 patients with midline shift, majority, 19 (52.7%) had it on left side and 17 (47.3%) had on right side. (Figure 3)

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

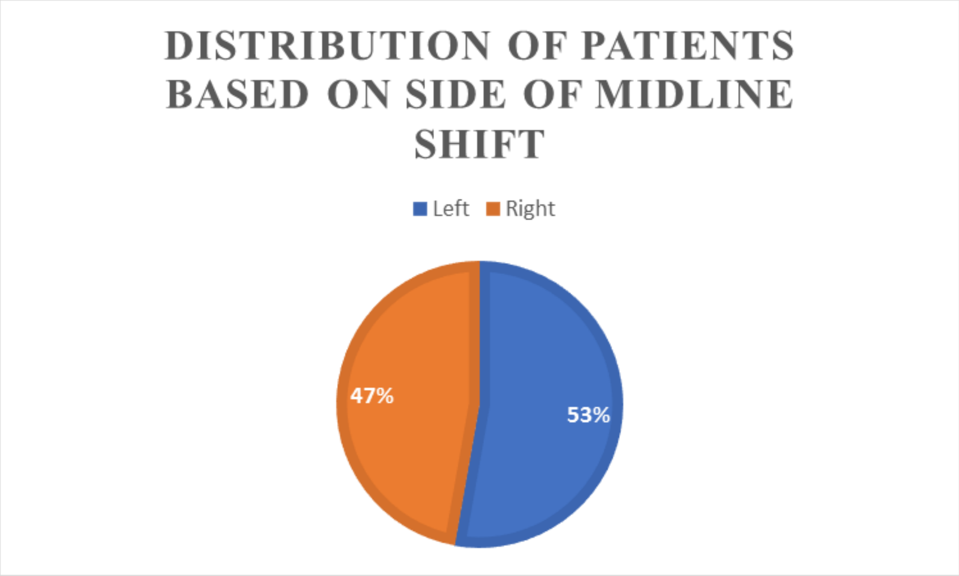

Figure 3: Pie chart of distribution of patients based on side of midline shift (N=62)

The commonest symptom among the patients was loss of consciousness 38 (61.3%) followed by vomiting 25 (40.3%) and hemiparesis 12 (19.3%). (Table 6)

Table 6: Distribution of patients based on Symptoms

Symptoms	Frequency	Percent
Loss of consciousness	38	61.3
Vomiting	25	40.3
Hemi-paresis	12	19.3

Out of 62 (100%) patients, majority 57 (92.0%) of patients had good recovery followed by 5 (8.0%) had moderate recovery. (Table 7)

Table 7: Distribution of patients based on Recovery

Recovery	Frequency	Percent
Good recovery	57	92.0
Moderate recovery	5	8.0
Total	62	100.0

About 86.1% patients with and 100.0% of patients without midline shift had good recovery. The association between midline shift and recovery was found to be statistically significant. (Table 8)

Table 8: Relationship between midline shift and recovery

Midline shift	Recovery		Total	Chi square	p
	Good	Moderate			
Present	31 (86.1)	5 (13.9)	36 (58.0)	3.928	0.047
Absent	26 (100.0)	0 (0.0)	26 (42.0)		
Total	57	5	62		

The size of EDH was significantly larger among patients with midline shift compared to those who did not have midline shift. (Table 9)

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

Table 9: Relationship between midline shift and size of EDH

Midline shift	Mean	Std. Deviation	t	p
Yes	10.95	2.53	6.775	0.001
No	6.23	3.26		

Patients with moderate recovery had significantly larger EDH compared to those with good recovery. (Table 10)

Table 10: Relationship between size of EDH and recovery

Recovery	Mean	Std. Deviation	t	p
Good	7.505	3.0967	6.576	0.001
Moderate	16.740	1.3145		

Case images

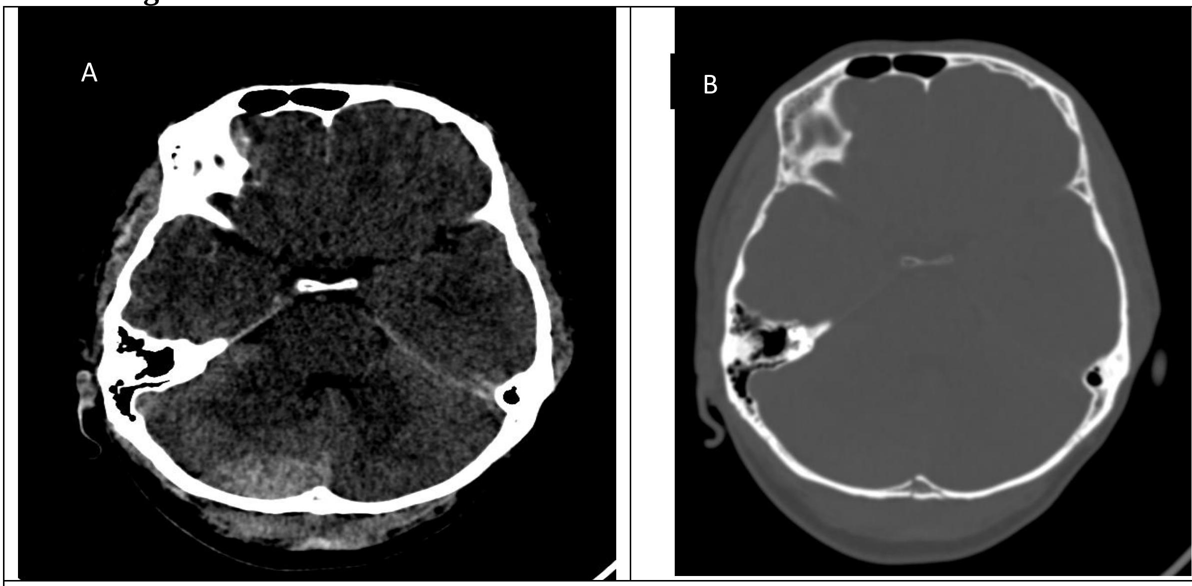

Figure 4: CT Brain plain study in a 45 years old male patient with history of Road traffic accident showing Extradural haemorrhage in right occipital region (A) and fracture of right occipital bone (B)

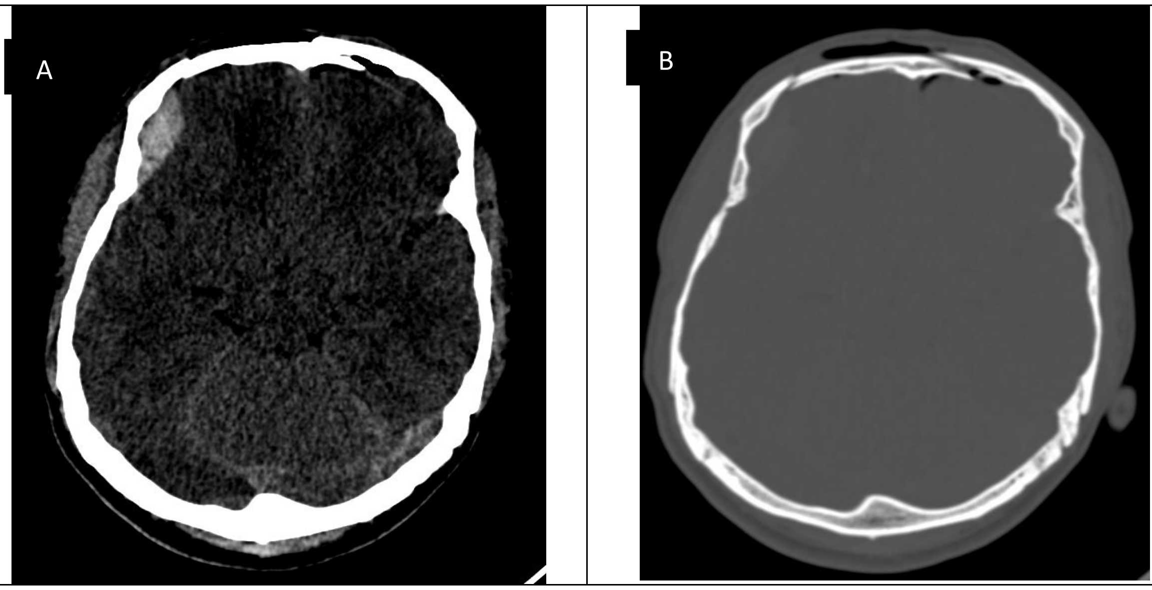

Figure 5: CT Brain plain study in a 31 years old male patient with history of Road traffic

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

accident showing Extradural haemorrhage in right frontal region (A) and fracture of right frontal bone (B)

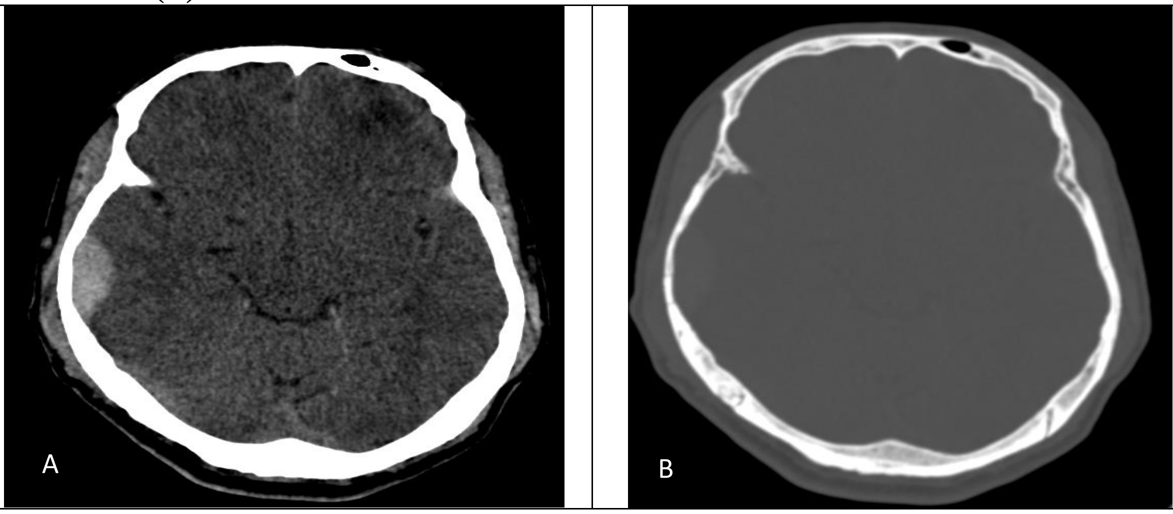

Figure 6: CT Brain plain study in a 28 years old male patient with history of Road traffic accident showing Extradural haemorrhage in right temporal region (A) and fracture of right temporal bone (B)

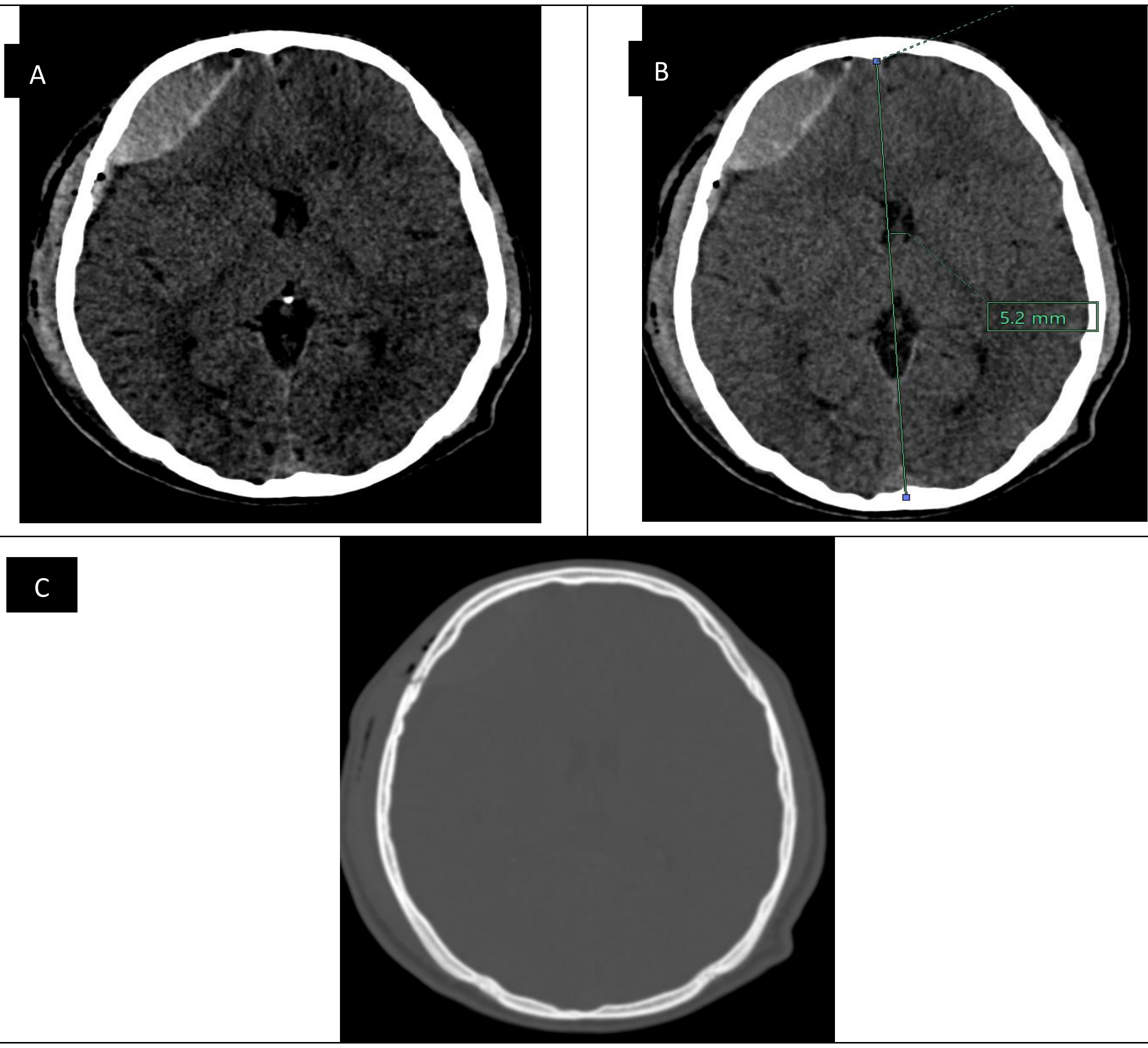

Figure 7: CT Brain plain study in a 21 years old male patient with history of Road traffic

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

accident showing Extradural haemorrhage in right frontal region (A) with a midline shift of 5.2 mm towards left side (B) and fracture of right frontal bone (C)

Discussion

Patients with traumatic brain injury are routinely diagnosed with MDCT imaging. MDCT scanning is useful for determining the severity of an injury, and multi-detector high-resolution scanners can be utilized to obtain its image. Soft tissue and bone windows might be used to view the pictures, and 3D CT sets could be used to identify skeletal and cerebral lesions.[7]

According to international surveys, middle-aged persons with head traumas made up the majority of reports of epidural bleeding. Out of 62 patients (100%) in the current study, 27 (43.6%) were in the 20 to 29 year age group, followed by 14 (22.6%) in the 30 to 39 year age group. A total of 460 individuals participated in the study by Amir et al., with a mean age of 19 years and a range of 2-55 9.59 years. Of these, 196 (42.60%) had epidural haemorrhages. The majority of the patients, 148 (75.51%), were between the ages of 15 and 44, with 40 (20.405) being under 14 years old.[8] The findings of a study carried out in India[9] and Pakistan[10] were comparable. This is because boys of this age group drive more than girls do in our traditional culture and society, making them more susceptible to head injuries.

Car accidents are the most common cause of TBI, and as males participate more actively in daily activities, they are disproportionately affected. Out of 62 individuals (100%) in our study, about 55 (88.7%) were men and 7 (11.3%) were women, indicating a male predominance. This is consistent with the research by Amir et al.[8] According to the study, out of the 196 cases of epidural haemorrhage, 152 (77.55%) patients were male and 44 (32.3%) were female. 2 Studies[11-13] have shown that men experience head trauma more frequently than women, which is consistent with our findings.

The clinical histories of all 62 (100%) patients revealed that all had a history of head injuries, with RTA being the most common mode of injury. Even all had a head injury diagnosis after RTA. Similar to our investigation, Amir et al. found that all brain injury patients had been involved in car accidents.[8] The enormous number of motor vehicles on our roads, as well as the drivers' propensity to disobey basic traffic laws and drive too fast, may be to blame for the high incidence of head injuries from road traffic incidents in this study. It is possible to hold passengers accountable for disregarding safety precautions like fastening their seatbelts. The low frequency of work-related brain injuries may indicate that employers and employees are both aware of the need of workplace safety.

Since it is less expensive, quicker, and more widely accessible, CT is one of the most important modalities and is a crucial diagnostic tool for many brain hematomas.[14,15] Out of 62 (100%) patients in our study, radiographic examination revealed that 17 (27.4%) had right temporal EDH, followed by l3 (21.0%) had left temporal EDH. The most common kind of EDH identified by Kumar et al. in their study was frontal, which presented in 36% of cases, followed by temporal in 21% of instances, and temporal parietal in only 10% of cases. Compared to occipital, posterior fossa EDH manifestation was detected in 5% of cases.[16] According to Pathak A et al's study, temporo-parietal EDH predominated in 43% of cases, followed by temporal in 21% of cases, and frontal in 17% of instances.[17] (Figure 4-6)

In the current study, out of 62 patients (100%), 26 (41.9%) had a mild category of GCS score, followed by 22 (35.5%) for moderate, and 14 (22.6%) for severe. In 188 patients, 23 (12%) suffered serious injuries, whereas 165 (88%) had intermediate injuries, according to Tariq's research.[18] According to De Sousa[19] and M. Naisseri[20], 56.8% and 75% of their patients, respectively, had mild brain injuries. The type of institution, private versus public and the

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

availability of medical coverage, as well as the screening procedure utilised prior to requesting a CT scan could be responsible for this discrepancy.

Patients in the study had an average EDH size of 8.25 mm, ranging from a minimum of 3 mm to a maximum of 18.2 mm. Mushtaq et al. also deduced from their research that the size and volume of the hematoma affect EDH result. A large volume is defined as 50 mL to 100 mL, and a small volume is 25 mL to 50 mL.[21] McKissock et al study's came to similar conclusions.[22]

Out of 62 study participants (100%) around 36 (58.0%) had midline shift. Most of the 36 individuals with midline shift, 19 (52.7%) on the left side and 17 (47.3%) on the right, had it on the left side. 17.5% of patients had midline shift, according to an earlier study.[11] Nitesh et al. found 12 cases with EDH; all of these individuals had skull fractures, and 94% of them had midline shift, which is a well-recognized finding.[23] (Figure 7)

Loss of consciousness was the most frequent symptom among the patients, occurring in 38 (61.3%), followed by vomiting in 25 (40.3%) and hemiparesis in 12 (19.3%). In past research, similar findings were made.[19] Patients who presented with many symptoms had a tendency to have a higher diagnostic yield than patients who just had one symptom. This was more prevalent in patients who had at least one variable in their combination that was loss of consciousness. This was also observed in patients who had minor head injuries. According to Tariq et al., the parietal bone was involved in roughly 43% of fractures, the frontal bone in 24.6%, the occipital bone in 21.1%, and the temporal bone in 20.2% of patients. In 29.8% of patients with linear skull fractures, extradural hematoma was observed. In comparison to other skull bones, the parieto-temporal sections of the skull were home to 73.5% of extradural hematomas.[18] In Kumar et al study's frontal EDH predominately presented in 36% of cases, followed by temporal EDH in 21% of cases, and only Temporal Parietal EDH in 10% of instances. Compared to occipital EDH presentation, posterior fossa EDH was present in 5% fewer cases.[16]

Out of 62 patients (100%) the majority (57, or 92.0%) recovered well, while 5 patients (8.0%) recovered moderately. Approximately 86.1% of patients with midline shift and 100.0% of patients without it made a satisfactory recovery. A statistically significant relationship between midline displacement and recovery was discovered. According to the research by Kumar et al, 79% of patients showed signs of a satisfactory recovery. 11% of patients had a moderate level of impairment. Only 10% of the cases resulted in death, a severe disability, or a vegetative state.[16]

Patients with midline shift had EDHs that were noticeably bigger than patients without midline shift. EDH was noticeably bigger in patients with intermediate recovery compared to those with strong recovery. This agrees with the research results of Tariq et al. Extradural bleeding size and volume are closely connected to the clinical and functional outcome. The prognosis deteriorates as the hematoma size grows.[18]

Conclusion

From this study we conclude that neurological status of patient on presentation and the thickness of extradural hemorrhage are the most important factors in management and outcome of extradural hemorrhage. The size of EDH was significantly larger among patients with midline shift compared to those who did not have midline shift. Patients with moderate recovery had significantly larger EDH compared to those with good recovery.

Computed tomography is a simple, inexpensive, highly accurate and provides the ability to rapidly evaluate patients with acute head injuries. CT aids in surgical planning, prognosticating outcome and recovery time. It can demonstrate extradural hemorrhage, skull fractures and other intracranial haemorrhages.

Thus it is justifiable to conclude that CT is and should be considered the first imaging of choice in acute head injury as it forms the cornerstone for rapid and accurate diagnosis. MDCT was found to be an accurate diagnostic tool in the evaluation of head trauma. The reduction in the scan delay time resulted in imaging more patients which greatly assisted the clinicians in instituting early appropriate therapy.

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