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ROLE OF COMPUTERIZED TOMOGRAPHY IN CRANIOCEREBRAL TRAUMA

Radio-Diagnosis

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ABSTRACT

Traumatic brain injury (TBI) is a major health issue responsible for considerable mortality and long-term morbidity worldwide, especially among subjects under the age of 44 years. The incidence of traumatic craniocerebral injuries is approximately 1.6 million per year in the USA, resulting in >50,000 deaths and >70,000 patients with permanent disability. **Materials And Methods:** A prospective Study is carried out in patients attending/referred to a government sector, Kollam. Patients with clinically suspected head injury during the period of June 2022 to June 2023. This study was conducted on 50 patients with clinically suspected head injury. They were evaluated with Multi detector Computed Tomography (GE 128 SLICE MDCT SCAN) and findings were correlated with clinical findings wherever applicable.

Aims And Objectives:

1.To assess the imaging characteristic of primary brain injury based on first CT scan.
2.To grade the severity of trauma using GCS score.

Inclusion Criteria

1. Patients of all age groups with head trauma.
2. Head trauma that has occurred within 24 hours.
3. Patients with head trauma treated as in-patients.

Exclusion Criteria

1. Cranial trauma during childbirth.
2. Patients with non-traumatic intracranial bleed.

Plan Of Study: complete clinical history of the patients was noted on proforma, which included, age sex, type of injury. The type of trauma was further classified into Road traffic accidents, Falls, Assaults, industrial accidents and miscellaneous. Follow up of patients during their hospital stay was performed. After initial resuscitation, severity of the craniocerebral injury was graded with the help of "Glasgow Coma Scale" (GCS). **Results:** The commonest lesion was SDH (26%) followed by SAH (22%) and EDH (10%). 80% of males were affected compared to females. Among them most of them belong to middle aged group (36%). 64% were impacted by RTA followed by fall from height (16%). Most of them presented with loss of consciousness (50%) followed by headache (38%). The severity of injury was categorized according GCS: -Mild (68%), Moderate (20%) and Severe (12%). **Conclusion:** The aim of emergency imaging is to detect treatable lesions before secondary neurological damage occurs. CT plays a primary role in the acute setting of head trauma, allowing accurate detection of lesions requiring immediate neurosurgical treatment. CT is also accurate in detecting secondary injuries and is therefore essential in follow-up.

KEYWORDS

Traumatic brain injury, Glasgow coma scale, Rotterdam CT criteria

INTRODUCTION

Traumatic brain injury (TBI) is a major public health problem, with an estimated yearly global incidence of 69 million and with an increasing prevalence over the past 25 years.[1,2] In the United States in 2013, there were nearly 2.8 million TBI diagnoses, 282000 TBI related hospitalizations, and 56000 TBI-related deaths.[3] Imaging CT and, to an increasing extent, MRI plays a critical role in TBI management and prognostication.[4]

TBI can be classified into primary and secondary injuries. Primary lesions are the direct result of trauma to the head, and secondary lesions arise as complications of primary lesions. Clinically, this classification is important because secondary injuries can be preventable, whereas primary injuries, by definition, have already occurred by the time the patient first presents for medical attention. TBI can be further divided according to location (intra- or extra-axial), mechanism (penetrating/ open or blunt/closed), and clinical severity (minor, mild, moderate, or severe).

TBI is a clinical diagnosis traditionally classified using the Glasgow Coma Scale (GCS). GCS scores 13–15 are mild brain injuries, 9–12 are moderate, and 3–8 are severe. There is a strong correlation between GCS score and morbidity and/or mortality at the severe end of the spectrum but limited correlation at the mild end of the spectrum. GCS score is determined by summing the scores from three categories: best eye response (score 1–4), best verbal response (score 1–5), and best motor response (score 1–6), yielding scores of 3–8 (severe), 9–12 (moderate), and 13–15 (mild).[5]

CT is the workhorse of imaging in TBI, especially in the acute setting, and able to identify the majority of injuries at the time of presentation. It is common for multiple injuries to be present simultaneously, such as the combination of cerebral contusions and traumatic subarachnoid, subdural and extradural haemorrhage as well as skull fractures and facial fractures. Benefits of CT in the acute setting over MRI include increased sensitive for detection of fracture, vascular injury, CSF leak, and not needing to assess for MRI safety (particular in the setting of penetrating injury).

CT can also be used to formally classify the degree of injury using a formal scale (e.g. Marshall classification or Rotterdam CT score).

The Rotterdam CT score of traumatic brain injury is a relatively recently described classification aimed at improving prognostic evaluation of patients admitted with moderate or severe traumatic brain injuries.

The Rotterdam classification includes four independently scored elements. Like the Marshall system, it includes 1) degree of basal cistern compression and 2) degree of midline shift. It does not, however, include contusions, but rather restricts mass lesions to 3) epidural haematomas, and adds 4) intraventricular and/or subarachnoid blood.[6]

Each of these is given a score, and these scores are tallied, with the addition of 1 to the total. In other words, a completely normal appearing scan has a Rotterdam score of 1 and the worst possible score is 6. To the sum of the score a plus 1 must be added, which makes it comparable to the Marshall system.[6]

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Classification

Basal Cisterns

0: normal

1: compressed

2: absent

Midline Shift

0: no shift or <5 mm

1: shift > 5 mm

Epidural Mass Lesion

0: present

1: absent

Intraventricular Blood Or Traumatic SAH

0: absent

1: present

MATERIALS AND METHODS

A prospective Study is carried out in patients attending/referred to a government sector, Kollam. Patients with clinically suspected head injury during the period of June 2022 to June 2023. This study was conducted on 50 patients with clinically suspected head injury. They were evaluated with Multi detector Computed Tomography (GE 128 SLICE MDCT SCAN) and findings were correlated with clinical findings wherever applicable.

Patients of all age groups with head trauma, Head trauma that has occurred within 24 hours and patients with head trauma treated as in-patients are included in the study. Cranial trauma during childbirth and patients with non-traumatic intracranial bleed. Are excluded from the study.

A complete clinical history of the patients was noted on proforma, which included, age sex, type of injury. The type of trauma was further classified into Road traffic accidents, Falls, Assaults, industrial accidents and miscellaneous. CT findings are noted. After initial resuscitation, severity of the craniocerebral injury was graded with the help of "Glasgow Coma Scale" (GCS).

Statistical Analysis

Table 1- Age Group Distribution

Age group	Frequency	Percentage
<20	6	12.0
20-40	16	32.0
40-60	18	36.0
>60	10	20.0
Total	50	100.0

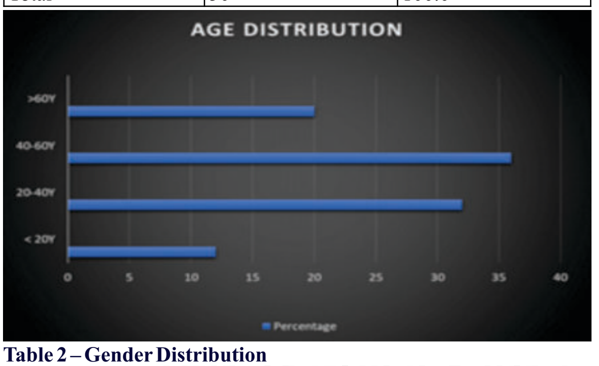
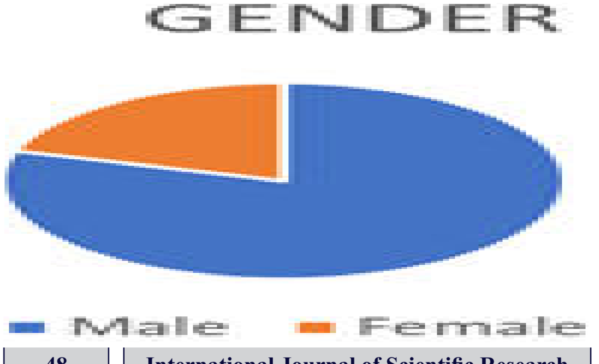


Table 2 – Gender Distribution



Gender	Frequency	Percentage
Male	40	80.0
Female	10	20.0
Total	50	100.0

Table 3 -Mode Of Impact Of Injury

Mode of impact	Frequency	Percentage
Alcoholic,Drunk and fall	1	2.0
Assault	7	14.0
Fall from height	1	2.0
H/o fall	8	16.0
RTA	32	64.0
Vertigo and fall 2 days back	1	2.0
Total	50	100.0

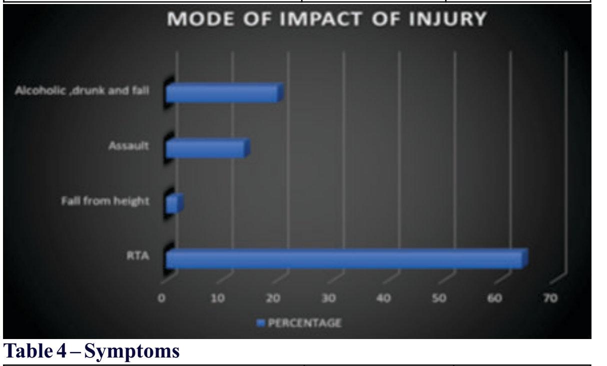


Table 4 – Symptoms

Symptoms	Frequency	Percentage
Forehead injury	1	2.0
Headache	19	38.0
left ear bleed	1	2.0
Loss of consciousness	25	50.0
Nasal bleed	1	2.0
Right ear bleed	2	4.0
weakness of right upper and lower limb	1	2.0
Total	50	100.0

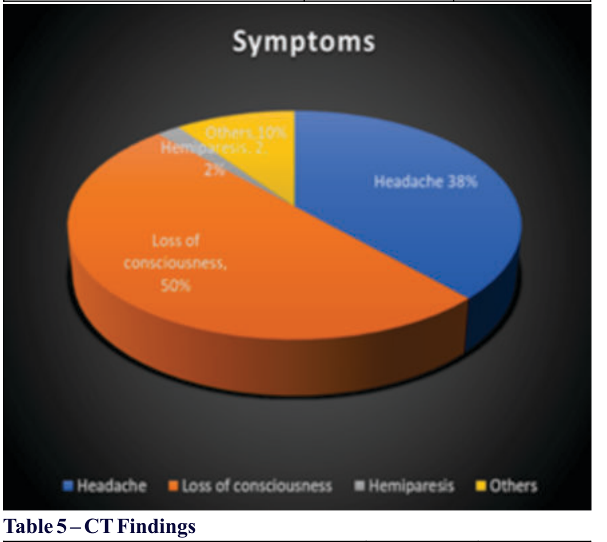


Table 5 – CT Findings

CT Findings	Frequency	Percentage
Comminuted fracture of left zygomatic arch	1	2.0
Diffuse axonal injury	5	10.0
Extradural haemorrhage	5	10.0
Fracture medial wall of orbit	1	2.0
Fracture of left frontal sinus with hemosinus	1	2.0
fracture of left orbit, zygomatic arch and left maxillary sinus	1	2.0
Fracture of right temporal bone	1	2.0
Fracture right maxillary sinus, right orbit	1	2.0
Fracture right temporal BONE, SPHENOID SINUS	1	2.0

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Haemorrhagic contusion with perilesional edema, severe hydrocephalus	1	2.0
Intraventricular haemorrhage	2	4.0
Left maxillary sinus fracture	1	2.0
Nasal bone fracture	2	4.0
Right complex zygomaticomaxillary fracture	1	2.0
Right frontal sinus fracture	1	2.0
Right temporal bone fracture	1	2.0
Subarachnoid haemorrhage	11	22.0
Subdural haemorrhage	13	26.0
Total	50	100.0

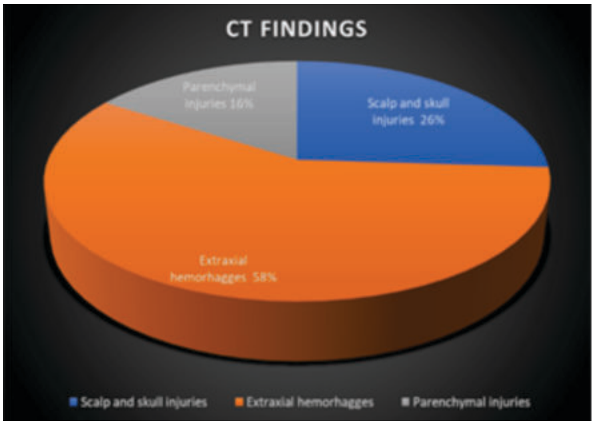
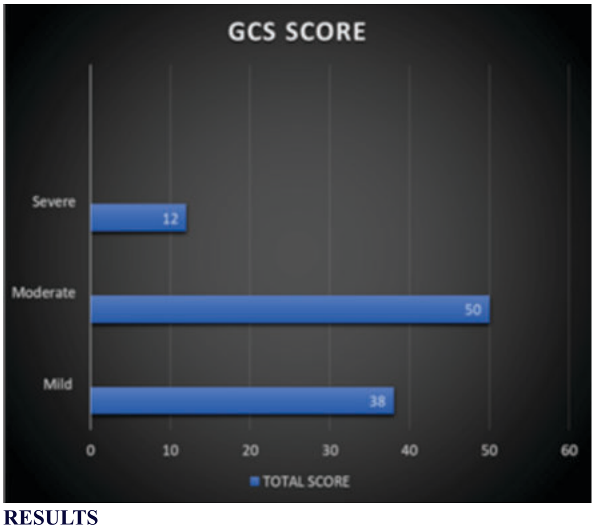


Table 6 – GCS SCORE

GC Score		
Mild head injury	34	68.0
Moderate head injury	10	20.0
Severe head injury	6	12.0
Total	50	100.0



RESULTS

The commonest lesion was SDH (26%) followed by SAH (22%) and EDH (10%). 80% of males were affected compared to females. Among them most of them belong to middle aged group (36%). 64% were impacted by RTA followed by fall from height (16%). Most of them presented with loss of consciousness (50%) followed by headache (38%). The severity of injury was categorized according GCS: -Mild (68%), Moderate (20%) and Severe (12%).

DISCUSSION

Computed tomography (CT), in the setting of acute trauma, is indicated for severe TBI (GCS 8), persistent neurologic deficit, antegrade amnesia, unexplained asymmetric pupillary response, loss of consciousness more than 5 minutes, depressed skull fracture, penetrating injury, or bleeding diathesis or anticoagulation therapy.[9] The goal of imaging is to identify treatable injuries to prevent secondary damage. In the acute setting, CT is the modality of choice because it is fast, widely available, and highly accurate in the detection of skull fractures and intracranial haemorrhage. Life-support and monitoring equipment can easily be accommodated in the CT scanner suite. In addition, CT is usually superior to MR in revealing skull fractures and radio-opaque foreign bodies.

With modern CT scanners, contiguous 3.75- or 5-mm sections from the skull base to the vertex can be obtained in less than 10 minutes. Thinner 1- or 2.5-mm sections are used to evaluate the orbits, maxillofacial structures, and skull base. With recent advances in multidetector CT (MDCT), thin cross-sectional slices can be performed which allowed for high-quality three-dimensional reconstruction. Thinner slices also improve the diagnostic accuracy of CT in the evaluation of maxillofacial, orbital, and temporal bone fractures. Intravenous contrast administration should not be performed because it can both mask and mimic underlying haemorrhage.

Because almost all head trauma patients undergo CT as the first imaging test, researchers have attempted to develop methods to use early CT findings for determining prognosis. For instance, in 1991, Marshall et al.[7] proposed a scoring scale for determining prognosis in head trauma patients based on CT criteria. The scale categorizes patients on the basis of the presence of a space-occupying lesion (or recent evacuation of such a lesion, e.g., a subdural hematoma), intracranial abnormalities, and findings of increased intracranial pressure (e.g., obliteration of basal cisterns or brain shift). Multiple studies have validated this scale and it has gained widespread acceptance.

Different types of traumatic brain injuries-

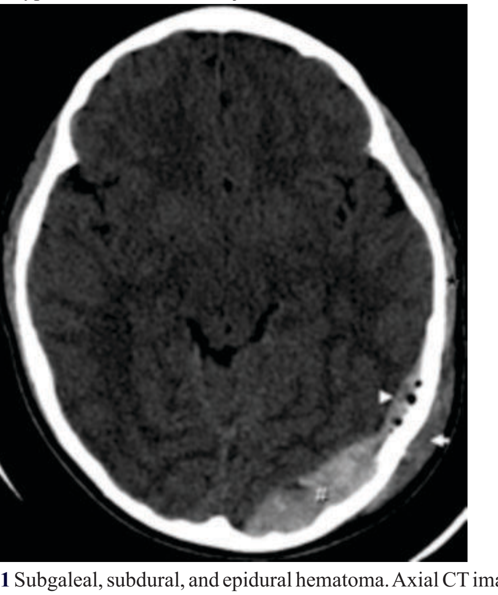


Figure 1 Subgaleal, subdural, and epidural hematoma. Axial CT image demonstrates a left parietal subgaleal hematoma (arrow). Note that it is superficial to the temporalis muscle (*). Subjacent to the scalp injury is a biconvex, hyperdense, extra-axial collection compatible with an acute epidural hematoma (#). Anterior to the epidural hematoma is a crescent-shaped hyperdense collection consistent with an acute subdural hematoma (arrowhead).

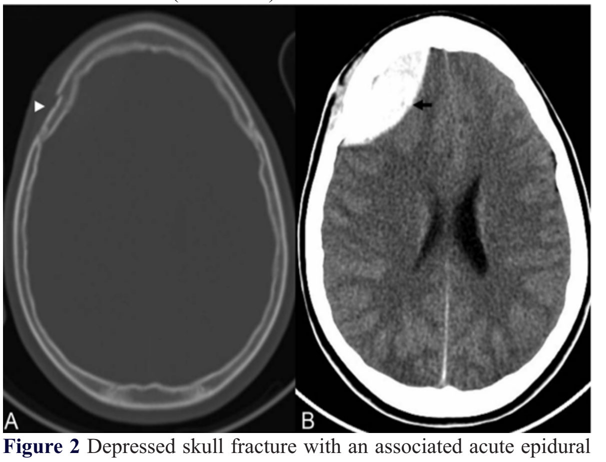


Figure 2 Depressed skull fracture with an associated acute epidural

hematoma (EDH). (A) Axial CT scan displayed in "bone window" shows a right frontal depressed skull fracture (arrowhead). Skull fractures can be associated with an underlying epidural hematoma (B, arrow) and/or contusion, especially depressed comminuted fractures.

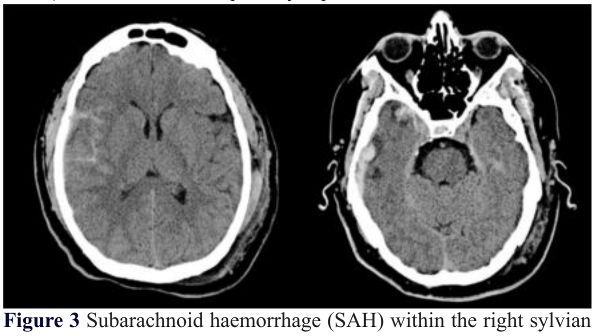


Figure 3 Subarachnoid haemorrhage (SAH) within the right sylvian fissure and cerebral contusions located at the right temporal pole and extensive scalp swelling on the left. Typical coup-contrecoup pattern.

In a recent article, investigators used imaging findings of patients from a previously published multicentre trial to refine the Marshall classification.[8] The subjects were between the ages of 15 and 65 years, had recent closed head trauma, and were classified as having either moderate (GCS score of 9–12) or severe (GCS score of 3–8) injury. Outcome prediction was based on CT findings within 4 hours of injury. The researchers refined the Marshall classification scheme in two ways. First, they provided a more detailed analysis of two parameters: presence of mass lesions and status of the basal cisterns (as a reflection of intracranial pressure). In addition, they added two CT parameters that were not included in the Marshall classification: traumatic intraventricular haemorrhage and subarachnoid haemorrhage. Next, the investigators compared the ability of this refined scheme to forecast outcome against alternative predictive models that the authors developed. Using this method, the authors confirmed the predictive value of the Marshall classification. However, they found that better discrimination was possible using individual components of the classification scheme (rather than the entire scheme) and adding the new haemorrhage parameters previously outlined. Based on these results, the authors devised a simple prognostic CT scoring scale for probability of mortality in patients with moderate or severe traumatic brain injury.

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