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Evaluation of computed tomography in management of patients with head injury

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ABSTRACT

Background: The primary goal in treating craniocerebral trauma due to any cause is to preserve the patient's life and remaining neurological function. It has also made the neuroradiologist an indispensable element of the trauma treatment team. The purpose of this study is to evaluate the efficacy of computed tomography (CT) in the diagnosis, treatment, and prognosis of patients with brain trauma. **Aims and Objectives:** The objectives of this study were to evaluate the efficacy of CT in the diagnosis, treatment, and prognosis of patients with brain trauma. **Materials and Methods:** The present study was conducted on patients with head injuries who were referred to the Department of Radiodiagnosis over a 2 years. Details were noted down on pro forma either immediately before or after the procedure was carried out, depending on the status of the patient. Few of the patients underwent plain radiography of the skull before conducting the CT scan. **Results:** In the present study, the most common lesion observed by CT was edema (49%) followed by contusion (48%), whereas least lesion was observed as intraventricular hemorrhage (4%) and intracerebral hemorrhage (8%). In the present study, the patient with low scores (3–5) showed early deterioration as compared to those with higher scores. This could be attributable to the severity of the primary injury. Late deterioration was more common than early deterioration in scores of >8 where mortality within 48 h was virtually nil and the recovery rate was much higher. **Conclusion:** This simple, affordable, highly successful, and safe imaging modality should be regarded the initial imaging modality of choice in acute head injury, as it serves as the foundation for cornerstone for rapid and effective diagnosis.

Key words: Head injury; Computed tomography scan; Edema; Contusion; Glasgow coma scale

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INTRODUCTION

The human brain is our most essential organ; it is designed and functions with extraordinary complexity, but it is prone to harm. Head trauma can cause either transitory or persistent signs or symptoms. The apparent severity of a brain injury might be deceiving. Minor trauma can cause major difficulties, and people with serious injuries can live. Acute head trauma medical care can be hard and costly. As more medical and surgical treatments for head trauma become available, the role of neuroimaging has grown.[1]

Fortunately, a perceptible change has occurred in the past 25 years. A sense of urgency is now discernable and a determination to improve results is increasingly visible. Today, it is clearly recognized that trauma can be identified, evaluated, and often prevented. The effects of trauma can be ameliorated and lives saved.

The primary goal in treating patients with craniocerebral trauma due to any cause is to preserve the patient's life and remaining neurological function. Optimal management of these patients depends on early and correct diagnosis, and therefore, neuroimaging has a vital role. The advent of computed tomography (CT) has been a major breakthrough as it meets these vital requirements. CT also forms the principle screening modality for victims of both blunt and traumatic injuries.

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In the examination of a patient with a head injury, CT is the single most informative diagnostic modality. It can show severe primary traumatic injuries such as extradural (Figure 1a), subdural (Figure 1b), and intracerebral hematomas, subarachnoid and intraventricular hemorrhages, skull fractures, cerebral edema, contusions, and cerebral herniations, in addition to aiding quick deployment. Due to improved technology, modern scanners may now assist in identifying diffuse axonal injuries that were previously unthinkable. CT's contribution to full damage evaluation is critical, and it serves as the foundation for the patient management.[2]

Recognizing curable injuries as soon as possible are crucial for reducing mortality, and CT of the head is the cornerstone for early diagnosis.[3] Follow-up CT scans are frequently required to identify progression and stability of lesions, as well as signs of delayed consequences and sequelae of brain damage, which can indicate whether surgical intervention is required.

Not only is an exact pictorial depiction of the effect of head trauma possible but CT has also furthered the understanding of the pathophysiology of head trauma. Technically superior 3rd and 4th generation scanners have decreased the scan time significantly and simultaneously increased the accuracy with which small lesions of minimally differing attenuation can be imaged.

CT 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 inability to use life supporting ferromagnetic equipment, inability to acquire bone details, and cost factors further makes MRI inferior to CT in the evaluation of craniocerebral trauma.[4] It has also made the neuroradiologist an indispensable element of the trauma treatment team. Keeping these above things in the mind, the present study was undertaken

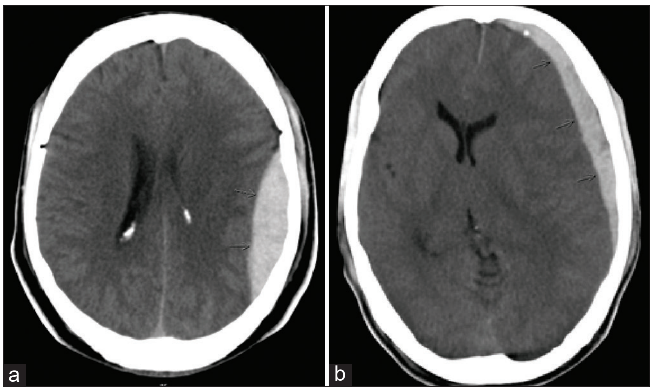

Figure 1: (a) Axial NECT scan image shows acute extradural hematoma (Arrows) in the left parietal region and (b) axial NECT shows acute subdural hematoma in the left frontoparietal region with mass effect and midline shift

to evaluate the efficacy of CT in the diagnosis, treatment, and prognosis of patients with brain trauma.

Aims and objectives

The objectives of this study were to evaluate the efficacy of CT in the diagnosis, treatment, and prognosis of patients with brain trauma.

MATERIALS AND METHODS

The present study was conducted on patients with head injuries who were referred to the Department of Radiodiagnosis over a 2-year period.

Inclusion criteria

The following criteria were included in the study:
1. Adults from the age of 18 years onward
2. Patients with a history of road traffic accident, fall, or assault were included in this study.

Exclusion criteria

The following criteria were excluded from the study:
1. Pediatric cases
2. Penetrating injuries.

Data collection procedure

Almost all patients had altered sensorium or neurological deficit or a combination of both. All these patients were clinically assessed and grouped according to the Glasgow Coma Scale (GCS) before the procedure was conducted.

Details were noted down on pro forma either immediately before or after the procedure was carried out, depending on the status of the patient. Few of the patients underwent plain radiography of the skull before conducting the CT scan. Patients are scanned using Philips 16 slice CT machine which was used for the study. It is a modified fifth generation scanner.

Proper immobilization and positioning of the head was achieved in all patients. Uncooperative patients were sedated by giving I.V Diazepam (5–20 mg). The Gantry tilt was given in the range of ±0–20 degrees, so as to parallel the scan plane to the orbitometal line. The obtained images were studied at brain and bone window settings. Average duration between scan and head injury was 6–8 h. The patient was evaluated as per the given pro forma. Surgical confirmation was obtained in six cases who were operated for elevation of the depressed fracture fragment, craniotomy, and evacuation of the hematoma. Follow-up cases were performed in three cases who showed persistent neurological abnormality or deteriorated or failed to improve following surgical intervention.

Clinical pictures

Figure 1: (a) Axial NECT scan image shows acute extradural hematoma (Arrows) in the left parietal region and (b) axial NECT shows acute subdural hematoma in the left frontoparietal region with mass effect and midline shift

Statistical analysis

Descriptive statistics such as mean, SD, and percentage was used to present the data. Chi-square test and the Spearman's correlation coefficient were used for comparison of CT findings with different variables. P<0.05 was considered as significant. Data analysis was performed using SPSS v20.0.

RESULTS

In the present study, the majority of the patients were belongs to the age group 18–30 years (45%) and male is predominate. Linear fractures were detected in 64% of patients, while depressed fractures were noted in 12% of patients. Both linear and depressed fractures were seen in 5% of the total spectrum (Table 1).

In the present study, the most common lesion observed by CT was edema (49%) followed by contusion (48%), whereas least lesion was observed as intraventricular hemorrhage (4%) and intracerebral hemorrhage (8%) (Table 2).

The outcome was poor with a GCS score of <8, while recovery was almost the rule with scores 13–15. Further, there is highly significant relationship between GCS and death (P=0.0001) (Table 3).

In the present study, patient with low scores (3–5) showed early deterioration as compared to those with higher scores. This could be attributable to the severity of the primary injury. Late deterioration was more common than early deterioration in scores of >8 where mortality within 48 h was virtually nil and the recovery rate was much higher (Table 4).

Table 1: Basic characteristics

Characteristics	Number	Percentage
Age (years)		
18–30	45	45
31–50	34	34
>50	21	21
Sex		
Male	90	90
Female	10	10
Types of fracture		
Linear	64	64
Depressed	12	12
Linear+Depressed	5	5

Table 2: Frequency distribution of various lesions by CT findings

Lesions	Number	Percentage
Pneumocephalus	26	26
Extradural hemorrhage	16	16
Subdural hemorrhage	28	28
Intracerebral hemorrhage	8	8
Intraventricular hemorrhage	4	4
Herniation	17	17
Edema	49	49
Contusion	48	48
Midline shift	27	27

CT: Computed tomography

Table 3: Outcome on basis of Glasgow coma score

Score	Number	Percentage	Death	Percentage
<8	47	47	22	46.8
9–12	27	27	0	0
13–15	26	26	1	3.8

χ^2=18.09, P=0.0001

Table 4: GCS – early and late deterioration

GCS	Number of patients	Died within 48 h (%)	Died after 48 h (%)	Recovered (%)
3–5	27	8 (29.6)	11 (40.7)	6 (22.2)
6–8	20	0	3 (15)	15 (75)
9–12	27	0	0	20 (74.1)
13–15	26	0	1 (3.8)	21 (80.8)

GCS: Glasgow coma scale

DISCUSSION

Age

Studies carried out in Western countries and India indicates that the incidence of head injury has increased steadily with age.

The patients in the present study ranged from 18 years to 80 years old. However, the maximum head injuries occurred in the age group 19–50 years (79%). People above 50 years were 21%. This reflects the fact that for adults constitute the major working population, they are more prone to road traffic accidents which are a major cause of head injury. A study done by Khan et al., stated that the peak incidence of traumatic brain injuries was between the ages of 15 and 35, and Saboori et al., reported a mean age of 29 years for patients with head injuries.[5,6] According to these studies, head injuries are more common in the socially and economically productive age groups of the population and, thus, have an impact on the financial aspect of the family.

Sex

The male-to-female ratio in the present study of 100 patients was 9:1. Study by Clifton et al., reported a similar ratio of 5:1.[7] This marked difference in sex ratio in our study may be attributable to the fact that in our society, it is usually the males who are bread winners of the family and are more mobile than the women.

In the present study, men were found to be more prevalent than females. Other investigations revealed incidence rates of 59% in Kalsbeek et al.,[8] 79% in Zimmermann and Curtis,[9] 65% in Holmes et al.,[10] and 78.2% in Saboori et al.,[6] Males outnumber females because they move out of their houses more frequently and work more actively outside.

Type of fracture

Fractures are readily detected with CT especially by increasing the window width through fractures, which are parallel to the axial slices, may be missed. Pneumocephalus is easily identified on CT. The CT value of air being easily detected. We had three isolated fractures, 64 linear, and 12 depressed fractures. Twenty-six had accompanying pneumocephalus. Plain skull radiograph as a primary mode of imaging was done only in two cases and both were also confirmed by CT. CT detected a fracture in 80% of the cases. Thus, skull radiograph has little or no role to play in modern day imaging in the presence of CT scan.[6,11,12]

Lesions by CT findings

Contusion and cerebral edema were found to be the most prevalent intracranial lesions seen on CT, accounting for 43% and 45% of all cases in the present study, respectively. Subdural hematoma was found to be the most prevalent kind of bleeding, accounting for 39% of all cases in the current study. Saboori et al., (34.7%)[6] and Ogunseyinde et al., (28.7%) reported incidence rates in other research.[13]

In the present study, intracerebral bleed accounted for 21% of lesions, whereas Ogunseyinde et al., found a slightly higher frequency of 26.3%.[13] Intraventricular hemorrhage was the least prevalent lesion seen in the current investigation, with a 3% prevalence. In their investigations, LeRoux et al., and Lee and Wang reported that IVH occurs in 1–5% of all patients with head injury.[14,15] Traumatic IVH is therefore uncommon and generally indicates significant damage.

Outcome on basis of GCS

In the present study, patients with a GCS of 8 had a 40.9% mortality rate, followed by 19.23% in patients with a GCS of 9–12 and 3.33% in patients with a GCS of 13–14. Gordon found a 34.50% death rate with a GCS score of 8.[16]

A few recent researches looked at the relationship between GCS score and CT scan to detect brain lesions. According to Farshchian et al., only three lesions, extra-axial hematoma, subarachnoid hemorrhage, and hemorrhagic contusion, are related with poor GCS scores.[17] A modest GCS score (GCS 13–15) in patients with an intracranial injury does not exclude development on repeat head CT and the requirement for neurosurgical intervention, according to a research by Joseph et al.,[18] According to Melo et al., neurosurgery was done in 6.7% of patients with moderate brain damage, and 9.2% had neurological impairments. In reality, modest brain damage based on GCS score may be linked with severe abnormalities in CT scan, necessitating neurosurgical surgery, and ICU hospitalization.[19]

GCS – early and late deterioration

Patients with low score showed early deterioration. This could be attributable to the severity of the primary injury. Late deterioration was noticed in scores <8, thereby pointing to added factors such as systemic insults and polytrauma that lead to increased mortality in this group besides the severity of the primary injury.

Limitations of the study

The present study has some limitations. The small sample size is major limitation of the study. This might be because a substantial proportion of individuals were referred for surgical intervention. As a result, more validation of the study on bigger and more diverse populations at various tiers of health-care facilities is required to produce a general agreement.

CONCLUSION

As a result, it is reasonable to infer that this simple, affordable, highly successful, and safe imaging modality should be regarded the initial imaging modality of choice in acute head injury, as it serves as the foundation for cornerstone for rapid and effective diagnosis.

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Authors Contribution:
SR- Concept and design of the study, prepared first draft of manuscript and revision of the manuscript; **NRP-** Interpreted the results; reviewed the literature and manuscript preparation; **PCM-** Concept, coordination, statistical analysis and interpretation, preparation of manuscript and revision of the manuscript.

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