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Evaluation of Craniocerebral Trauma Using Computed Tomography

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Abstract:
Aims And Objective: *Objective of the present study is to evaluate and assess the role of computed tomography in patients with craniocerebral trauma in respect to:*
- *study the different traumatic lesions in trauma to the head*
- *to establish that CT has a significant role in management of patients with head injury*
- *to assess the prognostic significance of CT in outcome of patients of head injury.*

Methods:*This is a prospective analysis of 100 patients with craniocerebral trauma using computed tomography who were treated at our institution from Nov 2009 to Oct 2011. Findings of the computed tomography using Helical CT scanner, GE CT machine were computed and compiled.*
Result: *The results of the study revealed that the incidence of craniocerebral trauma was more in male population. The peak incidence of age was found in the age group of 18-30 years. Although fractures and contusions constituted about 84.6% and 57% respectively, subdural hematoma was commonest cause of morbidity and mortality in craniocerebral trauma forming about 32.1% followed by extradural hematomas 12.5%*
Conclusion: *Computed Tomography is one of the comprehensive diagnostic modality for accurate localisation of the site of injury in acute craniocerebral trauma. The early and timely diagnosis of the precise lesion by CT not only had substantial impact over instituting appropriate treatment and timely surgical intervention but also helped in predicting the ultimate outcome.*
Key Words: *Craniocerebral trauma, Computed Tomography, Fractures, Epidural Hematomas, Subdural Hematomas, Contusions*

I. Introduction:

In a rapidly developing country like India, road transportation is massively increasing due to urbanisation and industrialization. As a result, head injuries due to road traffic accidents have 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) and therefore have a direct social and economic effect besides the emotional burden of suffering a lifelong debilitating loss of function.

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 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.

CT is the single most informative modality in the evaluation of patients with head injury. Besides facilitating rapid implementation, it can demonstrate significant primary traumatic injuries including extradural, subdural, intracerebral hematomas, subarachnoid and intra ventricular haemorrhages, skull fractures, cerebral oedema, contusions and cerebral herniations. Prompt recognition of treatable injuries is critical to reduce mortality and CT of the head is the cornerstone for rapid diagnosis[10] .

CT is currently the procedure of choice over MRI because it is faster and more readily available. CT is quick, cost effective, non-invasive method to assess the time and extent of cerebral injury and is an essential aid to triage patients to observation, medical or surgical management. This study attempts to assess the utility of CT in the diagnosis, management and prognosis of patients with cerebral trauma.

II. Materials And Methods:

Study Design: This is a prospective study carried out in patients of head injury, referred to the department of Radiodiagnosis ,Sri Adichunchanagiri Hospital and Research Centre, B.G. Nagara, Nagamangala Taluk, Mandya District from Nov 2009 to Oct 2011. A total of 100 patients with a history of road traffic accident, fall or assault were included and analysed in the study.

Inclusion Criteria:
1) Adults from the age of 18 years onwards
2) Patients with a history of road traffic accident, fall or assault were included in this study.

Exclusion Criteia:
1) Pediatric cases
2) Penetrating injuries

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

Preparation Of Patient:
No preparation was required as only plain study was indicated in these patients

Plan Of Study:
Details were noted down on proforma either immediately before or after the procedure was carried out, depending on the status of the patient

Equipment:
Patients are scanned using single slice spiral: GE CT/e machine was used for the study which is a modified 5^{th} generation scanner.
Slice thickness used :1mm,2mm,5mm,10mm and available gantry tilt:+/-20 degree
Matrix size of 512, Kv: 80-130 and Mas:60-200

Ct Technique:
Proper immobilisation and positioning of head was achieved in all patients. Unco-operative patients were sedated using 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 orbito-meatal line. The obtained images were studied at brain and bone window settings. Average duration between scan and head injury was 6 to 8 hours. The patient was evaluated as per the proforma.

Surgical confirmation was obtained in 6 cases who were operated for elevation of depressed fracture fragment, craniotomy and evacuation of hematoma.

Follow Up:
Follow up of cases were performed in 3 cases who showed persistent neurological abnormality or deteriorated or failed to improve following surgical intervention

III. Statistical Analysis:

All the data were collected and converted into percentages wherever necessary. Chi square test and Spearman's correlation co-efficient were used for comparison of CT findings of different variables and parameters , p value was calculated using MINITAB (USA 13.1) programme.

IV. Results:

In our study, 100 cases were included and analysed. The frequency distribution of various craniocerebral lesions in 100 patients has been summarised in table 1.

The commonest parenchymal lesion was contusion apart from oedema. Fractures formed the next major group accounting for 81% of lesions. Linear fractures were detected in 64% patients while depressed fractures were noted in 12% patients. Both linear and depressed fractures were seen in 5% (table 2).

About 45% of the patients were in 18-30 years age group and 80% were males.

Isolated fractures were seen in 3 cases while 78 cases showed associated lesions. The commonest lesion was contusion which was seen in 40 cases and pneumocephalus accounted for 26 cases(table 3). Intracranial haemorrhage was seen in 8% cases and most commonly found in the frontal region. Haemorrhagic contusion was seen in 83.3% cases and non haemorrhagic in 16.6% cases (Table 4) Temporoparietal location and hyperdense density pattern was seen in predominance. Extradural haemorrhage was associated with overlying fracture in 93.75% cases (Table 5).

Outcome was poor with GCS score <8 while recovery was the rule with scores between 13-15;$p<0.01$ shows that the relationship is highly significant(Table 6). GCS was found to be inversely proportional to midline shift. $p<0.01$ shows that the relationship is statistically significant.

Outcome was poor in mass lesions and poorer in ICH and SDH as compared to EDH. $p<0.001$ and $p<0.05$ respectively shows that relationship is significant (Table 7,8).Out of all the associated injuries, facio-maxillary injuries were seen most commonly in patients of head injury(Table 9).

Tables:

Table1: Frequency distribution of various craniocerebral lesions in 100 patients

CT findings	Number of Patients	Percentage(%)
Fracture	81	81
Pneumocephalus	26	26
Extradural haemorrhage	16	16
Subdural haemorrhage	28	28
Intracerebral haemorrhage	8	8
Intra ventricular haemorrhage	4	4
Herniation	17	17
Oedema	49	49
Contusion	48	48
Midline shift	27	27

Table 2: Types of fractures and their distribution

Types of fractures	Number of patients	Percentage(%)
Linear	64	64
Depressed	12	12
Linear +Depressed	5	5

Table 3: Association of fractures with various lesions

Fractures	Number of patients
Isolated fracture	3
Fracture associated with other lesions	78
Pneumocephalus	26
EDH	15
Contusions	40
SDH	21
Intracerebral haemorrhage	5

Table 4: Contusions

Contusions	Number	Percentage(%)
Non haemorrhagic	8	16.66
Haemorrhagic	40	83.3
Total	48	100

Table 5: Extradural haemorrhage: relationship with overlying fractures

	Number of patients	Percentage(%)
EDH with fracture	15	93.75
EDH without fracture	1	6.25
Total	16	100

Table 6: Outcome on the basis of Glasgow Coma scale

Glasgow coma scale	Number of cases	Death	Percentage(%)
<8	47	22	46.8
9-12	27	0	0
13-15	26	1	3.8

Table 7: Outcome on the basis of type of lesion

Type of lesion	Number of patients	Death	Death(%)
Mass lesions	61	22	95.65
Non mass lesions	39	1	4.34
Total abnormal scan	100	23	100

Table 8: Outcome in various hematomas

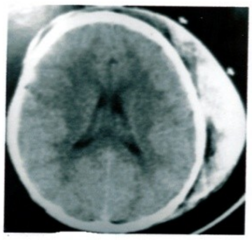
Hematomas	Number of patients	Death	Death(%)
EDH	16	2	12.5
SDH	28	9	32.1
ICH	8	5	62.5

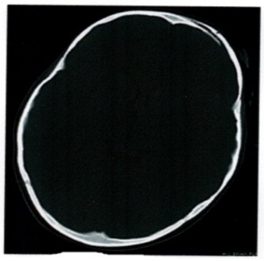
Table 9: Associated extra cranial injuries

Associated injury	Number of patients
Facio-maxillary	22
Chest	7
Chest +Extremity	1
Extremities	15

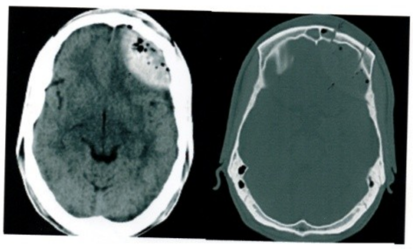
Table 10: Incidence of head injury in different ages (Zimmerman and Bilaniuk)

0-2 years	9.08%
3-10 years	25%
11-17 years	15.03%
18-30 years	19%
31-50 years	15%

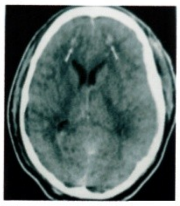


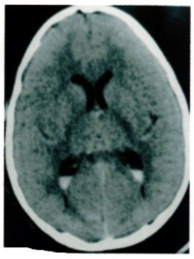


Axial NECT in a patient with trauma shows SUBGALEAL HEMATOMA (arrows) in the left parietal region and Axial NECT shows a linear fracture frontal bone on left side.

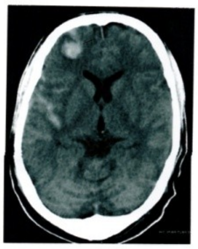


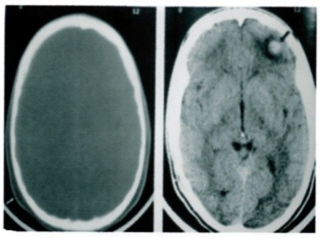
Axial NECT scan images shows ACUTE EXTRADURAL HEMATOMA (arrows) in the left parietal region and Axial NECT scan images shows EDH in the left frontal region with associated pneumocephalus and communited fracture of left frontal bone.





Axial NECT in a patient with trauma shows DIFFUSE AXONAL INJURY (bilateral frontal white matter hyperdensities (Arrows) with diffuse CEREBRAL EDEMA and axial NECT in a patient with trauma shows INTRAVENTRICULAR HAEMORRHAGE (hyperdense fluid levels in both the lateral ventricles).





Axial NECT in a patient with trauma shows HAEMORRHAGIC CONTUSION (arrow) in the right frontal region with minimal SAH and axial NECT in a patient with trauma minimal soft tissue contusion in the right occipital region and CONTRECOUP injury in the left frontal region.

V. Discussion:

The present study includes 100 patients with the history of head trauma. CT findings of different lesions were then studied. The various CT appearances of traumatic lesions can be classified into early, late and secondary effects.

Early effects are acute cerebral swelling and brain oedema, contusions, fractures , pneumocephalus, extradural hematoma, subdural hematoma, intracerebral hematoma, intra ventricular haemorrhage, subarachnoid haemorrhage. Late effects are post traumatic hydrocephalus, focal atrophy and infection. Secondary effects are subfalcine, transtentorial or uncal herniation.

In the present study, we had 49% of patients with oedema which accounted for highest number of cerebral lesions.

In the present study maximum head injuries occurred in age group of 19-50 years (79%) and people above 50 years were 21%. Zimmerman and Bilaniuk[1] reported the following incidence in 1978(Table 10).

In the present study, male to female ratio in our series of 100 patients was 9:1.Study by Clifton et al reported a similar ratio of 5:1[2].

In the present study, in case of mass lesions, 12.5% of EDH, 32.1% of SDH and 62.5% of ICH showed a fatal outcome. The outcome is therefore poor in SDH and ICH as compared to EDH , findings are correlated with those of Miller et al[3].

In the present study, 27 patients had midline shift .Outcome was poor in patients with shift of more than 5mm (45% mortality) while in patients with shift of <5mm, outcome was good with recovery in all cases. This showed that GCS was inversely proportional to the midline shift.

In the present study, operative intervention was planned in 6 patients of which poor outcome was noted in one patient of SDH.

In our series of 100 patients, we had 8 cases of intracerebral hematoma. The most frequent site for traumatic ICH was noted to be the frontal lobe. This correlates with findings by KOO and Laroque[4].

In the present study, out of 48% of contusions in our study, 8 cases (16.66%) were non haemorrhagic while 40 cases (83.33%) were haemorrhagic . Most had associated lesions. Associated intracranial hematoma, poor Glasgow coma scale and increasing age caused increased mortality in these patients[5].

In the present study, we had 28 cases of SDH of which 24 showed the typical hyper dense pattern[6,7]. 21 cases of SDH are associated with fracture. The findings correlated with the study done by Evans et al.

In the present study ,we had 3 isolated fractures, 64 linear and 12 depressed fractures. 26 had accompanying pneumocephalus . CT detected fracture in 80% of the cases. Thus skull radiography have little or no role to play in modern day imaging in the presence of CT scan[8,9].

VI. Conclusion:

In our study of 100 patients with definite history of head trauma, we tried to evaluate the role of CT in these patients. A majority of the patients were males in their second and third decades of life. CT affected management where patient treatment can be decided upon by characterizing lesions based on type, size and associated midline shift.

CT along with clinical evaluation and Glasgow coma score helps in predicting the outcome of patients indicating its prognostic value; midline shift and age also play a major role.

Since only plain study is required, CT does not need patient preparation and because of its non invasive nature, speed and ease of use with other monitoring systems, it is the technique of choice for evaluating head injuries.

Thus , it is justifiable to conclude that this simple, inexpensive, highly effective and safe imaging modality should be considered the first imaging modality of choice in acute head injury as it forms cornerstone for rapid and effective diagnosis

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