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Role of Computerized Tomography in Craniocerebral Trauma

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Abstract
Introduction: *Traumatic brain injury (TBI) is an extremely common and potentially devastating problem. CT is the single most informative modality in the evaluation of patients with head injury.*
Material and Method: *This Prospective Study is carried out in patients attending/referred to Sardar Patel Medical College & Associate Group of Hospitals, Bikaner patients with clinically suspected head injury during the period of March 2016 to Nov 2016. This study was conducted on 100 patients with clinically suspected head injury. They were evaluated with Multi detector Computed Tomography (PHILLIPS BRILLIANS 64 SLICE MDCT SCAN) and findings were correlated with clinical findings wherever applicable.*
Results: *out of 100 cases 58 cases underwent a conventional skull X-ray prior to CT examination. Skull radiography was found to be slightly better for detecting linear fractures than CT while CT was more specific for depressed fractures. The diagnostic accuracy of CT was 99% in the present study as compared to the accuracy of clinical examination which was 50%. The commonest lesion was contusion (39%) followed by edema (34%) and subdural hematoma (16%). 24% of cases revealed more than one type of lesion (Mixed) while 24% showed some associated soft tissue injury (Mainly hematoma). Mixed lesions were commonest in the adult age group. All the patients in normal category recovered fully. Among the minor, moderate and major categories the recovery was 70.58%, 42.87% and 28.57% respectively. An overall mortality of 19% was noticed. While edema, contusions and hematoma contributed to 31.5% of total mortality as individual lesions, as mixed lesions they accounted for more than 2/3rds (68.5%) of mortality. the gap between injury and CT scan increases the chances of recovery decrease and fatality increases.*
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*
Keywords: *Computed Tomography, Contusions, Hematoma.*

INTRODUCTION

Traumatic brain injury (TBI) is an extremely common and potentially devastating problem. Studies have estimated that nearly 1.6 million head injuries occur in the United States each year, resulting in over 50,000 deaths and over 70,000 patients with permanent neurological deficits.[1–3] TBI accounts for up to 10% of the health care budget and an estimated annual cost to society of $30 billion.[4] Because prompt proper management of TBI sequelae can significantly alter their course especially within 48 h of the injury, neuroimaging techniques, which can determine the presence and extent of the injury and guide surgical planning and minimally invasive interventions, play important roles in the acute therapy of TBI.[4,5] Imaging also can be important in the chronic therapy of TBI, identifying chronic sequelae, determining prognosis, and guiding rehabilitation.

Not all head trauma patients require neuroimaging.[6] Neuroimaging is, of course, costly and can consume scanner time that may be used for patients with other indications. Studies have found that less than 10% of patients that are considered to have minor head injuries have positive findings on CT and less than 1% require neurosurgical intervention.[7] But this implies that there are still a small number of low risk patients that would benefit from neuroimaging. On the other hand, reducing the number of CT's performed on minor head injury patients even by 10% may yield more than $10 million in savings each year.[8,9]

Defining minor versus major head injuries has been problematic. Certain circumstances suggest major injury and almost always merit imaging such as worsening level of consciousness, loss of consciousness for more than 5 min, focal neurological findings, seizure, failure of the mental status to improve over time, penetrating skull injuries, signs of a basal or depressed skull fracture, or confusion or aggression on examination.[10] However, there is debate over which other circumstances merit imaging. Whereas numerous criteria have been developed, including the New Orleans Criteria[11] and the Canadian Head CT rules,[12] even patients with the complete absence of clinical findings and high risk circumstances have been found to have intracerebral hemorrhage on imaging.[13]

MATERIAL AND METHODS

Study Area: Department of Radiodiagnosis, Sardar Patel Medical College & Associated Group of PBM Hospitals, Bikaner.

Study Design: Prospective Study

Study Duration: 6 months (Apr'2016- Oct'2016)

SOURCE OF DATA

Data for the study were collected from patients with clinically suspected head injury attending/ referred to the PBM Hospital, Sardar Patel Medical College, Bikaner.

Sampling Technique: Convenience sampling

Sample Size: All clinically suspected head injury patients, eligible as per inclusion criteria, reporting to Department of Radiodiagnosis within study duration.

Method of Data Collection: A descriptive correlational study was conducted on all patients with clinically suspected head injury. They were evaluated with Multi detector Computed Tomography (PHILLIPS BRILLIANS 64 SLICE MDCT SCAN) and findings were correlated with clinical findings wherever applicable.

A complete clinical history of the each patient was taken, which included, age, sex, type of injury and principal presenting complaints. The type of trauma was further classified into Road traffic accidents, falls, Assaults, industrial accidents and miscellaneous. This was followed by general physical examination and detailed examination of the whole abdomen. After initial resuscitation, severity of the cranio-cerebral trauma was graded with the help of "Glasgow Coma Scale" (GCS) as follows.

Grades Scores

- Normal 15
- Mild head injury 13-14
- Moderate head injury 9-12
- Severe head injury < 8

Inclusion Criteria

1. Patients of all age groups irrespective of their sex with craniocerebral trauma who were advised CT examination after clinical evaluation by treating surgeon.
2. Patients with a history of road traffic accident, fall or assault
3. Glasgow coma scale <15.

Exclusion Criteria

1. Patients with craniocerebral trauma who were hemodynamically unstable.
2. Penetrating injuries.
3. Patients with history of previous cerebrovascular accidents.
4. Patients with previous bleeding disorders.
5. Known diabetic and hypertensive patients receiving anticoagulant therapy.
6. Cranial trauma during childbirth.
7. Pregnant Women.
8. Patients who cannot be followed up.

Data Analysis: The information thus collected was entered into MS Excel worksheet and then analyzed with help of descriptive statistics and appropriate test of significance wherever required.

OBSERVATIONS

The present study "Role of computerized tomography in craniocerebral trauma" was carried out on 100 patients admitted to P.B.M. Hospital, Bikaner during April, 2016 to October, 2016. All patients were advised CT scanning after clinical examination by the treating surgeon. The following observations were made.

Table 1 Case distribution with respect to Age and Mode of Injury

S.N.	Age	RTA	Fall	Assault	Miscellaneous	Total
1.	0 – 10	4	14	-	-	18
2.	11 – 20	10	2	-	2	14
3.	21 – 30	18	2	5	1	26
4.	31 – 40	16	1	6	-	23
5.	41 – 50	3	1	-	2	06
6.	51 – 60	2	2	3	2	09
7.	61 & above	-	2	-	2	04
	Total	53	24	14	9	100

Above table shows that RTA was found to be the commonest mode of acute head trauma especially in the 20 – 40 years age group but in the pediatric age group (i.e. 0 – 10 years), fall was more common.

Table 2 Incidence of Fractures on Plain X – ray & CT

Modality	Total No.	%	Linear		Depressed	
			Total No.	%	Total No.	%
X ray skull AP/Lateral	34/58	58.6	27	79.4	7	20.6
CT scan	42/100	42.0	31	73.81	11	26.19

Table No. 2 shows that 58 of the 100 cases underwent a conventional skull X-ray prior to CT examination. Skull radiography was found to be slightly better for detecting linear fractures than CT while CT was more specific for depressed fractures.

Table 3 Diagnostic accuracy of CT and clinical judgement

S.N.	Diagnostic mode	Correct diagnosis		Wrong Diagnosis	
		Total No.	%	Total No.	%
1.	Clinical examination	50	50	50	50
2.	CT examination	99	99	1	1

The diagnostic accuracy of CT was 99% in the present study as compared to the accuracy of clinical examination which was 50%. The isolated wrong diagnosis was suspected to have an anoxic brain injury and no overt lesion was found in the brain parenchyma.

Table 4 Distribution of lesions on CT scan

S.N.	Lesion	No. of Cases	Percentage
1.	Normal*	29	29
2.	Contusion	39	39
3.	Edema Gen	22	22
4.	Edema Focal	12	12
5.	EDH	4	4
6.	SDH	16	16
7.	ICH	6	6
8.	SAH	6	6
9.	IVH	1	1
10.	Pneumocephalus	3	3
11.	Soft tissue swelling	24	24
12.	Mixed lesions	24	24

*= Including Cases with Fracture Skull but no parenchymal injury

The commonest lesion was contusion (39%) followed by edema (34%) and subdural hematoma (16%). 24% of cases revealed more than one type of lesion (Mixed) while 24% showed some associated soft tissue injury (Mainly hematoma).

Table 5 Correlation of clinical severity with CT grades

Clinical severity grade	Total No.	CT Grade							
		Normal		Minor		Moderate		Major	
		Total	%	Total	%	Total	%	Total	%
I	51	26	51.0	14	27.0	9	32.14	2	8.0
II	17	2	11.7	3	17.6	8	28.57	4	16.0
III	32	1	3.0	1	3.0	11	39.28	19	76.0

It is seen that as the clinical grade of severity increase, so does the probability of having an abnormal CT scan. This is evidenced by the fact that while more 50% of grade I cases had a normal CT scan, it decreased to 11.7 and 3% respectively in grades II & III. On the other hand 76% cases of grade III severity had lesions classified as major while only 16% and 8% of grades II and I respectively did so.

Table 6 Distribution of outcome in different CT categories in acute head trauma

S.N.	CT Category	Total No. of patients	Fully Recovered		Partly recovered	
			Total	%	Total	%
1.	Normal	29	29	100	-	-
2.	Minor	17	12	70.58	5	29.41
3.	Moderate	28	12	42.87	16	57.14
4.	Major	7	2	28.57	5	71.42

*=Incl. Focal Neurological Deficit, altered behaviour etc.

All the patients in normal category recovered fully. Among the minor, moderate and major categories the recovery was 70.58%, 42.87% and 28.57% respectively. On the other hand partial recovery was seen in 71.42% of major, 57.14% of moderate and 29.14% of mild category. Thus chances of partial recovery were more with increasing CT severity.

DISCUSSION

Data obtained in this study showed that in general, road traffic accidents were the commonest cause of craniocerebral trauma. In adults, they accounted for 57% of cases but in the pediatric age group, fall was the commonest mode accounting for nearly 75% of cases. Ghebrehiwet M, Quan LH, Andebirhan T et al[14] observed that the commonest causes of head injury were falls (36.4%), car accident (29.0%), stone injuries (15%), and bicycle accident (9%). Abnormal CT

findings were seen in 60 cases (54.5 %) and normal CT in 50 (45.5%).

In our study linear fractures occurred more than depressed fractures. CT was observed to be more specific for depressed fractures as compared to linear fractures. Ghebrehiwet M, Quan LH, Andebirhan T et al[14] observed that the most common CT findings were: intra cerebral hematoma 22 (20. %), cerebral contusion or laceration 18 (16.4%), skull fractures 16 (6%), and scalp swelling 3 (2.7%).

In our study linear fractures occurred more than depressed fractures. CT was observed to be more specific for depressed fractures as compared to linear fractures. Imtiaz AM (2016)[15] included 100 patients in the study. 72 % are males while females constituted only 28% showing male preponderance in acute TBI. 68% cases were associated with fracture of the vault. Of the 100 patients, 68 had positive CT scans. All patients with positive CT scan had one or more of 7 findings: headache, vomiting, age over 60 years, drug or alcohol intoxication, deficits in short term memory, physical evidence of trauma and seizures. Study revealed that performing CT in acute TBI, decreased morbidity and mortality and could lead to cost savings. Performing CT in all head injury patients was cost effective.

The diagnostic accuracy of CT examination was 99% as compared to the clinical accuracy (50%) in this study. The isolated wrong diagnosis was case no. 31 who was suspected to have anoxic brain injury despite having no overt lesion in his CT examination. Prayer and Rametsteiner[16] showed that computed tomography (CT) is the primary modality of choice for imaging patients with acute head trauma. Lesions of the soft tissues and bones can be assessed more precisely than with other imaging modalities

The present study indicates that the commonest lesions encountered in cranio – cerebral trauma were contusions (39%) followed by oedema (34% including general as well as focal). Of the hematomas, sub dural hematoma was commonest and resulted in 16% of cases. Mixed lesions were seen in 24% of cases. Similar results were observed by Tomar SPS et al[17] as they observed that the most common post traumatic consequences found in the study of adults are contusions, brain edema and intracerebral hematomas, while other sequelae such as subarachnoid hematomas, subdural hematomas and extradural hematomas are encountered less.

It was observed in this study that as the clinical grade of severity increases, so does the probability of having an abnormal CT scan. This is evidenced by the fact that while more than 50% of grade I cases had a normal CT scan, It decreased to 11.7% and 3% respectively in grades II and III. On the other hand, 84% of cases with grade III severity had lesions classified under Major while only 10% and 7% of grades II and I respectively did so.

Nayebaghayee H et al (2016)[18] observed that regarding clinical condition, of 200 study subjects, 161 (80.5%) had GCS 13–15 that among those, 45% had GCS 15. Also, 21 (10.5%) had GCS ranged 9–12 and 18 (9%) had GCS <8. Of all subjects, 109 (54.5%) had abnormal CT findings that of them, 77.1% categorized as mild head injury (GCS 13–15), 11.0% had moderate head injury (GCS 9–12), and 11.9% had severe head injury (GCS <9). Also, of those with GCS 15, 41.0% had abnormal CT scan. Of 109 patients with abnormal CT findings, 36 (33.0%) underwent surgery that 22 (61.1%) categorized in mild head injury group, 5 (13.9%) categorized in moderate head injury group, and 8 (22.2%) categorized in severe head injury group. Also, of those with GCS equal to 15, 10 (27.0%) underwent surgery. Regarding type of lesions in CT scans, the most common type of lesion was epidural hematoma (38.5%), followed by cerebral contusion (29.4%), and pneumocephaly (17.4%).

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.

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