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Radiology

A Descriptive Study on the Utility of Computer Tomography in the Patients of Head Injury

Dr. Sushant Bhadane[1], Dr. Sapana Bhadane[2*]

[1]MD Radiology, Associate Professor, Department of Radiology, SMBT Institute of Medical Sciences and Research Centre, Dhamangoan, Nashik, India
[2]MD Pathology, Assistant Professor, Department of Pathology, SMBT Institute of Medical Sciences and Research, Centre, Dhamangoan, Nashik, India

***Corresponding author:** Dr. Sapana Bhadane
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Abstract **Original Research Article**

Background: Cranio-cerebral trauma is one of the most common and grave forms of neurologic disease. Computed Tomography (CT) has been a major breakthrough in imaging of traumatized patient and offers the potential improvement in speed and diagnosis of injuries. ***Aims:*** To assess the utility of CT in the diagnosis, management and prognosis of patients with cranio-cerebral trauma. ***Settings and Design:*** An observational descriptive study was conducted at tertiary care teaching hospital of medical college of western Maharashtra.***Methods and Material:*** 600 patients with acute head injury were taken up for CT scanning, have been studied and analysed for evaluating the frequency of various lesions. ***Statistical Methods:*** Results analysed with mean, frequency & proportion. ***Results:*** Male to female ratio was 4:1. Oedema (29%) & Fracture (21%) were the most commonly encountered lesions while contusion (19%) was next to them. Patients with GCS scores <8 showed 80.7% mortality while scores between 13-15 showed only 2.5% mortality. SDH & ICH had poor prognosis (55% & 53% mortality) as compared to EDH (17% mortality). Prognosis was poor when midline shift was more than 5 mm (90% deaths). ***Conclusions:*** CT imaging modality should be considered as the investigation of first choice in cases of acute head injury & useful in management of acute head trauma cases and lead to change in management of significant number of patients.
Keywords: Head Trauma, Mild Head Injury (MHI), Sub Dural Haemorrhage, Prognosis, GCS.

INTRODUCTION

Cranio-cerebral trauma is one of the most common and grave forms of neurologic disease. Computed Tomography (CT) has been a major breakthrough in imaging of traumatized patient and offers the potential improvement in speed and diagnosis of injuries [1,2]. Earlier, mainstay of diagnosis of intracranial lesions was clinical evaluation, plain radiographs and cerebral angiography. But accurate and rapid diagnosis rarely be made on basis of physical examination alone. Plain radiographs and angiography suffer from lack of sensitivity and specificity [3, 4].

CT scan demonstrate significant primary traumaticcranio-cerebralinjuries[5]. CT is essential for establishing an accurate diagnosis and has direct bearing on deciding management. Follow up assessment using CT is frequently necessary to detect progression and stability of lesions and evidence of delayed complications of cerebral injury [6].

CT is quick and non-invasive method to assess 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 cranio-cerebral trauma.

METHODS & MATERIAL

An observational descriptive study of the usefulness of CT for the evaluation of patients with acute craniocerebral trauma was initiated after approval of the protocol by Institutional Ethical Committee (IEC). Study was conducted in Pravara Rural Hospital, Loni. Total 600 patients with acute head injury were taken up for CT scanning, have been studied and analysed for evaluating the frequency of various lesions. Criteria for inclusion of cases were that patients were suspected clinically of having cranio-cerebral traumatic lesions. Cases with normal CT scans and uneventful clinical course have been excluded. The study required a thorough neurologic evaluation and determination of the level of consciousness (GCS) [7] by an experienced neurosurgeon or neurologist within 6 hr of admission to the hospital. Six hundred patients constituted the study group.

CT Scanner with specifications- Model (GE Syteee 2000 I), Detectros (Xenon gas), Number of detectors (750), Image matrix (512*512), Scan time(2.3 sec, 3.6 sec), KVp (120), mA (40-160), Image memory (1200) & Gantry tilt (+/- 25 degrees) was used. Certain precautions were taken in head injury patients. Cervical spine X-ray with single lateral view including C7, T1 region was taken as neck manipulation was needed to position the head for CT scan. Post contrast CT scan was avoided in acute head injury patients. Patient was placed on CT scan table, in supine position. Table was manually adjusted so that light beam coincided with external auditory foramen of patient. Horizontal light beam was adjusted so as to overlap the orbito-meatal line. This represented zero position. Patient in supine position, 5mm axial section for posterior fossa and 10mm axial sections were taken thereafter. Additional high resolution sections were taken in areas of interest. Infants were kept with warm blankets. Computer generated coronal & sagittal reconstruction was used where positioning of patient was not achieved. Coronal information was not mandatory procedure in scanning patients with acute cranio-cerebral trauma.

An attempt was made to differentiate between injuries resulting from the initial traumatic force (primary) and those arising from delayed posttraumatic (secondary) causes such as diffuse brain swelling, brain displacement and herniation, delayed haemorrhage, cerebral infarction, and diffuse hypoxic injury [8]. In many instances it was difficult to separate primary and secondary damage. For purposes of statistical analysis, however, all focal abnormalities that were not obviously secondary in nature were classified as primary lesions. Primary intracranial lesions were classified as (1) Intra axial lesions; (2) Extra axial hematomas (subdural, epidural); and (3) Diffuse haemorrhage (intraventricular, subarachnoid). Intra axial lesions were sub classified as diffuse axonal injury (white-matter “shear” injury), cortical contusion, subcortical gray-matter injury, or primary brainstem injury. All intra axial lesions were further separated into haemorrhagic and non-haemorrhagic subsets [9]. Data was entered in Microsoft Excel 2007 and descriptive statistics like frequency and proportions were used to analyse the data. Tables & figures used at appropriate places.

Results

The present study aimed to evaluate the role of CT in patients of cranio-cerebral trauma. In all 600 patients with definite history of head trauma were studied. Table no. 1 depicts age and gender wise distribution of 600 patients. The number of male patient (80%) outnumbered female patients (20%). All ages were affected by trauma as patients in this study ranged from one and half month to 80 years of age. Maximum head injuries occurred in age group of 19-40 years of age (63%). Paediatric age group comprised 12.6% while adolescent patients were 6% [Table no.1].

The CT findings of 600 patients with acute cranio-cerebral trauma examined are summarized in figure no. 1 and table no. 2. Oedema (29%) & Fracture (21%) were the most commonly encountered lesions while contusion (19%) was next to them. Linear fracture was seen in 116 patients while depressed fracture was seen in 50 patients. Isolated fractures formed 32.5% while 67.5% fractures were associated with other lesions. Pneumocephalus associated with basilar & depressed fracture was seen in 44 patients. Heamatomas ware seen in 104 patients. EDH was seen in 5.6% patients and was associated with overlaying fracture in 70% of cases. SDH was seen in predominance. ICH was seen in 5% patients and was seen associated with subarachnoid haemorrhages equally.

Mass lesions were associated with midline shift in 44 cases while associated herniation was seen in 20 cases. Subfalcine herniation was seen commonly. There were 18 (2%) cases of IVH. Total 44 patients had herniation in isolation or combination. CT detected 97.5% fractures. 2.5% fractures were detected on plain radiographs alone while 77.5% fractures were detected on both modalities. 114 patients had associated faciomaxillary injuries, 56 patients had frontal injuries in isolation or combination of which had 24 parenchymal lesions [Table no.2 & Fig. no.1].

Table no. 3 shows GCS wise distribution of outcome. Those with scores <8 showed 80.7% mortality while scores between13-15 showed only 2.5% mortality, pointing to favourable outcome in this group. Patients were classified into those with Minor injury (i.e. GCS of 13-15) & Major injury (GCS of <13). Those with minor injuries i.e. GCS of 13-15, added lesions were noticed in 57% cases. In this study, out of 600 patients, 480 had GCS of 13-15. Out of this, fracture was noticed in 31.6% while oedema & contusion contributed to 20% lesions.Patients with GCS <13 having mass lesions, operative intervention was planned based on CT findings of its type, size & associated midline shift [Table no. 3].

Table no. 4 depicts mortality related to CT findings. Large EDH & SDH more than thick & causing midline shift of 5 mm or more were considered for operative intervention. Six cases of EDH, 14 cases of SDH & 2 cases of ICH underwent evacuation. In case of non-mass lesions like cerebral oedema, prompt & effective measures to reduce elevated intracranial pressure formed mainstay management. Presence of mass lesion pointed to unfavourable outcome (68.7% mortality) as compared to diffuse lesions. In haematomas SDH & ICH had poor prognosis (55% & 53% mortality) as compared to EDH (17% mortality). Prognosis was poor when midline shift was more than 5 mm (90% deaths). Presence of polytrauma was a pointer to poor prognosis [Table no. 4].

Table-1: Age & Gender wise distribution (n=600)

Age Groups	Male (%)	Female (%)	No. of patients (%)
Paediatrics (0-12 yrs)	56 (11.6)	20 (16.6)	76 (12.6)
Adolescent (13-18 yrs)	30 (6.2)	6 (5)	36 (6)
Adult (19-49 yrs)	312 (65)	70 (58)	382 (63.6)
Elderly (>49 yrs)	82 (17)	24 (20)	106 (17.6)
Total	480	120	600

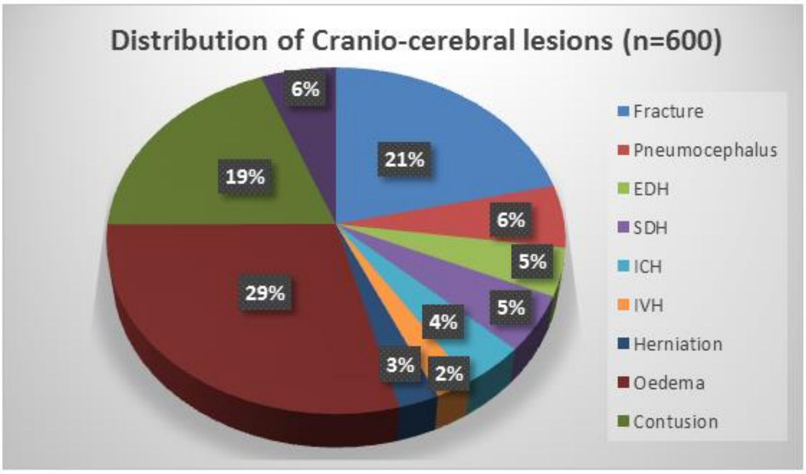

Fig-1: Distribution of Cranio-cerebral lesions (n=600)

Table-2: CT scan details of Cranio-cerebral lesions

CT Scan details of Cranio-cerebral lesions			
		No. of patients	Percentage
EDH (n=34)	With fracture	24	70.5
	Without fracture	10	29.5
SDH density pattern (n=40)	Hyperdense	34	85
	Isodense	2	5
	Hypodense	2	5
	Mixed	0	0
	Layering	2	5
ICH associated findings	Oedema	18	64.3
	SAH	8	28.6
	IVH	8	28.6
	EDH	4	14.3
	SDH	8	28.6
	Fracture	10	35.7
Contusion	Nonhaemorrhagic	68	46.6
	Haemorrhagic	78	53.4

Table-3: Glasgow Coma Scale- Early & Late deterioration

GCS	No of patients	Recovered	Died in 48 hr.	Died after 48 hr.	Total Deaths (%)
3-5	32	4	12	16	28(87.5)
6-8	20	6	2	12	14(70)
9-12	68	54	4	6	10(14.7)
13-15	480	466	0	12	12(2.5)

Table-4: Mortality related to CT findings

Mortality related to CT Findings			
CT findings		Deaths (%)	Total Deaths
Midline shift (n=44)	< 5 mm (n=22)	4 (19)	24
	>5 mm (n=22)	20 (91)	
Type of lesion (Total abnormal scan=420)	Mass lesion (n=104)	44 (68.7)	64
	No mass lesion (n=316)	20 (31.3)	
Haematomas (n=104)	EDH (n=34)	6 (17)	44
	SDH (n=40)	22 (55)	
	ICH (n=30)	16 (53)	

Discussion

It is advisable to perform CT in every case of head injury [9]. Neurologists usually follow various criteria by which they decide the necessity for performing CT on different patients of head trauma. Results from different countries reflect the effects of sampling bias, as there may be different marked variation in the type of patients and severity of head injury.

The male to female ratio in our study of 600 patients was 4:1. This reflects the fact that male were more to injuries as compared to female due to social role assigned to them. Study by Kelly *et al*. reported a ratio of 2:1[10]. Comparable findings were noted in study done by Jamieson &Yelland where ratio was 4.6:1[11]. Maximum number of head injuries occurred in adult age group which constitute major working population as they were more prone to road traffic accidents which is a major cause of head injury. Similar trend was noted in study done in Taiwan where the mean age of head trauma was 32 years [12] and study done by Zimmerman *et al*. [13]. In study done by Ewoud Pons *et al*. CT was performed in 3887 patients (85.4%), identifying 414 (9.1%) intracranial traumatic findings. Over time, the utilization of CTs in Minor Head Injuries increased [14].

Cerebral oedema occurs in maximum cases of head trauma. The CT pattern differs to certain extent in children and adults. We had 29% cases of oedema followed by 21% cases of fractures which is comparable to the study by Kelly *et al*. which had 34% cases of oedema & 14.3% cases of fractures in their series [10]. Stein and Ross [15] obtained 30.9% for the brain swelling andthe literature varied from 5% [16] to 11% [17]. Shackford *et al*. observed 19.3% of skull fractures, a finding closer to our study [16]. Focal brain contusion may develop at point of impact or remote from site. CT showed contusion as heterogenous lesions (50-70 HU) surrounded by irregularly marginatedhypodensity. There were 146 cases of contusion of which 46.5% were nonhaemorrhagic while 53.5% were haemorrhagic. 54.1% had associated fractures. Cerebral contusions were seen in 25% [18] to 26.8% [19]. The present study showed similar results (21%) which are higher than study done by Kelly *et al*. (12.9%) [10].

Plain radiographs may be useful in diagnosis of linear skull fractures that may go unnoticed on CT due to odd plane of occurrence. However, modern day CT in addition to detection of fractures detects minor lesions that would go unnoticed on plain radiographs. Hence no added benefit gained by plain radiographym[9]. Out of 34 cases of EDH, 70.5% patients had associated fracture. EDH has strong representation in 21-30 years of age group. Same age group showed maximum incidence of fracture &intradurallesions[13]. We had 40 cases of SDH of which 34 showed the typical hyperdense density pattern. SDH seen in other studies are 5% & 36%. Hyperdense SDH dominated the series [20, 21]. ICH appears on CT as homogenous hyperdense lesions (70-100 HU) with irregular margins surrounded by oedema. We had 30 cases of ICH. The most frequent site for traumatic ICH was frontal lobe. Frequently accompanying ICH were extracerebral haemorrhages as well as SAH & IVH. This correlates with findings by Koo & La Roque [22].

Stein and Ross found 6.8% of epidural hematoma (EDH) and 4.5% of subdural hematoma (SDH) [15]. Our study showed similar numbers: 6.6% of SDH and 5.6% of EDH. Similar findings are noted in study done by Kelly *et al*. [10].We had a same frequency of pneumocephalus (6%), when compared to Shackford [16] (5.4%) and Feuerman *et al*. [23] (13.2%). Lower frequency (1.5%) reported by Kelly *et al*. [10]. Patients with fracture but no neurodeficit were safely discharged after a period of observation of 48 hours. Among those with detected lesions 14 patients underwent operative intervention (2.9%), 8 for evacuation of haematomas, 4 for elevation of depressed fractures and 2 as combination of above. Studies done by Shravat *et al*. reported similar findings [24]. The outcome was therefore poor in SDH & ICH as compared to EDH. Study done by Miller et al attributed 28%, 65% % 58% deaths to EDH, SDH & ICH respectively [25]. CT in acute head trauma is frequently performed investigation in western countries [20, 26]. Stein *et al*. recommended routine and immediate CT scanning of all head injury patients who have lost consciousness, even if other physical findings were normal[15].

CONCLUSIONS

CT imaging modality should be considered as the investigation of first choice in cases of acute head injury & useful in management of acute head trauma cases and lead to change in management of significant number of patients.

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