Original Research Article

Study on Imaging Characteristics of primary brain injury on the first CT scan and its predicting outcomes

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Abstract

Background: Traumatic brain injury (TBI) is a form of acquired brain injury resulting from an external mechanical force leading to temporary or permanent impairment of cognitive, physical and psychological functions with associated diminished or altered state of consciousness. **Aim and Objectives:** to assess the imaging characteristics of primary brain injury on CT scan and to evaluate these imaging features as predictors of clinical outcome in patients with brain injury. **Material and Method:** This is prospective cohort study conducted for duration of one year, in the department of Radiodiagnosis, Katuri medical college and Hospital, Guntur, in which 50 Consecutive head injury patients with positive neuro parenchymal findings in CT scan with GCS less than 12, after following inclusion and exclusion criteria an approved by institutional ethical committee. **Results:** 50 patients with head injury were included with the mean age was 37.56±11.45 years, mean GCS at presentation was 8.43±1.46 (range: 3 to 12). 23 patients (46%) were noted to have moderate head injury and 27 (54%) had severe head injury. Major CT imaging findings observed subarachnoid haemorrhage (90%), contusion (84%), subdural haemorrhage (70%) and midline shift (36%), Extra Dural Haemorrhage (32%). Out of all 16 patients were non-survived **Conclusion:** Outcome of study subjects were positively associated with GCS score of study subjects as well as the CT findings of study subjects.

Keywords: Computed Tomography, Traumatic brain injury, Glasgow Coma Scale, subarachnoid haemorrhage

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INTRODUCTION

Many research literature have observed that "head injury (HI) and traumatic brain injury (TBI)" have being used interchangeably. However, there are basis to disagree or vary in opinion. Anatomically the word "head" refers to a unit structure constituted by skull (i.e. bony and soft tissue of face and vault), scalp (immediate soft tissue covering of the skull) and brain (structure enclosed in the skull). Hence, HI can be defined as physical damage that may involve the skull and or scalp and or brain, but TBI cannot entail injury of the skull and or scalp. Traumatic brain injury (TBI) is a form of acquired brain injury resulting from an external mechanical force leading to temporary or permanent impairment of cognitive, physical and psychological functions with associated diminished or altered state of consciousness. TBI is a major public health problem worldwide and is predicted to surpass many diseases as a major cause of death and disability by the year 2020.[1] The majority (60%) cases are due to road traffic accidents (RTA), followed by falls (20-25%) and violence (10%).[2] TBI pathogenesis is a complex process that results from primary and secondary injuries that lead to temporary or permanent neurological deficits. The primary deficit is related directly to the primary external impact of the brain. The CT scan of patient is useful, not only in demonstrating the underlying neuro parenchymal injury but can also play a predictive role in traumatic brain injury[3] TBIs are the commonest cause of morbidity, mortality, disability and socioeconomic losses. Due to availability, affordability and shorter scan time along with bone fracture delineation, CT is preferred over MRI as a primary investigation of traumatic brain injury. Computed Tomography scanning of head is routinely done in all severe brain injury patients which provides information for further management including surgical intervention or intracranial pressure (ICP) monitoring. It may also provide prognostic

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significance information. CT is the single most and primary modality in the evaluation of patients with acute head injuries.[4] Conventional CT is more available, cost-effective, requires shorter imaging time and easy to perform on patients on ventilator support, in traction, oragitated is the initial imaging modality of choice during the first 24 h after the injury. Reduced time as well as evaluation the bone injuries are the additional advantages. Thus we have undertaken this study to assess the imaging characteristics of primary brain injury on CT scan and to evaluate these imaging features as predictors of clinical outcome in patients with brain injury.

MATERIALS AND METHOD

Study Design: This is Prospective Cohort study.
Study Period: For the period of One year
Study Place: Department of Radiodiagnosis, Katuri Medical College and Hospital, Guntur.
Study Samples: 50 Consecutive head injury patients with positive neuro parenchymal findings in CT scan with GCS less than 12.

Inclusion Criteria: Head injury patients with positive neuro parenchymal findings in CT scan with GCS less than 12.
Exclusion Criteria: Poly trauma, GCS more than 12
Methodology
The findings of the CT scan were evaluated by two blinded independent radiologists. The data regarding demographic information, history of the patient, cause of the trauma and CT findings were obtained for all the patients and recorded in the questionnaire, particularly designed for the research. The CT scans of the patients were studied for the presence of intracranial bleed, contusion, effacement of basal cisterns, midline shift, diffuse axonal injury and herniation. Patients with significant operable lesions were operated upon immediately and others were managed conservatively with ventilator support, anti edema measures and anticonvulsants. Clinical outcome of the patients were evaluated at 6 months according to the Glasgow outcome score (GOS): Grade 1- good recovery, Grade 2- moderate disability, Grade 3- severe disability, Grade 4- persistent vegetative state and Grade 5- death.
The study was conducted according to local ethics committee requirements.

OBSERVATIONS AND RESULTS

A total of 50 patients with head injury were included in this analysis. The mean age at presentation was 37.56±11.45 years (range:17 to 68 years). Majority of patients (70%) were in the 20-40 years age group. In our study predominance of male patients were observed (Table 1)

Table 1: Distribution of socio-demographic profile of study population

Parameters	Frequency	Percentages
Age		
< 20 Years	3	6
20 - 40 Years	35	70
40 - 60 Years	7	14
> 60 Years	5	10
Gender		
Male	42	84
Female	8	16
Level of Injury (GCS)		
Moderate Injury (≤8)	23	46
Severe Injury (9 - 12)	27	54

The mean GCS at presentation was 8.43±1.46 (range : 3 to 12). 23 patients (46%) were noted to have moderate head injury and 27 (54%) had severe head injury.

Table 2: Distribution of major CT findings among the study of population brain Injury.

CT Findings	Frequency	Percentages
Extra Dural haemorrhage	16	32
Subdural haemorrhage	35	70
Subarachnoid haemorrhage	45	90
Contusion	42	84
Intraventricular haemorrhage	7	14
Basal cistern effaced	9	18
Midline shift	18	36
Diffuse axonal injury	4	8

The major CT imaging findings observed were (in order of frequency) subarachnoid haemorrhage (90%), contusion (84%), subdural haemorrhage (70%) and midline shift (36%), Extra Dural Haemorrhage (32%).

Table 3: Prognostic Factors on CT among outcomes of study population.

CT Findings	Death (n =16)	Alive (n = 34)	Total	P-value
Extra Dural haemorrhage	2	14	16	0.005**
Subdural haemorrhage	11	24	35	0.73
Subarachnoid haemorrhage	15	30	45	0.544
Contusion	13	29	42	0.71
Intraventricular haemorrhage	5	2	7	0.015*
Basal cistern effaced	5	4	9	0.094
Midline shift	7	11	18	0.0433*
Diffuse axonal injury	2	2	4	0.421

The presence of intraventricular haemorrhage, Extra Dural Haemorrhage, midline shift on baseline CT were significantly associated with adverse outcome in our study

Observed Images

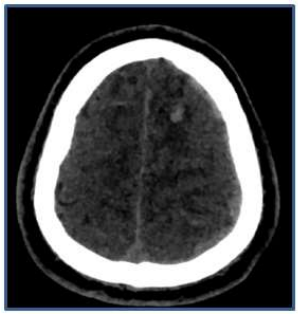

Figure 1: Subdural Haemorrhage; **Figure 2:** Subarachnoid haemorrhage

Figure 3: Contusion; **Figure 4:** Diffuse axonal injury

DISCUSSION

Assessment of prognosis of traumatic brain is one of the neglected areas in research barring a few attempts to create scoring system. First CT scan of traumatic brain injury patient is used not only in diagnosing neuroparenchymal injury but also plays predictive role. India has 1% of the worlds vehicles, but 6% of total global RTA deaths. TBI is thus associated with significant socioeconomic losses in India as well as other developing countries, placing a considerable burden on the health care system in these countries.

Although several combinations of predictors of outcome have been applied to assess the prognosis of these patients no model has satisfied all the requirements of an ideal model. Most of the models are from population in high income countries and only a few are developed using populations from low- and middle-income countries, where most of trauma occurs. therefore the generalizability of the models to these settings is limited.[5]

Figure 5: Intraventricular Haemorrhage **Figure 6: Subfalcine Herniation**

In the present study mean age at presentation was 37.56±11.45 years (range:17 to 68 years) and majority of the patients were form age group of 20-40 years of age. In a study by Dr Arun Kumar. V. B *et al.* (2014)[6] patients age were ranging from 16 to 70years. Out of 85 patients, 20-40yrs age group contributes maximum of 49patients. In our present study we have observed predominance of male over female, because maximum cases we have encountered with RTA and during office timings. According to the Dr Arun Kumar. V. B *et al.* (2014), out of 85 patients, study sample consists of 71 male and 14 female. In our study we have observed with moderate brain injury which was supported by De. Arun Kumar V. B *et al.* 90% study subjects had SAH, 84% subjects had contusion, 70% subjects had SDH, 36% study subjects shows midline shift, 32% subjects shows EDH, 18% shows basal cisterns injury and 8 % study subjects shows diffuse axonal injury. Compared to previous studies done elsewhere we observed a greater prevalence of intracranial haemorrhage in our series of patients with TBI. The rates of intracranial haemorrhage following TBI have been reported to vary between 46-56%.[7,8] Several studies have reported the presence of subarachnoid hemorrhage in TBI as a powerful

factor associated with poor outcome.[9,10] But in our study we could not find an association between subarachnoid hemorrhage and un favorable outcome. Although diffuse axonal injury (DAI) is difficult to diagnose by CT, out of the 4 patients with diffuse axonal injury, 2 patients had an unfavorable outcome (50%). The presence of Extra Dural haemorrhage, intraventricular hemorrhage, and midline shift on baseline CT were significantly associated with adverse outcome in our study. Fearnside *et al.* have also reported that midline shift was an important predictor of mortality along with intra-ventricular blood and cerebral edema.[11]

LIMITATION

We were not able to accomplish large population group due to loss of patients follow up and inadequate volume of cases(moderate to severe traumatic brain injury) and not included mild injury who can have less chance of Mortality.

Combination of individual imaging features not assessed.

CONCLUSION

From overall observation and after discussion with others study we can conclude that, predicting outcome in patients with severe traumatic brain injury is challenging and controversial. Features on CT such as intraventricular haemorrhage, Extra Dural haemorrhage, midline shift, were associated with unfavorable outcome. By noting these easily identifiable features on CT it would be possible to identify more severely injured patients with worse prognosis and target their management accordingly. And also outcome of study subjects were positively associated with GCS score of study subjects as well as the CT findings of study subjects.

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