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Original Article

Radiology Section

Evaluation of Craniocerebral Trauma by Computed Tomography

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ABSTRACT

Introduction: Craniocerebral trauma results in a substantial number of deaths and permanent disabilities around the world. Head injuries account a significant cause of death in younger age groups. Computed Tomography (CT) is a widely accessible, fast, effective and comparatively inexpensive imaging modality in assessing craniocerebral injuries. CT is now accepted as the investigation of choice in imaging of acute head trauma.

Aim: To assess the role of CT in traumatic brain injuries in correlation with clinical status of patients (GCS).

Materials and Methods: A total 100 cases with history of craniocerebral trauma undergoing CT scan within 24 hours of admission were selected. All the patients were subjected to CT for assessment of spectrum of primary craniocerebral injuries, followed by its association with severity of head injury with Glassgow Coma Scale (GCS) score as reference standard. CT was performed with high speed dual CT GE medical systems. Statistical analysis was performed by using Microsoft Excel 2013 and SPSS 20.0 software. Descriptive statistical analysis was conducted. The t-test and Fisher's-exact test was used for statistical correlation.

Results: Mild head injury accounted for 26%, moderate head injury accounted for 27% and severe head injury accounted for 47%. Significant statistical association was found between severity of the head injury and spectrum of primary craniocerebral injuries on CT and GCS score. Significant association was noted between Cerebral oedema, Midline shift, Extradural Haemorrhage (EDH), Subdural Haemorrhage (SDH), Subarachnoid Haemorrhage (SAH), Contusions, Pneumocephalus, Diffuse axonal injury with severity of head injury and GCS score. No significant association was noted between gender with severity of head injury and GCS score.

Conclusion: CT assessment of primary craniocerebral injuries in combination with clinical assessment of the patient using GCS as reference standard helps in deciding severity of the head injury thereby aids in planning treatment of the patient.

Keywords: Extradural haemorrhage, Glassgow coma scale score, Subarachnoid haemorrhage, Subdural haemorrhage, Traumatic brain injury

INTRODUCTION

Traumatic Brain Injury (TBI) is caused by a violent blow over the head by heavy objects and bullets which lead to TBI causing partial and total disturbances in its function [1]. TBI can be divided into primary and secondary injuries. Primary lesions are the direct result of trauma to the head, and secondary lesions arise as complications of primary lesions.

Clinical management of the head-injured patient begins with assessment of the degree of patient risk according to the symptoms of intracranial injury. This assessment can then be used as a guide to further treatment. The severity of TBI is clinically categorized using the Glasgow Coma Scale (GCS). The GCS is a summation of scores based on motor, verbal, and eye function with a range of 15-3, and can be categorized as mild 15 to 12, moderate 12 to 8; and severe as GCS less than 8 [2].

CT is a fast and accurate technique and is used for the detection of intracranial haemorrhage, mass effect and oedema, skull fractures, displaced bone fragments in cases of fractures, foreign bodies, and intracranial air.

Thus, this study aims to assess the role of CT in TBI in correlation with clinical status of patients (GCS) thereby helping clinicians in planning the appropriate treatment.

MATERIALS AND METHODS

The present observational study was conducted in the Department of Radiodiagnosis, Mysore Medical College and Research Institute, Mysore, Karnataka, India, during January 2015 to December 2015. A total 100 cases with history of craniocerebral trauma undergoing CT scan within 24 hours of admission were included. Cases with TBI >24 hours, clinical diagnosis of stroke and prospective cases were excluded from the study. Informed consent was obtained from all the cases. Study protocol was approved by institutional ethics committee (MMCRI/IEC/2015/31). A structured case proforma was used to enter the patient details and history. Clinical status of patients at admission was assessed using GCS and severity was determined. The CT examination was performed in head window settings using Dual slice CT GE Medical systems. The images were obtained in axial sections followed by multiplanar reconstruction. The images were evaluated to look for primary craniocerebral injuries and to associate CT findings with clinical status of the patients using GCS as reference standard. Primary craniocerebral injuries like Skull fractures, Pneumocephalus, Cerebral oedema, Midline shift, EDH, SDH, SAH, Contusions, Intraventricular haemorrhage, Diffuse axonal injury were documented. The severity of the craniocerebral trauma and levels of consciousness was graded with the help of GCS [3].

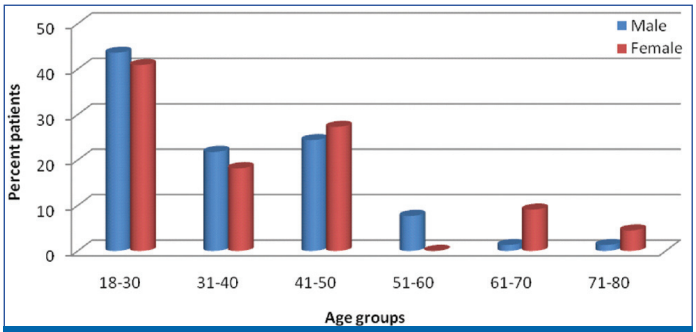
STATISTICAL ANALYSIS

Statistical analysis was performed using Microsoft Excel 2013 and SPSS 20.0 software. All the study cases were randomly assigned to compare the means of two groups, t-test was used. Descriptive statistical analysis was conducted. Fisher's-exact test was used for statistical correlation.

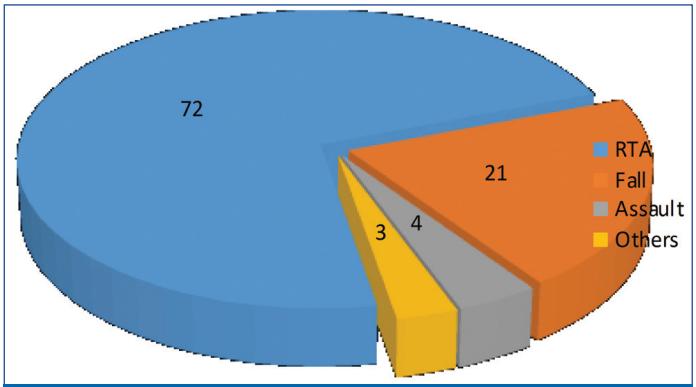
RESULTS

A total 100 cases with history of craniocerebral trauma undergoing CT scan within 24 hours of admission before the surgical procedure were considered. All cases were between age group 2nd to 8th decades with a mean age of 37.89. Majority cases were in between

2nd to 3rd decades (43%) [Table/Fig-1]. Among the cases 78% were males and 22% were female subjects. Cases distributed based on modes of injury is depicted in [Table/Fig-2].



[Table/Fig-1]: Age and sex wise distribution of patients.



[Table/Fig-2]: Distribution of cases based on modes of injury.
*RTA-Road Traffic Accidents.

Among the patients, 63% patients had fractures and 37% patients with no fractures. Among the 63 patients presented with fractures 46 patients (73%) had linear fracture, 12 patients (19%) had displaced fracture and 5 patients (7.9%) had skull base fracture [Table/Fig-3].

Distribution of fractures	Fracture frequency		Fracture type	
	Frequency	Percentage	Frequency	Percentage
Absent	37	37%	-	-
Linear	46	46%	46	73%
Displaced	12	12%	12	19%
Skull base	5	5%	05	7.9%

[Table/Fig-3]: Distribution of various kinds of fractures.

Among 100 cases, 72% cases had Extra-axial haemorrhages which comprise 35% cases of EDH, 42% patients of SDH (42%) and 28% patients of SAH. Few cases had combination of haemorrhages.

In the present study 18 patients had Pneumocephalus and 55 patients had Cerebral Oedema. Pneumocephalus, Cerebral Oedema and midline shift had a significant association with severity of head injury with GCS Score (p<0.005) [Table/Fig-4].

In this study among 100 patients, 35% patients had EDH and 65% patients with no EDH, 42% patients had SDH and 58% patients with no SDH and 28% patients had SAH and 72% patients with no SAH. EDH, SDH, SAH and contusions had a significant association with severity of head injury using GCS Score (p<0.005) [Table/Fig-5].

In the present study 26% patients had mild head injury, 27% had moderate head injury and 47% had severe head injury [Table/Fig-6].

			GCS			p-value
			Severe (3-8)	Moderate (9-12)	Mild (>13)	
Pneumocephalus	P	Number	16	2	0	0.005
		Percentage	34%	7.4%	0	
	A	Number	31	25	26	
		Percentage	66%	92.6%	100%	
Cerebral oedema	P	Number	39	10	6	0.005
		Percentage	83%	37%	23.1%	
	A	Number	8	17	20	
		Percentage	17%	63%	76.9%	
Midline shift	P	Number	21	0	0	0.005
		Percentage	44.7%	0	0	
	A	Number	26	27	26	
		Percentage	55.3%	100%	100%	

[Table/Fig-4]: Prevalence and association of Pneumocephalus, Cerebral oedema and Midline shift with GCS Score.

			GCS			p-value
			Severe (3-8)	Moderate (9-12)	Mild (>13)	
EDH	P	Number	24	8	3	0.003
		Percentage	51.1%	29.6%	11.5%	
	A	Number	23	19	23	
		Percentage	48.9%	70.4%	88.5%	
SDH	P	Number	27	10	5	0.005
		Percentage	57.4%	37%	19.2%	
	A	Number	20	17	21	
		Percentage	42.6%	63%	80.8%	
SAH	P	Number	20	6	2	0.005
		Percentage	42.6%	22.2%	7.7%	
	A	Number	27	21	24	
		Percentage	57.4%	77.8%	92.3%	
Contusions	P	Number	26	8	4	0.002
		Percentage	55.3%	29.6%	15.4%	
	A	Number	21	19	22	
		Percentage	44.7%	70.4%	84.6%	
IVH	P	Number	3	0	0	0.175
		Percentage	6.4%	0	0	
	A	Number	44	27	26	
		Percentage	93.6%	100%	100%	
DAI	P	Number	5	0	0	0.05
		Percentage	10.6%	0	0	
	A	Number	42	27	26	
		Percentage	89.4%	100%	100%	

[Table/Fig-5]: Prevalence and association of EDH, SDH, SAH, Contusions, IVH and DAI with GCS Score.

Severity	No of cases
Mild	26
Moderate	27
Severe	47

[Table/Fig-6]: Severity of head injury assessed with GCS score.

DISCUSSION

All cases were between age group 2nd to 8th decades with a mean age of 37.89. Majority cases were in between 18 to 30 years (43%). Study by Saboori M et al., reported a mean age of 29 years for patients of head injury [4]. Kumar A et al., in his epidemiological survey upon age group found that 21-30 years was the most vulnerable (34.06%), age group followed by 31-40 years (20.18%) for cerebral injuries [5]. Among the cases 78% were males and 22% were female subjects. Male predominance was found in several studies [1,6,7].

The most common mode of injury in this study was RTA 72%, followed by fall from height 21%, assault 4% and others 3%. In a cross-sectional study done by Farshchian N et al., the most common causes of TBI were car accidents (72.9%), violence (20.8%) and fallings (6.27%) [8]. Gururaj G in his study noted that craniocerebral trauma occured in 60% by RTA, 20-25% by falling injuries and 10% by violence [9]. Moragado FL et al., in their study stated that cranial fractures occurred in 52.9% cases by automobile accidents, in 20.6% cases by fall of heavy objects, in 10.8% cases by pedestrian injuries, in 7.8% cases by falling injuries and in 6.9% cases by aggression [1].

Among the patients, 63% patients had fractures and 37% patients with no fractures. Among the 63 patients presented with fractures 46 patients (73%) had linear fracture, 12 patients (19%) had depressed fracture and 5 patients (7.9%) had skull base fracture. In a study by Lloyd D et al., showed an incidence of linear fractures in 72.04% of cases and depressed fractures in 9% of cases [10]. Study by Nayebhageyee et al., the overall prevalence of skull fracture was 30.0% as linear fracture in 76.7%, a depressed fracture in 23.3%, and combined fracture in 3.3% [11].

In the present study 18 patients had Pneumocephalus and 55 patients had Cerebral Oedema. In a cross-sectional observational study by Gupta PK et al., reported an incidence of pneumocranium in 12.04% of cases and diffuse axonal injury, brain swelling and oedema in 63.35% [12].

Among 100 patients, 72 patients (72%) had Extra-axial haemorrhage comprised of 35 patients of EDH, 42 patients of SDH, 28 patients of SAH. Few of the patients had combination of haemorrhages. Study by Gupta PK et al., found intra-cerebral haematoma in 46.33% cases, epidural haematoma in 30.36% cases, subdural haematoma in 19.37%, subarachnoid haematoma in 28.79% and intra-ventricular haemorrhage in 10.73% cases [12].

In the present study 26% patients had mild head injury, 27% had moderate head injury and 47% had severe head injury. Farshchian N et al., in his study found 70.13% of patients had mild, 7.8% had moderate and 22% had severe TBI [8]. Study by Morgado FL et al., showed that distribution of patients in accordance with consciousness level at the moment of the first aid was 82.4% with mild TBI, 15.6% with severe TBI and 2.0% with moderate TBI [1].

LIMITATION

The drawbacks of this study were few of the patients were unconscious, intubated hence strict assessment of GCS score was not possible in those cases. Post-surgical findings were not assessed in few of the cases. Autopsy findings were not assessed in cases who had mortality.

CONCLUSION

CT is a fast and precise method, first imaging modality of preference in acute craniocerebral trauma, allowing quick diagnosis of TBI. Significant statistical association was noted between Cerebral oedema, Midline shift, EDH, SDH, SAH, Contusions, Pneumocephalus with Severity of head injury and GCS score. Hence, evaluating the primary craniocerebral injuries on CT in association with GCS scores aids in the further management of patients with craniocerebral trauma.

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