CORRELATION OF COMPUTERISED TOMOGRAPHY SCAN FINDINGS WITH THE LEVEL OF CONSCIOUSNESS IN ACUTE HEAD TRAUMA

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ABSTRACT

BACKGROUND

Trauma is one of the most common causes of death and lifelong disability in early decades of life, of which majority of cases are neurological trauma. TBI is becoming the most common and devastating problem due to exponential growth in population and increased vehicle use. Head injuries due to road traffic accidents (RTA) are the second most common cause of death, only next to cancer. The present study was observational, prospective study undertaken to evaluate the correlation between CT scan findings and level of consciousness in patients following acute craniocerebral trauma.

The aim of this study is to correlate the CT scan findings and level of consciousness and to observe the outcome of the patient with single and multiple lesions.

MATERIALS AND METHODS

The study was conducted in Department of Neurosurgery, Krishna Medical College and Hospital. All the patients presenting to the hospital with history of head injury and admitted to Department of Neurosurgery were included as study population. Of all patients admitted with head injury and polytrauma, a careful history was collected from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma. The patients were then assessed clinically to evaluate their general condition and the local injury. Glasgow coma scale, Glasgow outcome score and CT findings were evaluated.

Statistical analysis- The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 21 for Windows.

RESULTS

It was observed that majority of patients were in the age group of 21 - 40 years (55.65%) followed by 41 - 60 years (20%). The majority of patients were males (71.43%) and females were 28.57%. Patients had higher RTA incidences (72.40%) followed by fall (22.22%) and assault (5.38%). In the clinical findings, majority of patients presented with vomiting (67.20%) followed by loss of consciousness (38.74%). The other clinical presentation includes ENT bleeding (24.46%) and convulsion (18.34%). The history of alcohol consumed was given by 23.48% of patients. It was observed that majority of patients were having abnormal CT findings (80.74%) and only 19.26% patients had normal CT findings. The most common brain lesion among patients was cerebral contusion (46.74%) followed by subdural haematoma (22.11%), inter-parenchymal haematoma (12.34%), subarachnoid haemorrhage (14.17%), skull fractures (8.06%) and midline shift (30.28%). It was observed that majority of patients had mild injury (73.72%) followed by severe type (16.34%) and moderate injury among 174 (9.94%) patients. According to outcome of brain injury, the majority of patients had good recovery (73.89%). The death was observed among 198 (11.31%) patients. It was observed that epidural haematoma, subdural haematoma, inter-parenchymal haematoma, SAH and IVH showed statistically significant relation with level of consciousness, ($p < 0.05$). It was observed that pneumocephaly and midline shift showed statistically significant relation with level of consciousness ($p < 0.05$); while cerebral contusion, skull fractures and cerebral oedema showed no statistically significant relation with level of consciousness ($p > 0.05$).

CONCLUSION

Falls were considered the most common external cause of TBI in both the youngest and the elderly. The proportion of the transport accidents was highest in young men. The majority of hospitalised patients have mild TBI. A majority of the patients had good recovery. The correlation of CT findings and level of consciousness showed statistically significant relation with the level of consciousness. CT scanning is the primary modality of choice in the diagnostic workup of patients with acute traumatic brain injury for identification of various intracranial consequences, especially within 48 hours which helps in the initial assessment, treatment planning and follow-up and long-term management of patients.

KEYWORDS

Computed Tomography, Level of Consciousness, Acute Head Trauma.

HOW TO CITE THIS ARTICLE: Raje V. Patil D, Chotai T, et al. Correlation of computerised tomography scan findings with the level of consciousness in acute head trauma. J. Evolution Med. Dent. Sci. 2018;7(06):788-793, DOI: 10.14260/jemds/2018/179

'Financial or Other Competing Interest': None.

Submission 25-12-2017, Peer Review 24-01-2018,

Acceptance 31-01-2018, Published 05-02-2018.

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DOI: 10.14260/jemds/2018/179

BACKGROUND

Trauma is one of the most common causes of death and lifelong disability in early decades of life, of which majority of cases are neurological trauma.^[1] TBI is becoming the most common and devastating problem due to exponential growth in population and increased vehicle use. Head injuries due to road traffic accidents (RTA) are the second most common cause of death, only next to cancer.^[2]

Head injury remains an important cause of death and disability in young adults, with over 50% of patients experiencing unfavourable outcomes.^[3] Studies have shown 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.^[2,3]

TBI accounts for up to 10% of the health care budget and an estimated annual cost to society of \$30 billion.^[4] Traumatic brain injury (TBI) is defined as an aggression to the brain caused by an external physical force that may produce a state of diminished or altered consciousness and consequently affecting cognitive abilities or physical function. It may be temporary or permanent, and may cause partial or total impairment of such functions.^[1]

Traumatic brain injury constitutes one of the main health problems worldwide, currently with a high and increasing incidence, representing an important cause of morbidity and mortality among adolescents and young adults. It directly contributes to deaths by external causes. The main ones being car accidents, falls, aggressions and pedestrian run over. In Brazil in the year of 2008, the largest mortality rates due to such causes occurred in the Southeast and Northeast regions.^[1] The initial assessment of a patient with TBI includes the Glasgow Coma Scale (GCS) data regarding the accident and computed tomography (CT). It is essential to determine the cause of the trauma, the impact intensity, presence of neurological symptoms, convulsion and particularly document any reports on loss of consciousness,^[2] time elapsed between the accident and the examination, vomits and seizures.^[3]

According to the GCS, traumatic brain injuries are classified as mild, moderate or severe. The GCS was initially described by Teasdale and Jennet in 1974, and is currently the most widely used parameter for assessment of consciousness level, as amongst its advantages it comprises a set of very simple and easy-to-perform physical examinations.^[4]

Until 19 years ago radiography was the main imaging method recommended in emergency evaluations, where a sign of fracture was considered a risk factor. The protocols were then modified to include CT, GCS and the presence of cranial fracture as a risk factor.

Currently, the imaging method of choice for the diagnosis and prognosis of TBI is CT,^[5] which is also instrumental in the management of the lesions progression. Results reported in studies investigating the indications of cranial CT in cases of TBI are controversial. Several studies attempt to establish clinical indicators to justify the non-use of cranial CT in certain cases of TBI as a contribution to costs reduction in the health system.^[6,7,8,9] The most recent protocols indicate CT within the first three hours following trauma in patients with GCS < 15 and GCS= 15 presenting with one or more of the following findings: Convulsion, headache, vomiting, amnesia and/or syncope,^[10] age group extremes, focal neurological deficit, suspicion of intoxication, visible cranial trauma and history of coagulopathies.^[1]

Computed tomography findings in TBI vary according to the trauma severity, that is in accordance with the GCS score. Difficulties were experienced in comparison of tomographic findings, as there are only few scientific studies with that purpose in the literature. In the present study, effort was made to investigate such findings. The relationship among

types of brain lesions demonstrated at CT, type of TBI (severity of the lesion) and prognosis are described by several authors in the literature,^[11,12] all of them reporting approximately the same variation: the more severe the TBI is, more numerous and severe are the findings at CT.

So, aim and objective of my study is to correlate the computed tomographic findings with level of consciousness in acute head trauma.

MATERIALS AND METHODS

Study Design

The present study was observational prospective study undertaken to evaluate the correlation between CT scan findings and level of consciousness in patients following acute craniocerebral trauma. The study was conducted in Department of Neurosurgery, Krishna Medical College and Hospital.

Study Population

All the patients presenting to the hospital with history of head injury and admitted to Department of Neurosurgery were included as study population.

Time Frame

This study was carried out during July 2016 to June 2017 at Krishna Medical College and Hospital.

Sample Size

Total sample size was 1750 patients with history of head injury and admitted to Department of Neurosurgery during the study period were included in the study.

Inclusion Criteria

1. All patients with head injury and polytrauma.
2. Patients with acute craniocerebral trauma.

Exclusion Criteria

1. Conscious patients with grossly normal CT scan of head.
2. Pregnant women.
3. Patients with known bleeding disorder.
4. Patients who expired before the CT scan examination.

Methods of Study

- The selected subjects were visited and the questionnaire was administered after a written informed consent was obtained from the participants.
- All patients admitted with head injury and polytrauma, a careful history was collected from the patient and/or attendants to reveal the mechanism of injury and the severity of trauma.
- The patients were then assessed clinically to evaluate their general condition and the local injury.

Glasgow Coma Scale (GCS)

- Mild= GCS score $\geq$ 13
- Moderate= GCS score 9-12
- Severe= GCS score 3-8

Glasgow Outcome Score

- Grade I= Death.
- Grade II= Vegetative.
- Grade III= Mostly Dependant.

- Grade IV= Minimally dependant.
- Grade V= Good recovery.

Statistical Analysis

The statistical analyses was performed using the Statistical Package for Social Sciences (SPSS) version 21 for Windows. Data were expressed as mean values $\pm$ standard deviations (SD) for continuous variables. Frequency and proportions were reported for categorical variables. The p-value of < 0.05 was considered statistically significant using Chi-square test.

RESULTS

Age Group	No. of Patients	Percentage
0-20	210	12.00
21-40	974	55.65
41-60	350	20.00
>60	216	12.35
Total	1750	100

Table 1. Age Distribution

The above table shows distribution of patients according to age. It was observed that majority of patients were in the age group of 21 - 40 years (55.65%) followed by 41 - 60 years (20%).

Gender	No. of Patients	Percentage
Male	1250	71.43
Female	500	28.57
Total	1750	100

Table 2. Gender Distribution

The above table shows distribution of patients according to sex. It was observed that majority of patients were males (71.43%) and females were 28.57%.

Cause	No. of Patients	Percentage
RTA	1267	72.40
Fall	389	22.22
Assault	94	05.38
Total	1750	100

Table 3. Cause of Head Injury

The above table shows distribution of patients according to cause of head injury. It was observed that majority of patients had RTA (72.40%) followed by fall (22.22%) and assault (5.38%).

Clinical Findings	No. of Patients (n= 1750)	Percentage
Vomiting	1176	67.20
Convulsion	321	18.34
ENT bleeding	428	24.46
Loss of consciousness	678	38.74
H/O of HTN	362	20.68
Alcohol consumed	411	23.48

Table 4. Clinical Findings at Presentation

(*Multiple aetiologies present).

The above table shows clinical findings at presentation of patients. It was observed that majority of patients presented

with vomiting (67.20%) followed by loss of consciousness (38.74%). The other clinical presentation includes ENT bleeding (24.46%) and convulsion (18.34%). The history of alcohol consumed was given by 23.48% of patients.

CT Finding	No. of Patients	Percentage
Normal	337	19.26
Abnormal	1413	80.74
Total	1750	100

Table 5. Distribution according to CT Scan Findings

The above table shows distribution of patients according to CT scan findings. It was observed that majority of patients were having abnormal CT findings (80.74%) and only 19.26% patients had normal CT findings.

Brain Lesion	No. of Patients (n= 1750)	%
Cerebral contusion	818	46.74
Pneumocephaly	73	04.17
Epidural haematoma	124	07.08
Subdural haematoma	387	22.11
Inter-parenchymal haematoma	216	12.34
SAH	248	14.17
IVH	71	04.05
Skull Fractures	141	08.06
Cerebral oedema	636	36.34
Midline shift	530	30.28

Table 6. Distribution according to Type of Brain Lesions

(*Multiple aetiologies present).

The above table shows type of brain lesion. It was observed that most common brain lesions among patients was cerebral contusion (46.74%). The other lesions were subdural haematoma (22.11%), inter-parenchymal haematoma (12.34%), subarachnoid haemorrhage (14.17%), skull fractures (8.06%) and midline shift (30.28%).

TBI	No. of Patients	%
Mild (GCS score ≥ 13)	1290	73.72
Moderate (GCS score 9 - 12)	174	09.94
Severe (GCS score 3 - 8)	286	16.34
Total	50	100

Table 7. Distribution of Patients according to Type of Brain Injury by GCS Score

The above table shows distribution of patients according to type of brain injury. It was observed that majority of patients had mild injury (73.72%) followed by severe type (16.34%) and moderate injury among 174 (9.94%) patients.

Outcome	No. of Patients	Percentage
Grade I (death)	198	11.31
Grade II (vegetative)	16	00.91
Grade III (mostly dependant)	106	06.06
Grade IV (minimally dependant)	137	07.83
Grade V (good recovery)	1293	73.89
Total	1750	100

Table 8. Distribution of Patients according to Outcome of Brain Injury

The above table shows distribution of patients according to outcome of brain injury. The majority of patients had good recovery (73.89%). The death was observed among 198 (11.31%) patients.

CT Findings		Level of Consciousness			Total	P value
		Mild (n=1290)	Moderate (n=174)	Severe (n=286)		
Epidural haematoma	Present	15	31	78	124	<0.05
	Absent	1275	143	208	1626	
Subdural haematoma	Present	18	98	271	387	<0.05
	Absent	1272	76	15	1363	
Inter-parenchymal haematoma	Present	14	23	179	216	<0.05
	Absent	1276	151	107	1534	
SAH	Present	18	47	183	248	<0.05
	Absent	1272	127	103	1502	
IVH	Present	03	12	56	71	<0.05
	Absent	1287	162	230	1679	

Table 9. Correlation of CT Findings and Level of Consciousness

The above table shows correlation of CT findings and level of consciousness. It was observed that epidural haematoma, subdural haematoma, inter-parenchymal haematoma, SAH and IVH showed statistically significant relation with level of consciousness ($p < 0.05$).

CT Findings		Level of Consciousness			Total	P value
		Mild (n=1290)	Moderate (n=174)	Severe (n=286)		
Cerebral contusion	Present	528	98	192	818	<0.05
	Absent	762	76	94	932	
Pneumocephaly	Present	02	08	63	73	<0.05
	Absent	1288	164	223	1677	
Skull fractures	Present	57	38	46	141	<0.05
	Absent	1233	136	240	1609	
Cerebral oedema	Present	394	79	163	636	<0.05
	Absent	896	95	123	1114	
Midline shift	Present	223	129	178	530	<0.05
	Absent	1067	45	108	1220	

Table 10. Correlation of CT Findings and Level of Consciousness

The above table shows correlation of CT findings and level of consciousness. It was observed that pneumocephaly and midline shift showed statistically significant relation with level of consciousness ($p < 0.05$); while cerebral contusion, skull fractures and cerebral oedema showed no statistically significant relation with level of consciousness ($p > 0.05$).

DISCUSSION

Traumatic Brain Injuries (TBI) have been an important problem of public health for a long time. The correct and exact diagnosis of head trauma brain haemorrhage patients is necessary. It should be done correctly, but fast. For this purpose, CT scan is used as an important and non-aggressive method to diagnose and treat patients.

The present observational study was conducted to study the correlation of computed tomographic findings with level of consciousness in acute head trauma.

All patients admitted to Krishna Hospital with history of head trauma during the study period of August 2015 to August 2017 were included in the study.

A sample size of 1750 cases who were admitted in Neurosurgery Department in Krishna Hospital with head injury and polytrauma, both sexes were enrolled in the study.

Conscious patients with normal CT report of head, pregnant women, patients with known bleeding disorders, patients expired before CT scan were excluded from the study.

A written informed consent was obtained from the participant patient or his/her relatives. The study was approved by the Ethical Committee of the Institute. All the patients were investigated for basic investigations and special investigations like CT scan.

In the present study it was observed that majority of patients were in the age group of 21 - 40 years (55.56%) followed by 41 - 60 years (20%).

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed mean age of the entire series was 37.77 $\pm$ 18.69 years.

The majority of patients were males (71.43%) and females were 28.57%.¹³

Navdeep Singh Saini et al studied factors predicting outcome in patients with severe head injury, where the majority of patients were males (85.45%).¹⁴

Aiman Mohammed Imtiaz et al studied importance of computed tomography scans in acute traumatic brain injury and observed out of 100 cases included in the study 72% were males, while females constituted only 28%.¹⁵

In a study done by Ali Jafari Khalilabadi et al on the relationship between CT scan findings, level of consciousness and outcome score in patients with traumatic brain haemorrhage observed out of 100 patients 36 were females and 64 were males with average age of 37 years.¹⁶

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed among 102 patients prevalence of male patients was 80.4%.¹³

The majority of patients had RTA (72.40%) followed by fall (22.22%) and assault (5.38%).

Navdeep Singh Saini et al studied factors predicting outcome in patients with severe head injury, where the majority of patients with road traffic accidents (83.64%) is the most common mode of head injury.¹⁴

In a study done by Fabiana Lenharo Morgado et al on the correlation between Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed the most common causes of head injury were automobile accidents (52.9%), falls (20.6%), pedestrian injuries (10.8%), falls to the ground (7.8%) and aggression (6.9%).¹³

It was observed that majority of patients presented with vomiting (67.20%) followed by loss of consciousness (38.74%). The other clinical presentation includes ENT bleeding (24.46%) and convulsion (18.34%). The history of alcohol consumed was given by 23.48% of patients.

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed most of the patients (86.3%) presented with one or more risk factors related to the trauma (headaches, vomiting, convulsion, amnesia and/or syncope), and only 24.5% presented with one or more unrelated risk

factors (coagulopathy, use of drugs or alcohol, previous neurological surgery, epilepsy, age > 50 years, smoking).¹³

It was observed that majority of patients were having abnormal CT findings (80.74%) and only 19.26% patients had normal CT findings.

Aiman Mohammed Imtiaz et al studied importance of computed tomography scans in acute traumatic brain injury and observed out of 100 cases 68 had positive CT scans.¹⁵

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed tomographic findings were observed in 79.42% of the patients.¹³

In the present study, it was observed that most common brain lesion among patients was cerebral contusion (46.74%). The other lesions were subdural haematoma (22.11%), inter-parenchymal haematoma (12.34%), subarachnoid haemorrhage (14.17%), skull fractures (8.06%) and midline shift (30.28%).

Aiman Mohammed Imtiaz et al studied importance of computed tomography scans in acute traumatic brain injury and observed out of 100 cases 43% of the cases had brain contusion, 21% of the patients had subdural haematoma, 13% with subarachnoid haemorrhage, 4% had epidural haematoma, 12% of the patients had intracerebral haematoma and intraventricular haemorrhage and pneumocephalus was found to be the least common, 3% and 4% respectively.¹⁵

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed among the studied patients, 79.42% (81/102) had alterations reported at CT with 71.6% of them presenting subgaleal haematoma, 34.3% with craniofacial fractures 18.6% with subarachnoid haemorrhage, 10.8% with area of brain contusion with haemorrhagic suffusion, 7.8% with specific basilar skull fractures, 5.9% with diffuse cerebral oedema and 5.9% with extraparenchymal blood collection.¹³

In a study done by Ali Jafari Khalilabadi et al on the relationship between CT scan findings, level of consciousness and outcome score in patients with traumatic brain haemorrhage observed haematoma was subdural in 48% patients while epidural (44%) and in 26% people was inter-parenchymal.¹⁶

The majority of patients had mild injury (73.72%) followed by severe type (16.34%) and moderate injury among 174 (9.94%) patients.

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed 82.4% of patients had traumatic brain injury rated as mild, 2.0% as moderate and 15.6% as severe.¹³

The majority of patients had good recovery (73.89%). The death was observed among 198 (11.31%) patients.

In a study done by Ali Jafari Khalilabadi et al on the relationship between CT scan findings, level of consciousness and outcome score in patients with traumatic brain haemorrhage death was reported for 13% people, vegetative state for 3% people, severe brain injury for 17% people, mild

brain injury for 20% people and normal state for 47% people.¹⁶

The correlation of CT findings and level of consciousness showed that epidural haematoma, subdural haematoma, inter-parenchymal haematoma, SAH and IVH showed statistically significant relation with level of consciousness ($p < 0.05$).

In a study done by Fabiana Lenharo Morgado et al on the correlation between the Glasgow Coma Scale and cranial computed tomographic findings in patients with traumatic brain injury observed statistical significance was observed in the correlation between the Glasgow Coma Scale and CT findings.¹³

The correlation of CT findings and level of consciousness showed that pneumocephaly and midline shift showed statistically significant relation with the level of consciousness ($p < 0.05$); while cerebral contusion, skull fractures and cerebral oedema showed no statistically significant relation with level of consciousness ($p > 0.05$).

In a study done by Ali Jafari Khalilabadi et al on the relationship between CT scan findings, level of consciousness and outcome score in patients with traumatic brain haemorrhage observed volume of haematoma in entrance and midline shift relates to patient's level of consciousness significantly and reversely. Increasing haematoma volume causes to fall level of consciousness more ($p = 0.04$, $r = -0.62$). Also increasing midline shift is followed by less level of consciousness ($p = 0.02$, $r = -0.53$).¹⁶

Navdeep Singh Saini et al studied factors predicting outcome in patients with severe head injury, where greater degree of midline shift on CT scan was associated with unfavourable outcome. This increase in unfavourable outcome with greater degree of midline shift is statistically important with p value < 0.005 .¹⁴

Imaging is an important clinical tool used in the management of patients with TBI. Abnormal neurological examination is the most important criterion available to select patients for emergency CT. CT scanning is the primary modality of choice in the diagnostic workup of patients with acute traumatic brain injury for identification of various intracranial consequences, especially within 48 hours which helps in the initial assessment, treatment planning and follow-up and long-term management of patients.

CONCLUSION

The present observational study was conducted to study correlation of computed tomographic findings with level of consciousness in acute head trauma.

Falls were considered the most common external cause of TBI in both the youngest and the elderly. The proportion of the transport accidents was highest in young men. The majority of hospitalised patients have mild TBI. A majority of the patients had good recovery.

The correlation of CT findings and level of consciousness showed statistically significant relation with level of consciousness.

CT scanning is the primary modality of choice in the diagnostic workup of patients with acute traumatic brain injury for identification of various intracranial consequences, especially within 48 hours which helps in the initial assessment, treatment planning and follow-up and long-term management of patients.

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