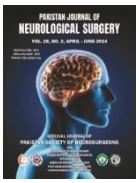

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Original Research

Computed Tomography Findings of Traumatic Brain Injury and its Assessment in a Teaching Hospital

Ghazan Khan[1], Mewat Shah[2], Khurram Saleem[3], Yasmeen[4], Shifa A. Khan[5], Muhammad Rizwan[6]

[1]Department of Radiology, College of Medical Technology, Bacha Khan Medical College, Mardan
[2]Department of Neurosurgery, Gajju Khan Medical College, Swabi
[3]Basic Health Unit, Chamkani, Peshawar
[4]Department of Physiology, Frontier Medical and Dental College
[5]Medical Ward, Lady Reading Hospital, Peshawar, Pakistan
[6]Department of Neurosurgery, Lady Reading Hospital, Peshawar- Pakistan

ABSTRACT

Background: A sudden trauma that damages cerebral parenchyma is known as traumatic brain injury (TBI). TBI can happen when the head strikes something hard and fast or when something pierces cranial bones and gets into the brain is the most prevalent cause of death after trauma in middle-income countries. The objective of the study was to evaluate the frequency and findings of traumatic brain injury on computed tomography in Tertiary Care Teaching Hospital, Mardan Medical Complex.

Materials & Methods: A prospective cross-sectional study from March 2023 to February 2024 was done in Mardan Medical Complex (MMC), Mardan. Non-probability convenience sampling technique was used with a sample size of 680. Data collection was done from the Radiology and Emergency departments with consent taken. Data descriptive statistical analysis was done through SPSS version 22.

Results: A total of 680 patients were scanned including 471(69.26%) males and 209(30.74%) females. The frequency (389) (57.20%) of traumatic brain injury was high in age group 1-19 and least (60) (8.82%) in age group >60. CT brain scan findings revealed 397(58.39%) normal and 283(41.62%) abnormal patients. In abnormal patients, the most common findings on CT were intra-axial hemorrhage 117(41.36%). The most common mode of injury was RTA 326(47.94%) followed by HOF 212(31.18%).

Conclusion: The study showed that in traumatic brain injury, the majority of the subjects were male as compared to female and the most common mode of injury was road traffic accidents followed by falls from height. The findings of intra-axial hemorrhage were the highest in all traumatic brain injuries.

Keywords: Computed Tomography, Traumatic Brain Injury, Road Traffic Accident (RTA), Fall from Height (FH), Fire Arm Injury.

Corresponding Author: Muhammad Rizwan
Department of Neurosurgery, Lady Reading Hospital, Peshawar, Pakistan.
Email: Docrix08@gmail.com

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INTRODUCTION

A sudden trauma that damages cerebral parenchyma is known as traumatic brain injury (TBI), which is one kind of acquired brain injury. Traumatic brain injury (TBI) can happen when the head strikes something hard and fast or when something pierces cranial bones and gets into the brain.[1] The most prevalent cause of death after trauma in middle-income countries.[2] The number of accidents and traumatic brain injuries (TBI) has greatly increased in developing nations as a result of huge vehicle traffic. According to World Health Organization estimations, vehicle accidents will be at the number 3 rank for injuries soon. Traffic safety rules implication and prevention initiatives have greatly decreased the number of instances of traumatic brain injury resulting from accidents while driving in developed nations. However, there is an increase in the rate of traumatic brain injury as a result of falls from height, which is causing an upsurge in the median age of traumatic brain injury patients.[3,4] Damage to the cranium and brain of any sort is considered to be a head injury. Head injuries are majorly classified into two groups. One is closed injuries and the other group contains those injuries to the brain which are penetrative.[2] Numerous things, including attacks, falls from great heights, car collisions, and striking by vehicles while crossing the road can result in close injuries. Sharp items and weapon pellets/bullets are two of the primary culprits of penetrating one.[5] Traumatic brain injuries (TBI) are closely associated with frequent head trauma (RTA) in teenagers and falls from height among kids.[6,7] Men are more exposed to traumatic brain injuries because they are usually involved in outside activities like working and driving.[8] The results of earlier studies revealed that generalized cerebral edema and swelling (63.34%), subdural hemorrhage (SDH) (19.38%), cranial fractures (62.04%), subarachnoid hemorrhage (SAH) (28.78%), epidural hemorrhage (EDH) (30.35%), and pneumocephalus (12.05%).[9] The patients having traumatic brain injury may have symptoms of LOC, persistent headache, vomiting, convulsions, dilatation of the pupils of eyes, seizures, amnesia, and loss of short-term memory.[10,11]

In the past, the modality of choice for skull imaging was plain radiography because of the not developed radiologic techniques but now axial (cross-sectional) imaging is the best choice for diagnosing and management of traumatic brain injury.[2,12] Computed tomography has now replaced plain X-ray radiography.[13] The sensitivity of CT is high and it has a high acquisition rate, cost-effective, and accessible as compared to magnetic resonance imaging.[14]

Computed tomography imaging is crucial in diagnosing and managing traumatic brain injury,[15] especially its role in those patients who require prompt surgical attention.[16] This study aimed to find out the frequency of traumatic brain injuries in different age groups, CT scan findings, and mode of injury.

MATERIALS AND METHODS

Study Design, Duration, and Setting

This study was a prospective cross-sectional study from March 2023 to February 2024 which was done in Mardan Medical Complex (MMC), Mardan.

Sampling Technique and Sample Size

Non-probability convenience sampling technique was used with a sample size of 680. The sample size was duration-based.

Ethical Approval

Ethical approval was taken from the Hospital

Ethical Committee with Reference No. 362/BKMC dated 27/02/2023, along with consent from each participant involved in this study.

Data Collection Procedure

Data collection was done from the Radiology and Emergency departments. Patients with traumatic brain injury due to; road traffic accidents, falls from height, firearm injury, physical assault patients who died before CT Brain/Head scanning, patients having congenital abnormalities of the brain, and brain injury due to stroke. The data was recorded from the patient or a relative of the patient in the case of an unconscious patient through a pre-designed questionnaire.

Imaging Procedure and Reporting

Each patient was scanned for axial imaging of the brain through Aquilion CT Scanner 64 Slice from the base of the skull to the vertex with a 3mm slice thickness and having 3mm slice interval with both soft tissue and bone window scanning. No contrast administration was given to avoid any other damage to cerebral parenchyma and masking of hyperdensities. The raw data volume was reconstructed in multiple planes like coronal, sagittal, and oblique through multi-planar reconstruction (MPR). CT scanner was quality assured before this study. After scan completion, the same technique/protocol was used for each patient, and data were acquired. Radiologists reported the scans after their completion and the CT scan abnormal findings data was acquired from the reports.

Statistical Analysis

Data analysis was performed through SPSS version 22. Frequency and Percentage were calculated for categorical variables. All final results were presented in text, tabular, and graphical forms. The P-value was calculated for categorical data after applying Chi-square statistical tests. A P-value less than 0.05 was considered significant.

RESULTS

Age and Gender-wise Distribution

There were 680 patients scanned and reported. All patients were categorized gender-wise into males having a frequency of 471(69.26%) and females having a frequency of 209 (30.74%). Patients were also categorized into age-wise groups. The study showed 389 (57.20%) patients from the age group 1-19 years and merely a small portion 60 (8.82%) belonging to the age group >60. The p-value was calculated at 0.251 (Table 1).

Computed Tomography Findings

The findings of computed tomography scanning of the head showed normal findings in 397(58.39%) patients and abnormal findings in 283(41.62%) with p-value 0.251. Among abnormal findings 69(24.45%) patients had extra-axial hemorrhage in which there was 19(27.54%) patients of EDH, 35(50.72%) of SDH, 16(23.19%) of SAH. Intra-axial hemorrhages were noted in 117(41.36%) patients of which there were 34(29.10%) patients with contusions and 83(70.94%) of hematomas. Skull fractures were noted in 46(16.25%) patients, intraventricular bleeding was noted in 9(3.18%), inflammatory changes were noted in 7(2.47%), generalized

Table 1: Age and gender distribution.

Parameters		Gender of Patient		Total	P-value
		Male	Female	% (n)	
Age of Patient in Years	1-19	286	103	57.2 (389)	0.251
	20-39	103	58	23.7 (161)	
	40-59	44	26	10.3 (70)	
	>60	38	22	8.8 (60)	
Total		69.3% (471)	30.7% (209)	680	

Table 2: Comparison of Age with CT Brain Findings and Mode of Injury.

Parameter	Detail	Age Groups				P-Value
		1-19 Years	20-39 Years	40-59 Years	>60 Years	
CT Brain	Normal	221	90	47	39	0.251
	Abnormal	168	71	23	21	
Mode of Injury	RTA	199	66	33	28	0.666
	HOF	111	56	25	20	
	FAI	67	33	11	11	
	Physical Assault	12	6	1	1	

RTA: Road Traffic Accident; HOF: Fall from Height; FAI: Fire Arm Injury

Table 3: Comparison of Gender with CT brain Findings, Reporting, and Mode of Injury.

Parameter	Detail	Gender		P-Value
		Male	Female	
CT Brain	Normal	270	127	0.33
	Abnormal	201	82	
CT Brain Findings on Report	Extra-axial Hemorrhage (EDH, SDH, SAH)	55	14	0.92
	Intra-axial Hemorrhage (Contusion, Hematoma)	75	42	
	Skull Fracture	35	11	
	Intraventricular Bleed	3	6	
	Inflammatory Changes	4	3	
	Generalized Edema	15	5	
	Pneumocranium	12	3	
Mode of Injury	RTA	216	110	0.025
	HOF	143	69	
	FAI	98	24	
	Physical Assault	14	6	

Table 4: CT findings related to head injury.

CT Findings	Frequency	Percentage (%)
Normal	397	58.39
Abnormal	283	41.62
Extra-axial Hemorrhage	69	24.45
EDH	19	27.54
SDH	35	50.72
SAH	16	23.19
Intra-axial Hemorrhage	117	41.36
Contusion	34	29.10
Hematoma	83	70.94
Skull Fractures	46	16.25
Intraventricular Bleed	9	3.18
Inflammatory Changes	7	2.47
Generalized Edema	20	7.07
Pneumocranium	15	5.30

cerebral edema was noted in 20(7.07%) and pneumocranium was noted in 15(5.3%) patients. The p-value was calculated at 0.666 (Table 2, 3 & 4).

Table 5: Mode of Injury of Patients.

Mode of Injury	Frequency	Percentage (%)
Road Traffic Accidents (RTA)	326	47.99
Fall from Height (HOF)	212	31.18
Fire Arm Injury (FAI)	122	17.94
Physical Assault	20	29.41

Patient Classification According to Mode of Injury

Patients were also classified according to mode of injury into 4 groups including RTA, HOF, FAI, and physical assault. Among total, 326(47.94%) patients were reported with traffic accidents,

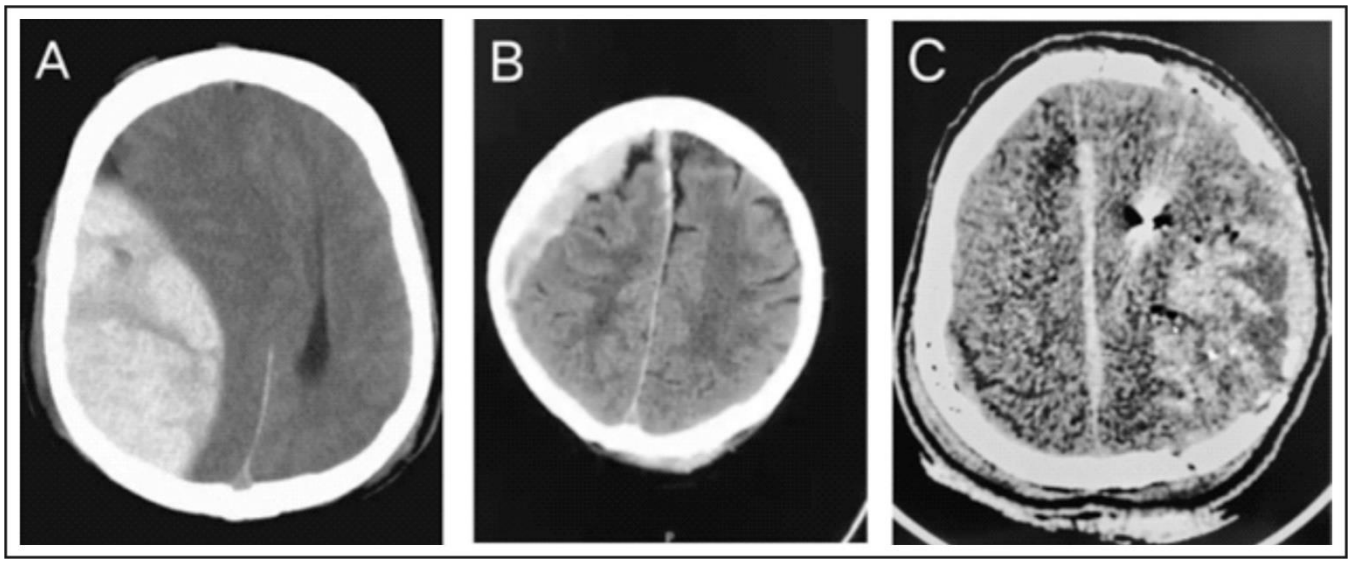

Figure 1: Showing (A) Road Traffic Accident (B) Fall from Height (C) Fire Arm Injury.

history of fall was 212(31.18%), fire arm injuries were 122(17.94%) and physical assault were 20(29.41%) (Table 5).

DISCUSSION

Our findings are consistent with earlier research indicating that traumatic brain injuries have been frequent in road traffic accidents for many years. According to research, 63% of vehicle accident patients reported brain trauma.[17] However, another study found that teenagers account for 59–69% of traumatic brain injuries.[18] In line with the findings of the Akanji et al, report,[19] They showed that 16.8% of traumatic brain injuries in their subjects were caused by falls; in our study, falls caused 31.18% of brain injuries and were the second most common cause of traumatic brain injury.[19]

Compared to females, male patients experienced greater brain injuries as a result of their more active work schedules.[20] The percentage of male and female participants in our study were 69.26% and 30.4% respectively, indicating a high male ratio as compared to female. The leading mode of injury was RTA followed by falls from height. Roughly one-third of all brain injury cases in America were caused by collisions on the road. Research conducted in Egypt and Nigeria revealed that the majority of cases included brain injuries brought on by car crashes.[21,22] It can be compared to our study in which patients had traumatic brain injuries most frequently from road traffic accidents (47.94%), followed by falls (31.18%). CT findings noted in our study were showing normal findings (58.39%) and abnormal (41.62%). In abnormal there were extra-axial hemorrhage (24.45%) and intra-axial hemorrhage (41.45%). In extra-axial hemorrhage, there was epidural hemorrhage (27.54%), subdural hemorrhage (50.72%), and subarachnoid hemorrhage (23.19%). In intra-axial hemorrhage, there were contusions (29.10%) and hematomas (70.94%). Skull fracture (16.25%), intraventricular bleed (3.18%), inflammatory changes (2.47%), generalized edema (7.07%), and pneumocephalus (5.3%) were similar to some other studies.[23,24] Most common spinal cord injury was observed due to a fall from height.[25]

RECOMMENDATION AND LIMITATIONS

Safety measures for road traffic should be strictly followed. For prompt and better diagnosing and

managing traumatic brain injury, health care, and traumatic centers must have computed tomography scanning machines installed in them. The limitations of this study were that the patients with traumatic brain injury were only diagnosed and further management of the patients was not assessed, moreover, the data was collected from a single teaching hospital in the region.

CONCLUSION

The study showed that in traumatic brain injury majority of the subjects were male as compared to female and the most common mode of injury was road traffic accident (RTA) followed by falls from height (HOF). It also showed that traumatic brain injuries were more common in teenagers. The findings of intra-axial hemorrhage were the highest in all traumatic brain injuries.

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Additional Information

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Human Subjects: Waiver of Consent was obtained from the ethical review board.
Conflicts of Interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:
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Human Subjects: Consent was obtained from all patients participated in this study. Pictures of CT scan images were added with the consent of the patient.

Data Availability Statement: or data sharing, interested researchers can contact the corresponding authors.

AUTHORS CONTRIBUTIONS

Sr.#	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Ghazan Khan	Study design and methodology, manuscript drafting and approval.
2.	Mewat Shah	Paper writing, critical review, and manuscript approval.
3.	Khurram Saleem	Data collection, analysis and manuscript approval.
4.	Yasmeen Syed	Analysis of data and interpretation of results and manuscript approval.
5.	Shifa A. Khan	Literature review and referencing and manuscript review and approval.
6.	Muhammad Rizwan	Editing and quality insurance, drafting and manuscript approval.