Original Article

Patterns of CT-Scan Findings Among Head Injury Patients Presenting to the Emergency Department in a Tertiary Care Hospital

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ABSTRACT

Objective: To analyze the pattern of CT-scan findings among head injury patients presenting to the emergency department in a tertiary care hospital.

Study Design: Retrospective, observational study

Place and Duration of Study: This study was conducted at the Department of Radiology / Neurosurgery, Liaquat National Hospital, June-December, 2021.

Materials and Methods: Patients' medical record files were reviewed to retries socio-demographic profiles and CT-scan findings. Data was entered in SPSS version 25 for statistical analysis.

Results: 423 records were reviewed. Median age was 40 (IQR= 26 – 55) years. Majority were males (n=326, 77.1%). Top most cause of head injury was road traffic accident (n=246, 58.2%) followed by fault (n=105, 24.8%), assault (n=29, 6.9%), others (n=12, 2.8%) and unknown mechanism (n=31, 7.3%). Injury of others included all those accidental fall of objects on head. Nearly half of the patient depicted normal findings of CT scan (n=190, 44.9%). The most frequent fractured site was parietal (n=78, 18.4%), temporal (n=73, 17.3%), frontal (n=60, 14.2%), occipital (n=13, 13.1%), maxillary (n=27, 6.4%), sphenoid (n=24, 5.7%), ethmoid (n=19, 4.5%), zygomatic (n=13, 3.1%) and mandible (n=6, 1.4%). Contusions, subarachnoid hemorrhage and subdural hemorrhage was present in 36.2% (n=153), 30.3% (n=128) and 10.4% (n=44) cases respectively. Few cases presented with blood in sinuses (n=65, 15.4%), extradural hemorrhage (n=62, 14.7%), intraparenchymal hemorrhage (n=31, 7.3%), intracranial mass (n=3, 0.7%), intraventricular bleed (n=30, 7.1%).

Conclusion: The current study analyzed that RTA was the leading cause of head injury and patterns of CT-scan findings was significantly different among all mechanism of injuries with a significantly higher proportion of abnormal CT-scan findings among RTA patients.

Key Words: Traumatic brain injury, emergency department, CT-scan findings, subarachnoid hemorrhage, extradural hemorrhage, subdural hemorrhage

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INTRODUCTION

Traumatic brain injury (TBI) as a consequence of head trauma is a usual presentation in emergency rooms, accounting for more than one million yearly visits[1]. According to the Centers for Disease Control and Prevention (CDC), a TBI results from a bump, blow, jolt to the head, or a penetrating injury that upsets normal brain functioning. Traumatic injuries may be categorized as closed (non-penetrating) or open (penetrating)[2,3]. TBI is a leading cause of death and everlasting disability among the age group 29-45 years[4].

TBI is frequently referred to as the silent epidemic and a rising public health concern and is considered the highest contributor to death and disability worldwide among all trauma-related injuries[5]. Globally, nearly 55.5 million were estimated to have sustained a head injury (HI)[6]. Global data shows that low- and middle-income countries (LMICs suffer from the major burden of this problem, the underlying key source being road traffic accidents (RTA)[4,7]. LMIC encounter at least 3 times higher HI proportion than occurred in high-income countries[8].

Available literature shows highly variable findings regarding the epidemiology of TBI which may be due

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to different definitions, inclusion and exclusion criteria, study approaches, and reporting styles[9]. Efforts for uncovering epidemiological facts about TBI are still required as the global trauma burden is continuously rising as a threat to public health[10]. Therefore, we planned a current study to investigate patterns, causes, and CT-scan findings among head injury patients presenting to the emergency department in a tertiary care hospital in Karachi, Pakistan.

MATERIALS AND METHODS

This retrospective study reviewed the records of head injury patients present in the emergency room in Liaquat National Hospital from June-December 2021. The study protocol was approved by the Ethics Committee of the hospital (IRB# 0777-2022 LNH-ERC). Records of the patients, who were brought dead, were not reviewed. Patients' medical record files were reviewed to retrieve their age, gender, and mechanism of injury. CT-scan findings were also recorded and all the gathered was documented in a pre-designed proforma.

Data was entered in SPSS version 25 for statistical analysis. Frequencies and percentages were computed for categorical variables. Numerical variable age was presented as median with interquartile range (IQR) after assessing the assumption normality with the Shapiro-Wilk test. CT scan findings were compared in patients with a different mechanism of injury and the incidence of neurological defects was compared with fractures using Chi-square or Fisher exact test. P-value less than or equal was defined as statistically significant.

RESULTS

A total of 423 records were reviewed. The median age of patients was 40 (IQR= 26 – 55) years. More than half of the injured were males (n=326, 77.1%). Topmost cause of head injury was road traffic accident (n=246, 58.2%) followed by fall (n=105, 24.8%), assault (n=29, 6.9%), others (n=12, 2.8%) and unknown mechanism (n=31, 7.3%). Injury to others included all those accidental falls of objects on the head. Nearly half of the patients depicted normal findings of CT scans (n=190, 44.9%). Table 1 shows the comparison of CT findings among patients with different mechanisms of injury. Frequency of abnormal CT scan findings, SAH, SDH, fracture of cranial vault and skull base, parietal, temporal and zygomatic, EDH, contusions, and blood in sinuses were significantly different among different mechanisms of injury.

Table No.1: Comparison of CT scan findings among patients with a different mechanism of injury

CT scan findings	Mechanism of injury					p-value
	RTA n(%)	Fall n(%)	Assault n(%)	Other n(%)	Unknown n(%)	
Abnormal CT scan findings	143(58.1)	46(43.8)	23(79.3)	4(33.3)	17(54.8)	**0.003
SAH	84(34.1)	23(21.9)	11(37.9)	2(16.7)	8(25.8)	0.117
SDH	28(11.4)	10(9.5)	3(10.3)	1(8.3)	2(6.5)	†0.965
Intraparenchymal bleed	13(5.3)	13(12.4)	4(13.8)	1(8.3)	0(0)	*†0.029
Cranial vault fracture	41(16.7)	8(7.6)	7(24.1)	2(16.7)	6(19.4)	**†0.008
Skull base fracture	17(6.9)	2(1.9)	2(6.9)	0(0)	4(12.9)	
Both vault and skull base fracture	41(16.7)	10(9.5)	6(20.7)	0(0)	2(6.5)	
Frontal	38(15.4)	7(6.7)	6(20.7)	2(16.7)	7(22.6)	*†0.045
Parietal	55(22.4)	8(7.6)	9(31)	1(8.3)	5(16.1)	**0.005
Occipital	7(2.8)	3(2.9)	2(6.9)	0(0)	1(3.2)	†0.673
Temporal	51(20.7)	7(6.7)	11(37.9)	0(0)	4(12.9)	**<0.001
Zygomatic	21(8.5)	2(1.9)	3(10.3)	0(0)	1(3.2)	†0.950
Nasal	10(4.1)	1(1)	2(6.9)	0(0)	0(0)	†0.275
Ethmoid	12(4.9)	2(1.9)	2(6.9)	0(0)	3(9.7)	†0.265
Maxillary	21(8.5)	3(2.9)	2(6.9)	0(0)	1(3.2)	†0.296
Sphenoid	18(7.3)	1(1)	3(10.3)	0(0)	2(6.5)	†0.054
Mandible	4(1.6)	0(0)	2(6.9)	0(0)	0(0)	†0.132
EDH	39(15.9)	11(10.5)	5(17.2)	1(8.3)	6(19.4)	†0.574
Intracranial mass	2(0.8)	1(1)	0(0)	0(0)	0(0)	†1.000
Contusions	99(40.2)	24(22.9)	17(58.6)	2(16.7)	11(35.5)	**†0.001
Blood in sinuses	47(19.1)	6(5.7)	4(13.8)	1(8.3)	7(22.6)	*†0.010
Intraventricular bleed	17(6.9)	8(7.6)	2(6.9)	1(8.3)	2(6.5)	†0.984

EDH: Extradural hemorrhage, RTA: Road traffic accident, SAH: Subarachnoid hemorrhage, SDH: Subdural hemorrhage, †: Monte-carlo Fisher-exact test was reported, *Significant at p<0.05, **Significant at p<0.01

Table No.2: Association of CT scan findings with fractures.

CT findings	Fractures				p-value
	Cranial vault n(%)	Skull base n(%)	Both vault and skull base n(%)	Absent n(%)	
SAH	42(65.6)	9(36)	39(66.1)	38(13.9)	**<0.001
SDH	12(18.8)	0(0)	11(18.6)	21(7.7)	**<0.001
EDH	29(45.3)	5(20)	20(33.9)	8(2.9)	**<0.001
Intracranial mass	0(0)	0(0)	1(1.7)	2(0.7)	0.534
Contusions	49(76.6)	12(48)	48(81.4)	44(16.1)	**<0.001
Blood in sinuses	9(14.1)	12(48)	37(62.7)	7(2.6)	**<0.001
Intraventricular bleed	9(14.1)	1(4)	5(8.5)	15(5.5)	†0.105
Intraparenchymal bleed	4(6.3)	2(8)	5(8.5)	20(7.3)	†0.938

EDH: Extradural hemorrhage, SAH: Subarachnoid hemorrhage, SDH: Subdural hemorrhage, †: Fisher-exact test was reported, *Significant at p<0.05, **Significant at p<0.01

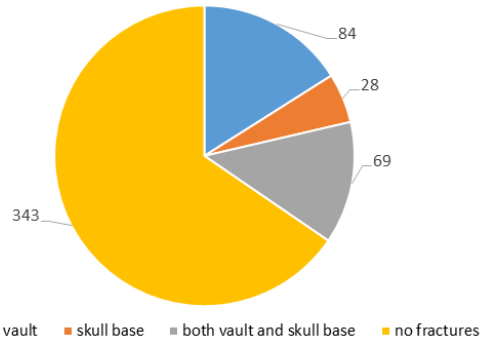

Figure No.1: Frequency of fractures among study participants

Figure 1 shows the frequency of fractures among patients with abnormal CT findings. The most frequent fractured site was parietal (n=78, 18.4%), temporal (n=73, 17.3%), frontal (n=60, 14.2%), occipital (n=13, 13.1%), maxillary (n=27, 6.4%), sphenoid (n=24, 5.7%), ethmoid (n=19, 4.5%), zygomatic (n=13, 3.1%) and mandible (n=6, 1.4%). Contusions, subarachnoid hemorrhage and subdural hemorrhage was present in 36.2% (n=153), 30.3% (n=128) and 10.4% (n=44) cases respectively.

Few cases presented with blood in sinuses (n=65, 15.4%), extradural hemorrhage (n=62, 14.7%), intraparenchymal hemorrhage (n=31, 7.3%), intracranial mass (n=3, 0.7%), intraventricular bleed (n=30, 7.1%).

Table 2 shows the association of CT scan findings with fractures. SAH (p<0.001), SDH (p<0.001), EDH (p<0.001), contusions (p<0.001), blood in sinuses (p<0.001) were significantly associated with fractures site.

DISCUSSION

Worldwide mobilization and urbanization trend is giving a high incidence of trauma as one of the leading public health concerns. Among all other traumatic injuries, TBI remains considered a top cause of death and permanent disability in young people, particularly in the developing world[11]. The rising burden of HI requires knowing patterns and causes of injuries for devising and modifying the management strategies to appropriately manage ER rooms and treat the victims.

In the present study, the median age of patients presenting with HI is forty years. In literature, it is reported that most of the trauma victims are of youth to middle age group with an age range of 21-40 years when the period of productive activity is at its peak[12]. Another Pakistani study analyzing HI patterns reported that nearly half (48%) of the HI patients included in the study were in the age range of 20-49 years[13]. An Indian study demonstrating clinical profile and autopsy findings in fatal head injuries reported that the median age injured was 43 years[14]. Similar studies from Saudia Arabia and Uganda also reported that victims were the youth age group with a mean age of 27.01 ± 13.9 years and 29.34 ± 14.13years respectively[11,15].

In the present study, the majority of the victims were males, which is consistently reported finding in across the globe the hat male gender is more exposed to the accidental injuries than women and the reason is obvious that men are more frequently engaged in outdoor activities than females due to which they are highly exposed to traumatic injuries[12-14].

In low and middle-income countries, road traffic crashes are the leading causes of TBI in young people while falls are the leading causes in the elderly[1]. It must be noted that RTAs contribute 2.12% to the total global mortality[15]. The same phenomenon is depicted in our study that the most frequent cause of injury was RTA followed by fall and assault and blast injuries whereas the cause was unknown in some of the injuries. Another report from Pakistan also reported the same pattern of cause; RTAs followed by falls and assaults[7]. Studies from Saudi Arabia, India, and China also reported RTAs as the leading cause of HI[8-10].

According to the CDC guidelines, CT is indicated with the loss of consciousness or posttraumatic amnesia only if one or more of the following is present: headache,

vomiting, age > 60 years old, drug or alcohol intoxication, deficits in short-term memory, physical evidence of trauma above the clavicle, posttraumatic seizure, GCS score < 15, focal neurologic deficit, or coagulopathy[16]. In our study, nearly half of the patients (44.9%) had normal CT scan findings. A similar study conducted in Bangladesh reported that 47.03% patients of with head injury were found to have traumatic brain injury[17]. A Nigerian study assessing the patterns of CT findings in head trauma reported a lower proportion of normal findings of CT ((35.81%)[18]. Clinical and radiological findings could vary among the studies due to differences in the severity of the cases.

In our study, the most frequently occurred abnormality on CT scan was contusion followed by (36.2%) followed by subarachnoid hemorrhage (30.3%), blood sinuses (15.4%), extradural hemorrhage (14.7%), subdural hemorrhage (10.4%), intraparenchymal hemorrhage (n=31, 7.3%), intraventricular bleed (n=30, 7.1%) and intracranial mass (n=3, 0.7%). Another Pakistani study reported frequent head injury patterns as extradural hemorrhage (27.5%) followed by subdural hemorrhage (22.3%), contusions (21.8%), diffuse axonal injury (13.2%), skull fracture (7.3%), subarachnoid hemorrhage (4.2%) and intracerebral hemorrhage (19). Onwuchekwa and Alazigha reported that intra-axial hemorrhage in nearly half of the patients (42.26%) whereas extra-axial hemorrhage was found in nearly a quarter of the patients (23.55%)[18]. Alnaami et al reported that EDH (22.9%), SDH (18.1%), SAH (20.4%), contusions (19.3%), IVH (11.9%) and fractures (7.4%) were seen on CT scan findings[15]. MS Islam reported that SDH (35%), EDH (27%), concussions (15%), cerebral contusion (14%), diffuse axonal injury (6%), and SAH (3%) were causes of traumatic brain injury among patients presenting with head trauma[17].

In the present study, the frequency of fractures among patients with abnormal CT findings was 64% whereas 27.5% had a fracture of the cranial vault only, 10.7% of patients had skull base fractures only and 25.3% had a fracture of both cranial vault and skull base. Onwuchekwa found an incidence of 28.06% of skull fractures among patients with abnormal CT findings and the parietal bone was the most involved in fractures which is a comparable finding to our study (18). In the present study, the frequency of SAH, EDH, and contusions was significantly higher among patients with cranial vault fracture only whereas SDH frequency was significantly lower among patients with fractures than patients not having fractures. Moreover, the frequency of blood in sinuses was significantly higher in patients with skull base fractures only. In contrast to our study, skull base fracture was found to be associated with paranasal sinus collection and cerebrospinal fluid leakage in previously available literature[18,20].

The present study suffers from some limitations including a retrospective review of a single-center study. The study was not focused to assess the impact of CT findings on the survival of the patient. Furthermore, we only disclose adults' data, which could underestimate the overall burden of head injuries presented in a hospital. Therefore, a multi-center study may be conducted in the future to overcome these limitations.

CONCLUSION

The current study analyzed that RTA was the leading cause of head injury and patterns of CT-scan findings was significantly different among all mechanism of injuries with a significantly higher proportion of abnormal CT-scan findings among RTA patients.

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Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Bellomo R, Kellum JA, Ronco C. Acute kidney injury. Lancet 2012;380(9843):756-66.
2. Mishra OP, Gupta AK, Pooniya V, Prasad R, Tiwary NK, Schaefer F. Peritoneal dialysis in children with acute kidney injury: a developing country experience. Perit Dial Int 2012;32(4): 431-6.
3. Kaddourah A, Basu RK, Bagshaw SM, Goldstein SL. Epidemiology of Acute Kidney Injury in Critically Ill Children and Young Adults. N Engl J Med 2017;376(1):11-20.
4. Maas AIR, Menon DK, Adelson PD, Andelic N, Bell MJ, Belli A, et al. Traumatic brain injury: integrated approaches to improve prevention, clinical care, and research. Lancet Neurol 2017;16(12):987-1048.
5. Dewan MC, Rattani A, Gupta S, Baticulon RE, Hung YC, Punchak M, et al. Estimating the global incidence of traumatic brain injury. J Neurosurg 2018:1-18.
6. Global, regional, and national burden of neurological disorders, 1990-2016: a systematic

analysis for the Global Burden of Disease Study 2016. Lancet Neurol 2019;18(5):459-80.
7. Jiang JY, Gao GY, Feng JF, Mao Q, Chen LG, Yang XF, et al. Traumatic brain injury in China. Lancet Neurol 2019;18(3):286-95.
8. Karthigeyan M, Gupta SK, Salunke P, Dhandapani S, Wankhede LS, Kumar A, et al. Head injury care in a low- and middle-income country tertiary trauma center: epidemiology, systemic lacunae, and possible leads. Acta Neurochir (Wien) 2021;163(10):2919-30.
9. Maegele M, Lefering R, Sakowitz O, Kopp MA, Schwab JM, Steudel WI, et al. The Incidence and Management of Moderate to Severe Head Injury. Dtsch Arztebl Int 2019;116(10):167-73.
10. World Health Organization. Injuries and violence. Available from: https://www.who.int/news-room/fact-sheets/detail/injuries-and-violence.
11. Bangirana P, Giordani B, Kobusingye O, Murungyi L, Mock C, John CC, et al. Patterns of traumatic brain injury and six-month neuropsychological outcomes in Uganda. BMC Neurol 2019;19(1):18.
12. Onwuchekwa RC, Echem RC. An epidemiologic study of traumatic head injuries in the emergency department of a tertiary health institution. J Med Tropics 2018;20(1):24.
13. Raza S, Shahzad Y, Tassadaq A, Akhtar N. Pattern of Head Injury and Associated Injuries in the Patients Presenting to Neurosurgical Emergency. J Rawalpindi Med Coll 2018;22:120-3.
14. Alexis RJ, Jagdish S, Sukumar S, Pandit VR, Palnivel C, Antony MJ. Clinical Profile and Autopsy Findings in Fatal Head Injuries. J Emerg Trauma Shock 2018;11(3):205-10.
15. Alnaami I, Alshehri S, Alghamdi S, Ogran M, Qasem A, Medawi A, et al. Patterns, Types, and Outcomes of Head Injury in Aseer Region, Kingdom of Saudi Arabia. Neurosci J 2019; 2019:2782146.
16. Centers for Disease Control and Prevention. Updated milk traumatic brain injury guidelines for adults 2008. Available from: https://www.cdc.gov/traumaticbraininjury/pdf/tbi_clinicians_factsheet-a.pdf.
17. Islam MS, Rahman MF, Islam MA. Patterns and Outcome of Traumatic Brain Injury Patients: A Study in a Tertiary Level Military Hospital. J Armed Forced Med Coll Bangladesh 2019; 15(1):75-8.
18. Onwuchekwa CR, Alazigha NS. Computed tomography pattern of traumatic head injury in Niger Delta, Nigeria: A multicenter evaluation. Int J Crit Illn Inj Sci 2017;7(3):150-5.
19. Ali M, Dilber M, Bhatia MR, Mari AR, Shaikh HA, Brohi SR. Pattern of head injuries in patients admitted in tertiary trauma Centre. The Prof Med J 2020;27(05):921-8.
20. Adeyekun AA, Obi-Egbedi-Ejakpovi EB. Computerised tomographic patterns in patients with head injury at the university of Benin teaching hospital. Niger J Clin Pract 2013;16(1):19-22.