Evaluation of Brain CT Findings in Patients with Head Trauma Visiting Khatam Al-Anbia Hospital in Zahedan in 2022

Maryam Ziaei[1], Ali Dah Mardeh Ei[2], Alireza Bahmani[1*]

[1] *Department of Emergency Medicine, Khatam Al Anbia Hospital, Zahedan University of Medical Sciences, Iran.*
[2] *Department of General Surgery, Shariati Hospital, Tehran University of Medical Sciences, Iran.*

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Abstract

Background: Traumatic brain injury (TBI) remains a leading cause of mortality and long-term disability. This study aims to evaluate brain CT scan findings in patients with head trauma admitted to Khatam al-Anbia Hospital in Zahedan during 2022.

Methods: This cross-sectional, descriptive-analytical study focused on patients presenting with head trauma at Khatam al-Anbia Hospital in Zahedan throughout 2022 who underwent brain CT scans. A census-based sampling method was employed, and data were collected using a structured checklist. The analysis was conducted using SPSS software.

Results: The study included patients with a mean age of 51.78 ± 26.75 years, ranging from 1 to 99 years. Among the 100 participants, 25 (25%) were women and 75 (75%) were men. The highest incidence of TBI was observed in the 70 to 80-year age group, with 15 patients, whereas the lowest incidence was found in the 50 to 60-year and over 90-year age groups, with 6 patients each. Car accidents were identified as the leading cause of head trauma, accounting for 32 cases (32%), followed by physical altercations, which contributed to 10 cases (10%). CT scan results indicated that 10% of the scans were normal, while 90% were abnormal. Notable abnormal findings included subdural hemorrhage (6 cases), frontal bone fractures (16 cases), and cytotoxic edema (6 cases). The most frequent location and type of skull fractures were in the temporal region (8 cases, 29.6%) and linear fractures (16 cases, 59.3%), respectively. The majority of TBIs were classified as mild (54 cases), with moderate TBIs being the least common (16 cases). Additionally, significant associations were found between injury type, gender, and the nature of the trauma.

Conclusions: This study highlights that road traffic accidents are a predominant cause of traumatic brain injuries, consistent with findings from various studies. The most frequently affected age group was 70 to 80 years, with a predominance of men. Abnormal CT findings commonly included subdural hemorrhage, frontal bone fractures, and cytotoxic edema. These results indicate potential regional differences in TBI patterns and emphasize the importance of targeted diagnostic and treatment strategies. The findings underscore the need for early and precise CT imaging in managing head trauma to improve patient outcomes. Further research is essential to refine management approaches and address regional variations in TBI.

Keywords: Traumatic Brain Injury (TBI), CT Scan, Head Trauma, Road Traffic Accidents

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Introduction

Traumatic Brain Injury (TBI) ranges from minor head injuries to severe penetrating brain injuries, and it represents a significant health issue globally. In the United States alone, approximately 1.7 million people are affected by TBI each year, with teenagers aged 15 to 19 and adults aged 65 and older being particularly vulnerable [1]. TBI is a major health, social, and economic problem, imposing substantial costs on healthcare systems and is one of the leading causes of mortality [2,3]. Often termed a "silent epidemic," TBI's consequences are not always immediately apparent, reflecting

*** Corresponding author**: Alireza Bahmani, Assistant Professor,
Department of Emergency Medicine, Khatam Al Anbia Hospital, Zahedan University of Medical Sciences, Iran.
Address: F. 1, No 4., Ghalambor Ave, Zahedan, Iran.
Tel.: +98 913 227 0507; Email: drbahmani@yahoo.com

its underestimation and the general unawareness of its impact on society [4]. In Iran, road traffic accidents are a leading cause of brain injuries in men aged 21-30 [5]. TBI is a primary cause of disability in individuals under 30 and significantly affects patients and their families [6]. TBI can lead to focal neurological deficits such as impairments in memory, vision, or executive functions and is associated with mental health issues, with about 30-70% of survivors experiencing depression [7]. The severity of TBI ranges from mild, with no structural changes and a Glasgow Coma Scale (GCS) score of 13 to 15, to severe, with life-threatening conditions and a GCS score of less than 8 [8, 9]. Causes of TBI include falls, motor vehicle accidents, assaults, and sports-related injuries [10]. Traumatic brain hemorrhages are classified into primary and delayed types. Primary hemorrhages are detectable on CT scans obtained within the first six hours post-trauma, while delayed hemorrhages might not be visible initially but can appear on follow-up scans after six hours [11]. The advent of CT scanning in the 1970s greatly improved the diagnosis and management of head trauma. Despite the prevalence of head injuries, diagnostic practices vary, and CT scanning remains a crucial tool in evaluating head trauma, particularly in emergency settings [12, 13]. CT scans are essential for assessing brain injuries, but they also come with risks, including radiation exposure and increased financial costs [15]. Nonetheless, CT scanning is the preferred diagnostic method due to its availability, speed, and effectiveness in providing critical information for trauma management [16-18]. Trauma centers extensively use CT scans to diagnose various injuries, as they reveal findings in a significant proportion of trauma patients [19]. Factors influencing the use of CT in head trauma cases include initial GCS score, age, injury mechanism, and clinical symptoms. Guidelines such as the New Orleans criteria and Canadian head trauma guidelines outline indications for CT scanning, including factors like GCS score, age, and presence of symptoms like vomiting and amnesia [20]. Delayed CT scanning is particularly important for mild head trauma cases (GCS=14-15), where initial scans may not show significant findings, but later scans might be necessary [21]. CT scanning's advantages include non-invasiveness, high detection speed, sensitivity, and cost-effectiveness [22]. Despite these benefits, the role of delayed CT scanning remains a subject of ongoing research. CT scans can reveal acute trauma-related findings such as skull fractures, intracranial hemorrhages, brain edema, and ischemia, as well as incidental findings like calcifications, brain atrophy, arachnoid cysts, and rare tumors [23].

Methods

This retrospective study aimed to investigate brain CT scan findings in patients with isolated head trauma or head trauma as part of multiple traumas during the first half of 2022 at Khatam al-Anbia Hospital, Zahedan. The study utilized reports from patient records, prepared by radiology specialists. Ethical approval for the study was obtained from the university's ethics committee (IR.ZAUMS.REC.1402.036), ensuring that the research adhered to the ethical standards required for studies involving human subjects. Additionally, necessary permissions were secured to access the patient archiving system after coordinating with the relevant university departments. This ensured that all legal and institutional protocols were followed, safeguarding patient confidentiality and data security. Data collection tools were developed by the researcher and included a checklist of variables under study. These tools were meticulously designed to capture all relevant data points necessary for the analysis. The collected data included patient age, gender, presence or absence of skull fractures (as identified via brain CT scans), presence or absence of hemorrhage (identified via brain CT scans), presence or absence of contusion (identified via brain CT scans), presence of edema (identified via brain CT scans), the patient's GCS score, and final outcomes (discharge, transfer to other departments, operating room, or death). The checklist was structured to ensure that all variables were systematically recorded, minimizing the potential for data entry errors and ensuring consistency across all patient records. The study included all patients who presented with isolated head trauma or multiple trauma involving the head during the first six months of 2022 at Khatam al-Anbia Hospital. Inclusion criteria were broad to encompass a diverse patient population, allowing for a comprehensive analysis of brain CT scan findings across different trauma types and severities. A total of 130 cases were reviewed, with 100 cases meeting the inclusion criteria. The exclusion criteria were rigorously applied to ensure the integrity of the dataset. Specifically, exclusion criteria involved 10 patients under 16 years old, as pediatric patients often require different diagnostic and therapeutic approaches; 9 cases without CT scan reports, where the lack of imaging data would preclude meaningful analysis; 5 patients who did not consent to CT scanning, respecting patient autonomy and ethical considerations; and 6 cases where CT scan requests were made by departments other than the emergency medicine team, ensuring consistency in the clinical context of the cases analyzed. Brain CT findings were reviewed using the hospital's Picture Archiving and Communication System

(PACS), a digital imaging technology that allows for the storage, retrieval, and analysis of diagnostic images. PACS was instrumental in enabling the researcher to systematically review and categorize the brain CT scan findings. All data were recorded by the researcher in the checklist, ensuring that each case was thoroughly documented. This process involved cross-referencing imaging findings with the corresponding clinical data to ensure accuracy and completeness. The collected data were then analyzed using SPSS software version 25. This statistical software was selected for its robust capabilities in handling complex datasets and performing a wide range of statistical analyses. Descriptive statistics were used to summarize quantitative data, such as patient age and GCS scores, with means and standard deviations providing measures of central tendency and variability. Qualitative data, including the presence or absence of specific CT findings, were described using frequencies and percentages, offering a clear overview of the distribution of these variables within the study population.

Results

The mean age of the patients was 51.78 ± 26.75 years, with a range from 1 to 99 years. In this study, 25 women, accounting for 25% of the participants, and 75 men, accounting for 75% of the participants, were included. The highest incidence of TBI was observed in the 60 to 80-year age group, with 26 cases, while the lowest incidence was in the 80 to 100-year age group, with 18 cases.

Table 1 presents the findings from CT scans of patients with traumatic brain injuries. Out of the total patients, 10% had normal CT scan results, while 90% showed abnormal findings. In the category of hemorrhage, 23.1% of patients had normal results, whereas 46.2% had subdural hemorrhages, making it the most common type. Epidural hemorrhages were observed in 7.7% of patients, subarachnoid hemorrhages in 15.4%, and intraparenchymal hemorrhages in 7.7% of patients. Regarding contusions, the frontal region was most frequently affected, accounting for 40% of cases. Temporal contusions were noted in 25% of patients, followed by parietal contusions in 17.5%, occipital contusions in 7.5%, and diffuse contusions in another 7.5%. Basal ganglia contusions were the least common, observed in 2.5% of cases. Edema was also observed, with cytotoxic edema being the most prevalent, occurring in 60% of the cases. Vasogenic and interstitial edemas were less common, each accounting for 20% of the cases.

Table 2 presents the findings from CT scans regarding the location and type of skull fractures in the study population. Among the different locations, the most common site of skull fractures was the temporal region, accounting for 29.6% of the cases, followed by the frontal region at 22.2%, the parietal region at 14.8%, and the occipital region at 11.1%. Less common locations included the basal and maxillofacial regions, each comprising 7.4% of the cases. Complex and unspecified fractures were the least frequent, each representing 3.7%. Regarding the types of skull fractures, linear skull fractures were the most prevalent, occurring in 59.3% of cases. Depressed skull fractures were the second most common, making up 22.2% of the cases. Diastatic skull fractures were found in 7.4%, and basal skull fractures were present in 11.1% of the patients. These findings highlight the variability in both the location and type of skull fractures observed in patients with head trauma.

Table 1: Frequency distribution of patients by lesion type

CT Scan Findings	Variable	Levels	Count	Percentage
Normal			10	10.0%
Abnormal	Hemorrhage	Normal	3	23.1%
		Epidural hemorrhage	1	7.7%
		Subdural hemorrhage	6	46.2%
		Subarachnoid hemorrhage	2	15.4%
		Intraparenchymal hemorrhage	1	7.7%
		Total	13	14.0%
Contusion	Frontal		16	40.0%
	Occipital		3	7.5%
	Parietal		7	17.5%
	Temporal		10	25.0%
	Basal Ganglia		1	2.5%
	Diffuse		3	7.5%
	Total		40	45.0%
Edema	Cyctotoxic edema		6	60.0%
	Vasogenic edema		2	20.0%
	Interstitial edema		2	20.0%
	Total		10	11.0%

Table 2: Distribution of patient population according to type and location of skull fracture

CT Scan Findings	Variable Levels	Count	Percentage (%)
Location of Skull Fracture			
	Frontal	6	22.2
	Occipital	3	11.1
	Parietal	4	14.8
	Temporal	8	29.6
	Basal	2	7.4
	Maxillofacial	2	7.4
	Complex	1	3.7
	Unspecified	1	3.7
Type of Skull Fracture			
	Linear Skull Fracture	16	59.3
	Depressed Skull Fracture	6	22.2
	Diastatic Skull Fracture	2	7.4
	Basal Skull Fracture	3	11.1

Table 3: Distribution of patient population according to level of consciousness

Variable Level	Count	Percentage
Mild (GCS 14-15)	54	54.0%
Moderate (GCS 9-14)	16	16.0%
Severe (GCS <9)	30	30.0%

Table 4: Distribution of patient population according to level of consciousness

Variable	Variable Levels	Fracture	Hemorrhage	Contusion	Edema	Statistic	P-Value
Age Group	20 to 40 years	6	5	8	2	1.309	0.146
	40 to 60 years	7	1	5	2		
	60 to 80 years	6	4	13	2		
	80 to 100 years	5	2	11	2		
	Total	24	12	37	8		
Gender	Female	11	2	8	2	0.876	0.007
	Male	16	11	32	8		
	Total	27	13	40	10		
Type of Trauma	Motorcycle Accident	2	3	4	1	0.693	0.001
	Car Accident	8	3	16	6		
	Fall from Height	9	2	9	2		
	Natural Heights	6	4	8	0		
	Physical Assault	2	1	3	1		
	Total	27	13	40	10		

The table presents the Glasgow Coma Scale (GCS) scores for patients with traumatic brain injuries (TBI) in three severity categories: mild, moderate, and severe. Among the patients, 54% had a mild TBI with GCS scores between 14 and 15, indicating minor brain injuries. Moderate TBI, with GCS scores ranging from 9 to 14, accounted for 16% of the cases, reflecting a more significant impact on consciousness. Lastly, 30% of the patients had severe TBI with GCS scores below 9, indicating serious brain injuries with a higher risk of poor outcomes. These results highlight that the majority of the patients in this study experienced mild traumatic brain injuries, while nearly a third of the cases were severe (Table 4).

The table presents the distribution of skull fractures, hemorrhages, contusions, and edema across different age groups, genders, and types of trauma in a study of patients with head injuries. In terms of age, the 20 to 40-year age group had 6 fractures, 5 cases of hemorrhage, 8 contusions, and 2 instances of edema. The 40 to 60-year age group showed similar numbers with 7 fractures, 1 hemorrhage, 5 contusions, and 2 cases of edema. The 60 to 80-year age group had slightly more contusions (13), along with 6 fractures, 4 hemorrhages, and 2 edemas. The 80 to 100-year age group had 5 fractures, 2 hemorrhages, 11 contusions, and 2 cases of edema.

In terms of gender, females had 11 fractures,

2 hemorrhages, 8 contusions, and 2 instances of edema, while males had higher numbers with 16 fractures, 11 hemorrhages, 32 contusions, and 8 cases of edema. The P-Value for gender differences was 0.007, indicating a statistically significant difference between males and females in these outcomes.

Regarding the type of trauma, motorcycle accidents resulted in 2 fractures, 3 hemorrhages, 4 contusions, and 1 case of edema. Car accidents were associated with higher numbers: 8 fractures, 3 hemorrhages, 16 contusions, and 6 edemas. Falls from height accounted for 9 fractures, 2 hemorrhages, 9 contusions, and 2 edemas. Natural heights caused 6 fractures, 4 hemorrhages, 8 contusions, and no edema. Physical assaults resulted in 2 fractures, 1 hemorrhage, 3 contusions, and 1 case of edema. The P-Value for the type of trauma was 0.001, showing a statistically significant difference among the different types of trauma in relation to these variables.

Discussion

Traumatic brain injury (TBI) is one of the most significant causes of mortality. Traumatic brain hemorrhages are further classified into primary and delayed hemorrhages. Various factors, such as the Glasgow Coma Scale (GCS) at admission and its changes, age, mechanism of injury, and clinical symptoms, influence the use of paraclinical methods for patients with head trauma. Therefore, the present study aimed to investigate brain CT scan findings in patients with head trauma who were admitted to Khatam al-Anbia Hospital, Zahedan, in 2022. According to the findings of this study, 25% of the participants were women, and 75% were men. The highest incidence of TBI was observed in the age group of 70 to 80 years, with 15 cases, while the lowest incidence was in the age groups of 50 to 60 years and over 90 years, with 6 cases each. Shah Hosseini et al. [14] reported that 72.3% of the participants in their study were women, a result consistent with our study. However, Shah Hosseini et al. [14] found no significant relationship between age and the incidence of trauma, which could be due to differences in the study populations. Azizi et al. [5] reported a mean age of 38.3 ± 23.8 years among patients, with 79.5% being men. The highest incidence of TBI was in the age group of 21 to 32 years (21.5% of the total population). In the study by Monsef Kasmaei et al. [24], the mean age was 38.5 ± 21.7 years, and 81.8% of the patients were men, similar to our study. However, they reported that men aged 20 to 60 years were more frequently exposed to TBI. In the present study, car accidents were the most common cause of head trauma (32 cases, 32%), while assault was the least common cause (10 cases, 10%). Azizi et al. [5] also reported that vehicular accidents were the most common cause of head trauma, accounting for 301 cases. In the study by Satyen et al. [25], 41.75% of head traumas were due to road accidents, and 32% were due to falls. Monsef Kasmaei et al. [24] also reported road accidents as the leading cause of TBI. Farzaneh et al. [26] reported road accidents and falls from height as the most common causes of head trauma and TBI, respectively. In contrast, Rutland-Brown et al. and Fall et al. [27] reported falls as the most common cause of trauma. It appears that road accidents are the most frequent cause of TBI, as highlighted in previous studies. The findings of the present study revealed that subdural hemorrhage (6 cases), frontal hemorrhage (16 cases), and cytotoxic edema (6 cases) were the most common abnormal CT scan findings in the patients. Azizi et al. [5] reported subarachnoid hemorrhage as the most common abnormal CT scan finding, which does not align with our results. Gajjar and Moody reported that 18% of cases had subdural hemorrhage, which differs from our study. According to the present study, the most common site and type of skull fracture were in the temporal region (8 cases, 29.6%) and linear fractures (16 cases, 59.3%), respectively. Azizi et al. reported that temporal and frontal fractures were the most common, with 32 and 31 cases, respectively, and linear fractures accounted for 100 cases, the most frequent type of skull fracture. In the study by Forouzan et al. [28], depressed fractures were the most common, followed by linear fractures. The present study found that mild traumatic brain injuries (TBI) were the most common (54 cases), while moderate injuries were the least common (16 cases). Azizi et al. [5] also reported that headache was the most common symptom at the time of admission, followed by nausea and vomiting. Additionally, 54% of patients had a GCS score of 13-15, while 27.6% had a GCS score of less than 9. In the study by Forouzan et al. [28], headache, nausea, vomiting, and dizziness were also the most common symptoms reported upon admission. This study provides significant insights into the characteristics and findings of brain CT scans in patients with head trauma at Khatam al-Anbia Hospital, Zahedan, during the first half of 2022. Our results highlight that traumatic brain injury (TBI) is a prevalent and critical issue, with road accidents being the leading cause of head trauma, consistent with findings from several studies. Notably, the age group most frequently affected by TBI was 70 to 80 years, with a predominance of men, which aligns with the general trend reported in the literature. CT scan findings revealed that subdural hemorrhage, frontal hemorrhage, and cytotoxic edema were the most common abnormalities. This diverges from some previous studies that identified subarachnoid

hemorrhage as the most frequent abnormality, indicating potential regional differences or variations in patient populations. The study also identified temporal region fractures and linear fractures as the most common types of skull fractures, further underscoring the need for targeted diagnostic and therapeutic approaches. The majority of patients presented with mild TBI, as indicated by GCS scores of 14-15, while moderate TBI cases were less common. This pattern reflects similar findings in the literature, where mild TBI is more frequently encountered in clinical settings. The study's results emphasize the importance of early and accurate CT imaging in diagnosing and managing head trauma to prevent complications and improve patient outcomes.

Conclusion

In conclusion, this study underscores the need for ongoing research and tailored management strategies for TBI, particularly in the context of regional variations and demographic factors. It also highlights the necessity for continued vigilance in diagnosing and treating head trauma, as early intervention remains crucial for optimal patient recovery.

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