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Assessment of Traumatic head injury by Computed tomography in Mosul, Iraq

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ABSTRACT

Traumatic head injury has a high mortality and morbidity in low- and middle-income countries. Brain injury following trauma is the cause of death in about one-third of patients that die after trauma. The aim of the study was to assess the pattern of computed tomography (CT) findings in head trauma at the tertiary health institutions serving the Mosul city.

Key word: Traumatic head injury, Computed tomography, Subdural hemorrhage.

INTRODUCTION

Head injury according to WHO will surpass many diseases as the major cause of death and disability by the year 2020.[2] The general incidence of traumatic brain injury (TBI) in developed countries is approximately 200/100,000/year. Head injury is any trauma to the scalp, skull, and brain. It remains the most common cause of death following trauma, with particularly high mortality and morbidity in low- and middle-income countries (LMIC).[1]

The global burden which heads injury-related mortality and morbidity imposes on society makes the condition a pressing public health concern. The burden of head injury is more challenging in developing countries including Iraq where trauma rate in general and head injury in particular are increasing. These challenges are compounded by poor and bad road network, influx of substandard vehicles such as motorcycles, tricycle, There is also poor regulation of driving license as some motorcycle riders transform into motor vehicle drivers without proper training or driving test. The challenge of head injury is daunting as the health system is inadequately prepared to address the cause and mitigate the associated health consequences.

Radiological imaging techniques provide some of the most important diagnostic, prognostic, and path physiologic information in the management of brain injury. The introduction of computed tomography (CT) in 1973, revolutionized the assessment of head-injured patients, and it gives direct visualization of the brain tissue and lesion. Since its introduction, it has been rated the gold standard for evaluation of acute head trauma. CT is readily available, fast, and compatible with equipment for monitoring of vital functions and artificial ventilation.[10] Magnetic resonance imaging (MRI) is recommended for patients with acute TBI when the neurologic findings cannot be explained by CT. The pitfall in MRI evaluation of head trauma is in the acute phase; due to its ferromagnetic property, it is not compatible with resuscitation equipment and metallic foreign bodies. It also has long scanning time and is unable to evaluate skull fractures adequately.

The aim of the study was to assess the pattern of CT findings in head trauma in the tertiary health institutions serving the Mosul city and also to assess the relationship of the findings to the social and biophysical data.

PATIENTS AND METHODS

The CT scans of the head of 310 consecutive patients referred specifically for evaluation of head trauma were prospectively reviewed. The study lasted over a period of 2 years between September 2012 and August 2014. The CT scan was done using the Brilliance Philips CT scanner six multislices (Netherland 2004). The study participants were placed in the supine position in the CT gantry and scanned from the skull base to the vertex with contiguous axial slices parallel to the inferior orbitomeatal line using 5 mm slice thickness at an interval of 3 mm. Intravenous contrast medium was not administered for all the patients as was the practice in our centers. This is to prevent further damage to the brain as the blood–brain barrier has been compromised and also to avoid masking any Hyper-density which is a typical CT appearance of acute hemorrhage. Both the bone and soft tissue windows were viewed, and images were reformatted into sagittal, coronal, and oblique planes as were necessary. The images acquired were analyzed by the radiologists. The radiological features and anatomical distribution of the lesions on the CT Images were assessed and documented. The demographic data of the patients were also recorded. Patients with congenital abnormalities of the head and those whose fall or injury were secondary to stroke were excluded from the study. Patients who died before arriving the hospital were also excluded from this study. The Ethical Committee of our institutions gave approval for the study, and the procedure was explained to the patients or relatives depending on the state of consciousness and age of the patient.

RESULTS

A total of 310 CT scan images of patients that sustained head injury were analyzed. The male to female ratio was 2.6:1. The age range was from 1 year to 86 years, with a mean age of 32.09 ± 17.50 years (mean ± standard deviation). About 44.84% of the patients were in the third and fourth decades of life with the age range of 21–30 constituting 23.87% [Table 1]. The major causes of head injury were RTAs in 67.74%; the cause of injury could not be ascertained in 20 (6.45%) [Figure 1].

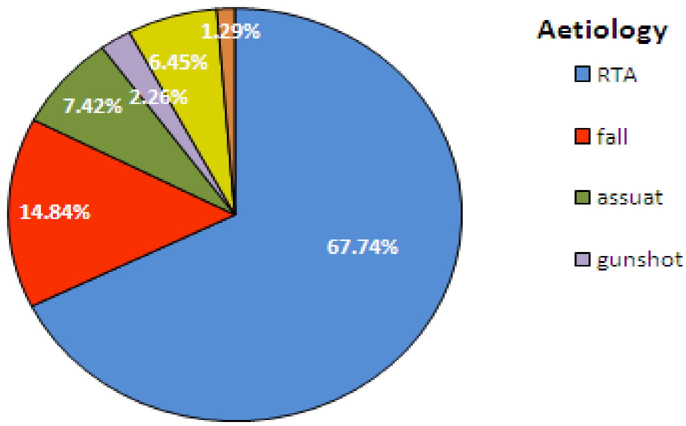

Figure 1: Pie chart of the etiology of injury

Table 1: Age and gender distribution

Age	Gender		Total (%)
	Female	Male	
<1-10	19	26	45 (14.52)
11-20	12	22	34 (10.97)
21-30	17	57	74 (23.87)
31-40	11	54	65 (20.97)
41-50	10	34	44 (14.19)
51-60	8	12	20 (6.45)
61-70	7	11	18 (5.81)
71-80	1	8	9 (2.90)
>80	0	1	1 (0.32)
Total	85	225	310 (100)

Figure 2 shows the duration between injury and CT scan examination. Most of the patients 102 (33.0%) presented within 1 week. Out of these, only 4 (1.29%) patients had CT scan done within the first 24 h of the injury. In this series, 60.4% had normal CT findings while 39.6% had abnormal CT findings [Table 2]. The abnormality features comprised of acute intracranial haemorrhage as the commonest findings and the least being arachnoid cyst and hydrocephalus [Table 2].

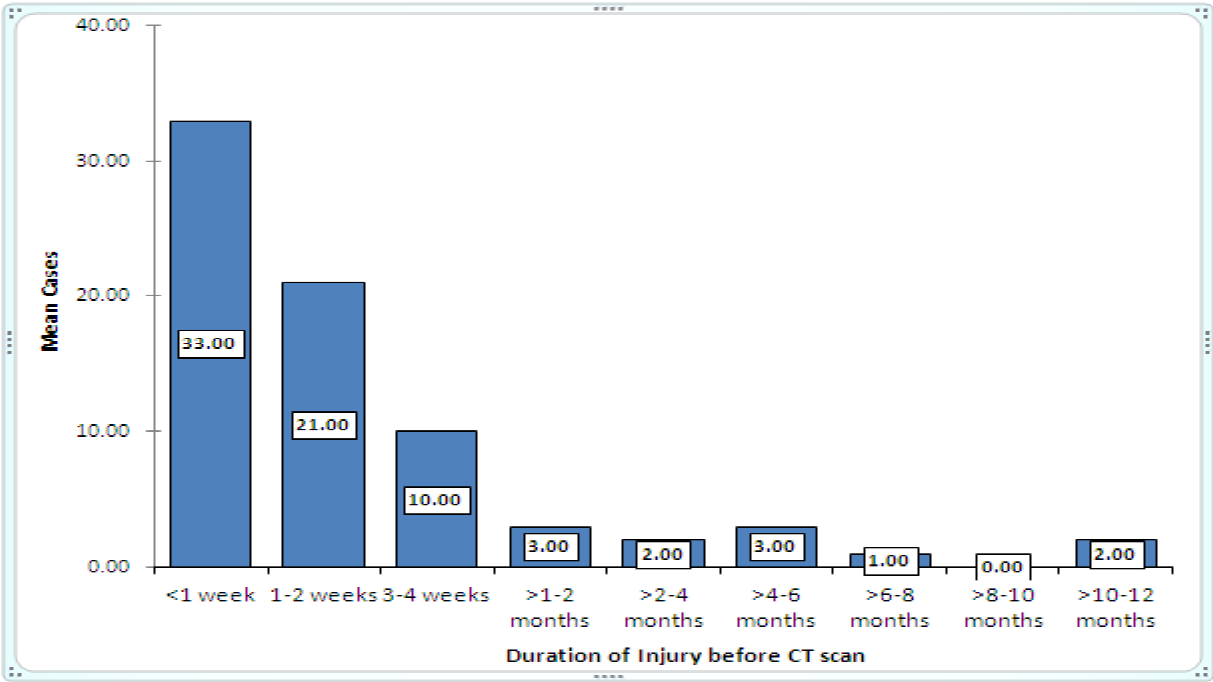

Figure 2 Histogram of duration of injury before computed tomography scan examination

Table 2 Mediums of accident and age group specific distribution (n=444).

Findings	Frequency	Percentage (%)
Main (n=53)		
Normal	32	60.4
Abnormal	21	39.6
TBI Specific (n=21) ***Intracranial Haemorrhage***		
EDH	2	5.7
ADH	4	11.4
SAH	1	2.9
ICH	4	11.4
Effacement		
Effaced ventricle	1	29
Effaced sulci	1	2.9
Infarct		
Caudate nucleus infract	1	2.9
Cerebral infract	3	8.6
Contusion		
Cerebral	3	8.6
Hemorrhagic	4	8.6
Mass effect		
Ventricular shift	1	2.9
Falx cerebri shift	2	5.7
Others		
Brain atrophy	4	8.6
Arachnoid cyst	1	2.9
Hydrocephalus	1	2.9
Small vessel disease	2	5.7

*Multiple findings observed in 7 of the reports.

Involvement of a combination of the temporoparietal bones was most common. The parietal bone 39 (32.77%) and the frontal bone 25 (21.01%) were the most common skull bones involved in fractures [Table 3]. Linear fractures were the most common involving 46 (52.87%) of the cases of cranial fractures.

Table 3 Frequency of distribution of cranial bones fractures

Cranial	Number of cases (%)
Parietal bone	39 (32.77)
Frontal bone	25 (21.01)
Facial bone	17 (14.29)
Temporal bone	12 (10.08)
Skull bone	10 (8.40)
Occipital bone	9 (7.56)
Sphenoid wing	6 (5.04)
Mastoid	1 (0.88)
Total	119 (100)

Intracerebral hemorrhage was seen in 83 patients constituting 63.36% of the intra-axial lesions. There were 40 cases of cerebral contusion which constituted 30.53%.

Figure 3 shows the axial CT images of the various intracranial hemorrhages found in the study. Most of the acute lesions were associated with cerebral edema, and in 13 (4.19%), generalized cerebral edema was the only finding. There were ten cases of pneumocranium (3.23%) found, and these were all associated with fractures.

Figure 4 shows the bone window of the axial CT images demonstrating the fractures and pneumocranium and (d) demonstrating scalp edema from soft-tissue injury. Paranasal sinus collection was found in 9 (2.90%). The sphenoid and maxillary sinuses were mostly involved. Metallic foreign bodies were seen in 6 (1.94%), and all were from gunshot injuries.

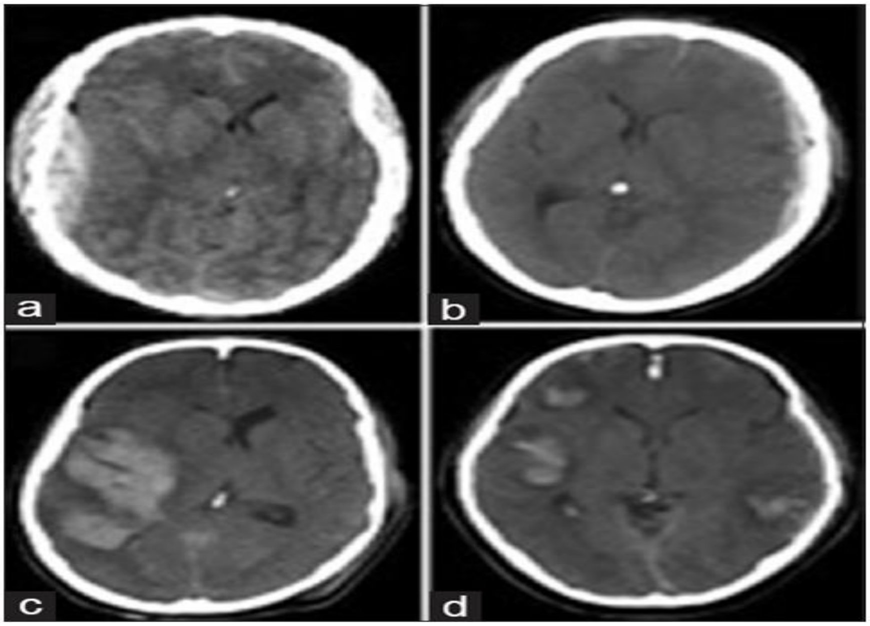

Figure 3 Axial cranial computed tomographic images of the different intracranial hemorrhages in the study.
(a) Hyperdense epidural hematoma in the right parietal region of the cranial cavity with mass effect occluding the ipsilateral lateral ventricle and a mild midline shift to the contralateral side.
(b) hyperdense subdural hematoma with skull fracture in the right parieto-occipital region.
(c) hyperdense intracerebral hematoma in the right cerebrum with a midline shift.
(d) acute subarachnoid hemorrhage outlining the fissures.

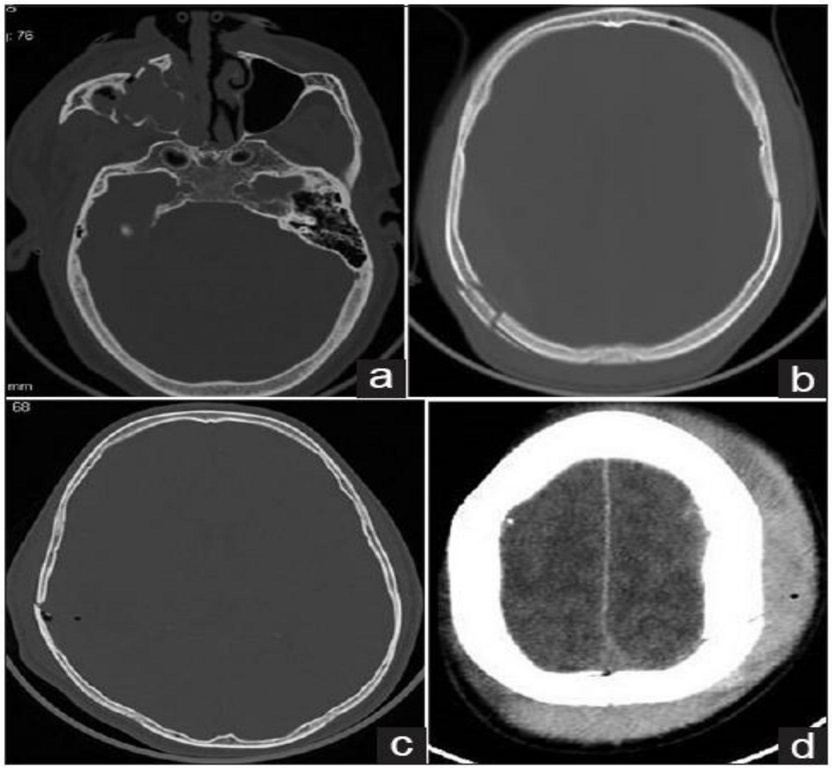

Figure 4 Axial cranial computed tomographic images from the study.
(a-c) Bone window images demonstrating right facial bone fractures with maxillary sinus hemorrhage, occipital bone fracture, right parietal bone fracture with pneumocranium.
(d) scalp edema with bilateral parietal bone fractures

DISCUSSION

Head injury remains the most common cause of death following trauma; with particularly high mortality and morbidity in LMIC, due to poor health facilities. Radiologic imaging especially CT facilitates a comprehensive diagnosis and permits early and targeted management.

All age groups were affected by head injury, but it was more common in the third and fourth decades of life. These age groups constitute the active, productive, and adventurous group of our society and are more likely to be exposed to the risk factors for head injury. In this study, males are more affected than females with male to female ratio of 2.6:1. The male preponderance can be explained by the fact that more males are involved in occupations and activities which predisposed them to trauma and injuries compared to the females. This demographic pattern is similar to other data from our region which had shown that more than 60% of people involved in traumatic head injury were below 40 years.[11,12,13]

The leading causes of TBI in most parts of Iraq are RTAs, violence, and falls   The prevalence of RTAs as the most common cause of head injury in this study was in keeping with previous observation in Iraq This study and others in parts of Iraq were in tandem with the projected increase in cases of head trauma from RTAs by the WHO report. The increasing rate of RTAs in Iraq may be attributed to poor and bad road network, poor vehicle maintenance, use of substandard vehicles such as motorcycles, tricycles, and imported fairly used cars and tyres for commercial transportation. Use of alcohol and negligence of road safety rules are also contributing factors. Also, attributed the high prevalence of RTAs to poor compliance to road safety rules, high level of illiteracy, and ignorance of traffic laws and road signs.

Falls constituted 14.84% of the cases of head injury in this study and was observed to be the second most common cause of head injury. Of these cases of fall in this study, 28.9% were in the first decade of life. This high incidence in pediatric age may be attributable to their involvement in high-risk activities and adventures at home and in schools. It is a call for adequate supervision of the children by adults. The period between the injury and CT scan evaluation in most (33.0%) of the patients were within 7 days. However, only 4 (0.29%) had CT scan done within the first 24 h of the injury..[17] Many patients could not have the CT done until they developed symptoms that necessitated verification. This restricted use of CT may be as a result of high costs, distance from the facility/location, and lack of awareness of the role of CT in the management of head injury by patients and their relatives as was revealed by previous studies Due to the above reasons, follow-up CT evaluation was not common. In our series, there was no follow-up CT evaluation even though it may have been necessary in some patients especially in monitoring postoperative patients or those who have not achieved the expected clinical improvement.

In this study, 64.19% had lesions on the CT scan images while 35.81% revealed a "normal CT scan finding." Those with an apparently normal CT scan finding but who had clinical evidence of severe head trauma that necessitated CT evaluation may have diffuse axonal injury which is not easily diagnosed by CT scan.[18,19] These values for pathologies on the CT images were in consonance with values of 74%[17] and 78%[20] recorded in the previous literature in our country. Our value is lower than the 80.1%, of abnormalities recorded by which could be due to the fact that their study was conducted in a purely neurosurgical center and most of their patients had been evaluated in other centers before referral. Prior evaluation may have restricted the number of cases with potential normal findings.[12]

The most frequent abnormality seen in this study was intracranial hemorrhage constituting 58% of the abnormal cases, which is similar to the observation in a similar study. Intra-axial hemorrhage was the most common, constituting 42.26%. Of these, intracerebral hemorrhage ranked the highest with 63%.. This variation may be ascribed to the pattern of patient's selection in these studies.

The incidence of 28.06% of skull fractures was found in the abnormal CT images. Many of these are associated with intracranial lesions, especially intracerebral hemorrhage. These lesions were ipsilateral to the fractures. The parietal bone is the most involved in fractures. This could be explained by the prominence of the parietal bone as the most convex surface of the cranium. Fracture of the base of the skull was associated with paranasal sinus collection and cerebrospinal fluid leakage.

Most of the gunshot cases were associated with metallic foreign bodies (bullet, pellets). There may be underreporting of the gunshot cases as this appears to have low incidence especially with the insurgency, militancy, and military assaults on civilians which are rampant in this region. The explanation for this may be due to high mortality associated with gunshot. Most of the victims may have died at the spot or before having the opportunity to be evaluated with CT scan. Moreover, these militants were mainly youths with no one to care for them as they were usually abandoned by their families having been associated with insurgency, militancy, and cultism. It is mandatory in Iraq that gunshot cases be reported to the police by the health institutions. Hence, for fear of arrest by police and other law enforcement agencies, most of the victims of these unlawful acts seek medical attention secretly and mainly from traditional healers instead of going to the recognized hospitals.

The main limitation of this study is that it was hospital based and only patients who survived until CT evaluation were included in the study. This may have led to an underestimation of the impact of head injury on the society hence limiting extrapolation of the result to the wider society. Due to financial constraint, no follow-up CT was done for the patients to monitor the outcome of treatment.

CONCLUSION

This study had demonstrated that majority of head trauma evaluated by CT were associated with cranial and brain injuries and the intra-axial injuries were more prevalent. Significant number of the patients had injuries which required immediate intervention to achieve a good outcome. This could be made possible by early evaluation with CT. However, due to the poor health facilities in LMIC, this is not achievable as the patients presented late for evaluation. The challenges were also worsened by the poor road network and poor regulation of road safety laws which increased the risk of RTAs and hindered rapid transfer of patients to health facilities. We recommend enforcement of traffic rules and regulations and improvement of road network to reduce RTAs and enhance easy access to health facilities and also adequate funding of the health sector to make CT and other imaging equipment readily available and cheap.

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