Prevalence of CT Scan Findings in Patient with Traumatic Brain Injury with Respect to Glasgow Coma Scale

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ABSTRACT:

BACKGROUND:

Traumatic brain injury (TBI) contribute to a significant mortality and substantial morbidity. CT is essential for identifying lesions requiring urgent intervention & those that require observation and non surgical management .

OBJECTIVE:

To assess the prevalence of CT findings with respect to the severity of TBI & to find out the relation between the age of the patient & the severity of TBI.

PATIENTS AND METHODS:

100 patients with TBI evaluated by brain CT. All age groups with Glasgow coma scale (GCS) of less than 15 were included.The abnormal CT findings were evaluated & recorded. The findings were further correlated with the patient`s age & the GCS score

RESULTS:

Eighty percent of the cases had mild TBI, 6% had moderate TBI and 14% had severe TBI. Ninety three percent had closed type of injury . Twenty four percent of the patients had normal CT scan , all of them had mild TBI . The most common CT findings in mild TBI cases were subgalial haematoma(SGH) & calvarial skull fracture, with minority of cases had cerebral contusion , fracture base of skull , diffuse cerebral oedema & intracranial haemorrhage . Two third of patients with moderate TBI had subarachnoid haemorrhage(SAH) & cerebral contusion, 50% had diffuse cerebral oedema, calvarial skull fracture,& 1/3 had Subdural haematoma & fracture base of skull. More than half of patients with severe TBI had calvarial skull fracture, fracture base of skull, cerebral contusion, SAH, with lower prevalence of diffuse cerebral oedema,and intracranial haemorrhage.

CONCLUSION:

The lower the GCS score, the more significant CT findings,predominantly fracture base of skull, subarachnoid haemorrhage and diffuse cerebral oedema.

KEY WORDS: traumatic brain injury, computed tomography, glasgow coma scale.

INTRODUCTION:

Traumatic brain injury (TBI) is an extremely common and potentially devastating problem. The TBI contribute to a significant number of deaths and substantial cases of morbidity & permanent disability. In 2010 , 2.5 million TBIs took place in the united states in the form of an isolated injury or with other associated injuries & they are contributing to about 30% of all injury deaths[(1)]. CT remains the essential tool for identifying lesions that require urgent neurosurgical intervention as well as those that require in-hospital observation and non surgical management [(2)].

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

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impairment of such functions. Traumatic brain injury constitutes one of the main health problems worldwide, currently with a high and increasing incidence, representing an important cause of morbidity & mortality among adolescents and young adults. It directly contributes to deaths by external causes, the main one being car accidents, falls, aggressions and pedestrian run over[3] .

Head injuries can be categorized in several ways: by mechanism of injury (closed or penetrating injury), morphology (fractures, focal intracranial injury, and diffuse intracranial injury), or severity of injury (mild to severe) [4].

Brain trauma can be divided into primary and secondary injury. Primary head injuries occur at the time of initial trauma and caused by direct trauma, whereas secondary injuries typically present later and caused by edema with or without brain herniation, metabolic and perfusion alterations, and a variety of other induced effects [5].

Clinically, scoring systems are frequently used to classify the severity of traumatic brain injury. The clinical severity of intracranial injuries is commonly assessed according to the degree of depression of the level of consciousness as assessed by the Glasgow Coma Scale (GCS). The GCS consists of the sum of scores (range, 3 to 15) of three components (eye, motor, and verbal scales), each assessing different aspects of reactivity [6].The motor component provides more discrimination in patients with severe injuries, whereas the eye and verbal scales are more discriminative in patients with moderate and mild injuries. For assessment of severity in individual patients, the three components should be reported separately[4,6].We aimed at this study to assess the different CT findings with respect to the severity of TBI

PATIENTS AND METHODS:

A total of 100 patients were enrolled in this prospective study. These patients were presented within the first 12 hours following TBI to the emergency unit & neurosurgery department at Al-Imamain Al-kadhimain medical city, Baghdad/Iraq from October 2013 through July 2014 . After stabilizing the patient's condition , all patients underwent complete clinical assessment and GCS score identified . Those patients with GCS of less than 15 were referred to the department of radiology for native brain CT scan . The scan was performed using 64 slices, Somatom Definition AS 2010(Siemens Medical Solutions; Germany), utilizing 120 kVp and effective mAs of 35 mAs with scan time of 38.12 seconds and delay of 2 seconds. Axial sections were taken parallel to the orbitomeatal line, usually in caudocranial direction of scan with scan range from the first cervical vertebra to the vertex and 5 mm-thick slices. The CT images in axial & reformatted sections were assessed at both brain & bone windows by two radiologist who are unaware of the GCS of the patients

The following findings were searched for and recorded: subgaleal haematoma (SGH), calvarial skull fracture , fracture base of skull, cerebral contusion, intraparenchymal haemorrhage, extradural haematoma , subdural haematoma, subarachnoid haemorrhage and diffuse cerebral oedema.

RESULTS:

A total of 100 patients were included in this study . According to the GCS , the patients were classified as following: 80% with mild TBI (GCS score13-15), 6% with moderate TBI (GCS score 9-12) and 14% with severe TBI (GCS score3-8) (figure1).

Figure 1: The three-D pie chart shows the classification of patients with TBI.

Sixty seven patients (67%) were males and 33 patients (33%) were females . The age range was 16-77 years , 88% of the patients were under 70 years of age and these are divided into 33% under the age of 18 years old and 55% above at age of 18 or above and under the age of 70, whereas 12% of patients were aged 70 years or above (figure2). The age range for each group if TBI is presented in table 1.

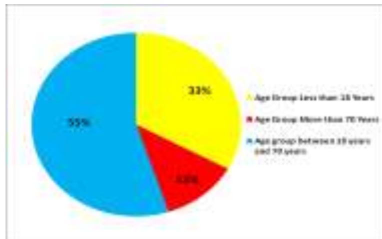

Figure 2: Two-D pie chart shows the age groups of patients with TBI.

Table 1: Age range of the patients according to severity of TBI.

Type of TBI	Age range (years)
Mild	16-63
Moderate	21-71
severe	55-77

The majority of the patients had closed type of injury (93%) , 7% had penetrating injury , all of them were categorized as severe TBI .
Regarding the CT scan findings in the group of mild TBI cases (80 patients), 24 patients had normal CT of the head , while the majority of those with abnormal CT findings had subgaleal haematoma (SGH) (50/80 = 62.5%)(figure 3) , other abnormal findings including calvarial fractures(figure 4) , subarachnoid haemorrhage(SAH) , subdural haematoma (SDH) , extradural haematoma (EDH) (figure 5) were found in minority of patients with different combinations (table2).

Regarding the 6 patients who were classified as moderate TBI, the majority s had SGH & SAH (5/6 (83.33%) & 4/6 (66.66%)) respectively with occurrence of other findings as cerebral contusion, diffuse cerebral oedema, calvarial skull fracture, SDH and fracture base of skull in different proportions & combinations (table 2).
Concerning patients with severe TBI (14 patients) , subgaleal hematomas , calvarial skull fracture, fracture base of skull & cerebral contusion were recorded in the majority of patients (table 1) . Other CT findings as SAH , diffuse cerebral oedema, SDH, EDH, intracerebral haemorrhage (ICH) & midline shift were found in different proportions (table 2).

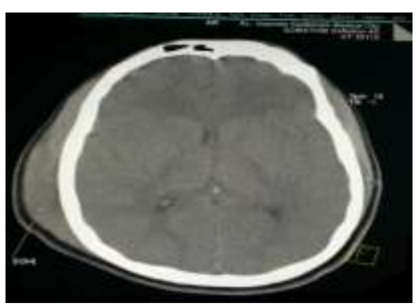

Figure 3 : Brain CT scan, axial soft tissue window, showing Rt. Occipito parietal subgaleal haematoma.

Figure 4: Brain CT scan, axial bone window, showing Rt. Frontal compound fracture.

Figure 5: Brain CT scan, axial soft tissue window, showing Lt. parietal EDH.

Table 2:The prevalence of different CT findings according to TBI severity.

Severity of TBI	SGH NO. (%)	Calvarial Fracture NO. (%)	Cerebral Contusion NO. (%)	SAH NO. (%)	Fracture Base of Skull NO. (%)	SDH NO. (%)	Diffuse Cerebral Oedema NO. (%)	EDH NO. (%)	ICH NO. (%)	Multiple CT findings NO. (%)
Mild TBI 80 patients	50 (62.5)	25 (31.25)	4 (5)	3 (3.75)	2 (2.5)	1 (1.25)	1 (1.25)	1 (1.25)	----	6 (7.50)
Moderate TBI (6 patients)	5 (83.33)	3 (50)	4 (66.66)	4 (66.66)	2 (33.33)	2 (33.33)	3 (50)	----	----	4 (66.66)
Severe TBI (14 patients)	12 (85.71)	9 (64.28)	8 (57.14)	8 (57.14)	8 (57.14)	4 (28.57)	4 (28.57)	2 (14.28)	2 (14.28)	12 (85.71)

The combination of three or more CT findings were observed in 22% of the patients, and these CT findings observed as follow: 6/80 (7.5%) patients with mild TBI had association of three or more CT findings , 4/6 (66.66%) patients with moderate TBI had association of three or more CT findings and 12/14 (85.71%) patients with severe TBI had association of three or more CT findings (figure 6).

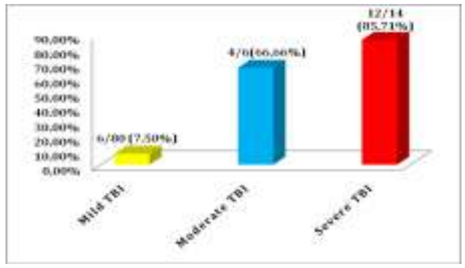

Figure 6: The three-D column chart shows the percentage of detecting 3 or more findings in brain CT scan with respect to severity of TBI.

Mechanism of TBI had a significant role in the severity of TBI, and all those 7 patients that presented with penetrating brain injury were presented with severe TBI.

DISCUSSION:

Traumatic brain injury is an important public health problem.Neuroimaging techniques play an important role in the management of patients with traumatic brain injury .At the acute stage , the presence and extent of injury can be assessed by imaging & thus surgical planning and minimally invasive interventions can be determined . Likewise , neuroimaging have vital contribution in defining the chronic therapy of TBI, diagnosing the remote consequences , determining prognosis, and guiding rehabilitation.

In the present study, 67% of the patients with TBI were male individuals; similar statistics were observed in several epidemiological studies available in the literatures [(7-8)]. This can be explained by greater exposure of male individuals to risk factors for TBI such as road traffic accidents, blast & bullet injuries in war and violence. Moreover , in our society , the number of men who drive cars, motor cycles, and other automobile vehicles are much more than women thus being more exposed to risk of automobile accidents.

Regarding mechanism of head injury, in this study, 93% of the patients were presented with closed head injury and just 7% were presented with penetrating TBI, these data are in agreement with other study which found that the majority of head trauma presented to the emergency department were of closed type [(11)].

In the current study 80 patients had mild TBI , 1/3 of these did not show any abnormality at CT scan . In a similar study[(10)], lower incidence of abnormal CT findings were reported in patient with mild TBI (9.4% &) , the discrepancy can be attributed to the variation in the methodology of study conduction as Jeret et al [(10)] did not included soft tissue swelling & linear fracture in their study .

The most prevalent CT finding in patients with mild TBI was subgaleal haematomas (62.5%) followed by calvarial skull fractures (31.25%) . Some authors have reported that the most frequent lesions in mild TBI were subgaleal and palpebral haematomas, followed by skull fractures and cerebral contusions[(12)], other studies describe calvarial fractures as the most prevalent findings in mild cases [(13)], and one study stated a relatively high prevalence of cerebral contusions (26.8%) [(14)].

Regarding moderate TBI, the main CT findings were SGH which were observed in 83.33% of patients, brain contusions and SAH were both observed in 66.66 % of patients, while calvarial skull fractures and diffuse cerebral oedema being observed in 50% for each of them. Our result came in accordance with that of Servadei et al [(15)]who stated that the most prevalent CT findings in moderate TBI were SGH, skull fractures and cerebral contusions, however in the present study, we also observed a high incidence of other tomographic findings like traumatic subarachnoid haemorrhage and diffuse cerebral oedema in cases of severe TBI.

In patients with severe TBI the most common findings at CT scan were as follow: subgaleal haematomas in 85.71% , calvarial skull fractures in 64.28% , areas of cerebral contusion in 57.14% , fractures base of skull in 57.14% , subarachnoid haemorrhages in 50% , diffuse cerebral oedema in

35.71%, & SDH in 28.57% . Comparing these results with those of Leitgeb et al [16] , some discrepancy is noticed as they found that the most common findings were contusion & diffuse cerebral oedema . Several other studies reported even higher Prevalence of intracranial haemorrhage & oedema & found to be associated with poor patient outcome [17,18]

A combination of more than 3 abnormal findings at CT scan was more prevalent in sever TBI in comparison with other types and these were associated with worst prognosis, in agreement with other studies [19-21].

Advanced age has been described as independent variable associated with worst prognosis. In the present study, there was an observation of a relationship between the age of the brain traumatized patients (older than 70 years) and TBI severity (GCS), that is when the age of the patient increase there will be a greater chance for that patient to present with severe TBI and had poor outcome, in agreement with the findings reported by Freitas et al [21].

CONCLUSION:

It was concluded from this study that:

1- The lower the GCS score, the more severe were the TBI and CT findings, with the predominance of fracture base of skull, subarachnoid haemorrhage and diffuse cerebral oedema.
2- Multiplicity of abnormal CT scan findings are associated with severe cases of TBI.
3- Advanced ages (above 70 years) is an important indicator of poor outcome

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