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ORIGINAL ARTICLE IN NEURORADIOLOGY

Intracranial CT findings in traumatic brain injury: A retrospective, cross-sectional study among Igbo population in Nigeria

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Abstract

Introduction: Traumatic brain injury (TBI) is a major cause of death and disability and in recent years has been increasingly reported even in developing countries. Computed Tomography (CT) plays a key role in accurate TBI diagnosis and management. The objective of this study was to document the pattern of CT findings in TBI cases reported from Igbo people, in Nigeria.

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Method: In this retrospective, cross-sectional study, a sample of 287 patients, who were consecutively referred to the CT Unit of the Radiology Department of Federal Medical Centre in Umuahia, Nigeria, between January 2015 and December 2016, on account of trauma to the head was reviewed. Only CT scan without contrast and intracranial findings were considered. Descriptive statistics (frequency and percentages) and confidential intervals were collected.

Results: After applying exclusion criteria, our sample comprised 242 patients (M = 163, 67.4%; mean age 32.6 ± 17.6 years). The peak age range was 20–29 years. Abnormal findings were reported for 205 patients (84.72%, 95% Confidential Interval [CI] 80.0 to 86.8). Cerebral oedema was the most common finding observed in the study (*n* = 64, 24.44%, CI 19.03% to 29.85%), followed by subarachnoid haemorrhage (*n* = 41, 16.94%, CI 12.21% to 21.67%) and epidural haematoma (*n* = 26, 10.74%, CI 6.84% to 14.64%). Only 37 patients (15.28%) showed normal findings. Main reported causal factors of TBI were: Road Traffic Accidents (RTA) (35.5%), falls (20.2%) and assault (15.7%). Most cases of RTA (34.9%) occurred in the age group of 20–29 years.

Discussion and Conclusion: CT brain without contrast is useful in screening of patients with TBI. In this Nigeria-based study the most common cause of TBI was RTA and cerebral oedema was the most common intracranial finding reported.

KEY-WORDS: Computed tomography; craniocerebral trauma; neuroradiology; Nigeria; traumatic brain injury.

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Riassunto

Introduzione: Il trauma cranico è la causa più importante di morte e disabilità ed in anni recenti è stato riportato un aumento della sua incidenza anche nei Paesi in via di sviluppo. La Tomografia Assiale Computerizzata (TAC) svolge un ruolo chiave nella diagnosi accurata del trauma cranico e nella sua gestione. L'obiettivo di questo studio è stato quello di documentare il pattern dei risultati di TAC effettuate nei casi di trauma cranico riportati nella popolazione Igbo in Nigeria.

Metodi: In questo studio retrospettivo di tipo trasversale, un campione di 287 pazienti che consecutivamente si sono rivolti all'Unità Tac del Dipartimento di Radiologia del Federal Medical Centre di Umuahia in Nigeria tra gennaio 2015 e dicembre 2016 per trauma cranico è stato esaminato. Solo le immagini TAC senza mezzo di contrasto ed i reperti intracranici sono stati considerati. Le statistiche desscrittive (frequenza e percentuali) e gli intervalli di confidenza sono stati calcolati.

Risultati: Dopo aver applicato i criteri di esclusione, il nostro campione risultava formato da 242 pazienti (maschi = 163, 67.4%; età media 32.6 ± 17.6 anni). La fascia di età più rappresentata era quella di 20-29 anni. Risultati anormali sono stati riportati per 205 pazienti (84.72%, 95% Intervallo Confidenziale (IC) al 95% tra 80.0 e 86.8). L'edema cerebrale è stato il risultato più frequentemente riscontrato nello studio (*n* = 64, 24.44%, IC 95% tra 19.03% e 29.85%), seguito dall'emorragia subaracnoidea (*n* = 41, 16.94%, IC al 95% tra 12.21% to 21.67%) e dall'ematoma

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epidurale (*n* = 26, 10.74%, IC 95% tra 6.84% e 14.64%). Solo 37 pazienti (15.28%) hanno evidenziato risultati negativi. I principali fattori causali di trauma cranico sono stati gli incidenti stradali (35.5%), le cadute (20.2%) e l'aggressione fisica (15.7%). Molti casi di incidenti stradali (34.9%) si sono verificati nella fascia di età di 20–29 anni.

Discussione e Conclusione: La TAC cerebrale senza mezzo di contrasto è utile nello screening dei pazienti con trauma cranico. In questo studio nigeriano, gli incidenti da traffico stradale sono stati la causa più comune di trauma cranico e l'edema cerebrale il stato il reperto intracranico più frequentemente rilevato.

TAKE-HOME MESSAGE: This study confirms the usefulness of CT in early diagnosis and management of traumatic brain injury (TBI) and the need of socio-economic investments in Nigeria to decrease TBI cases associated with road traffic accident and provide hospitals with CT scanning equipment.

Competing interests: none declared

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INTRODUCTION

Head injury is any injury to the head, which may be traumatic or non-traumatic [1]. Traumatic head injury, which is otherwise called traumatic brain injury (TBI) or intracranial injury, often involves damage to scalp, skull or brain and is usually a devastating consequence of Road Traffic Accidents (RTA), falls, violence or assaults. It is a major global health problem, which most times leads to death and disability [2]. Traumatic brain injury occurs when an external force injures the brain and is a consequence of a sudden acceleration or deceleration within the cranium or may result by a complex combination of both movement and sudden impact. It is defined as 'a traumatically induced structural injury and/or physiological disruption of brain function as a result of an external force' [3]. It has been observed that traumatic brain injury is a leading cause of mortality and morbidity in the world's population, especially for those aged 44 or below [4] and is responsible for one-third of total deaths caused by trauma [2]. It was also estimated that by the year 2020, head injury will be a major leading cause of death globally [5]. The prevalence of TBI is increasing even in developing countries like Nigeria and this has contributed to a great concern in our country [5], due to the poor road conditions and status of vehicles as well as improper driving lessons/training, which are well-recognized as major risk factors to TBI. Increased rates of many types of violence and assault in Nigeria, especially among the youth, complete the picture and worsen those risk factors. Skull X-ray are routinely obtained in all cases of head injuries.

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With advancements in technology, CT and MRI have positively changed the diagnosis and management of TBI as well as neuroradiology in general. The essence of imaging in the management of TBI is to identify treatable cerebral and cranial injuries early enough to prevent secondary injury [4]. Computed Tomography (CT) is the modality of choice for evaluation of acute head injury. It is preferred in the acute setting because it is fast, widely available, and can easily accommodate life-support and monitoring equipment. Moreover, it can accurately identify space-occupying lesions, acute haemorrhages, mass effect, midline shift, hydrocephalus, ischemia, herniation and bony pathology. On the other hand, MRI is indicated in patients with traumatic brain injury when the neurologic findings are unexplained by CT [6]. Traumatic brain injury (TBI) was earlier regarded as an injury, which affects mostly young males, but recent epidemiological studies have shown that older females are as frequently affected as males, especially in case of falls [3]. Moreover, there are several CT findings associated with traumatic brain injuries as a result of different causal factors. With this background of poor road system and increasing rates of violence and assault among the youths, our study seeks to document the pattern of CT findings in head trauma cases that presented in a Nigerian hospital.

METHODS

This was a retrospective, cross-sectional study carried out at the Radiology Department of Federal Medical Centre, in Umuahia Abia State, Nigeria. The study population comprised patients of Igbo descent, who were referred to our Department during the years 2015 and 2016 for CT brain scans with a medical diagnosis of head traumatic injury. Our sample comprised 287

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patients, who consecutively underwent CT brain. However, all patients with congenital abnormalities or trauma secondary to stroke were excluded from the study. Moreover, only CT scan without contrast and intracranial findings were considered. Different neurocranial findings such as skull fractures, scalp oedema and lacerations and other types of findings different from intracranial lesions were not documented. Therefore, the final sample comprised 242 patients.

The instrument used for the study was a 16-slice, brightspeed, General Electronics (GE) Milwaukee, Wisconsin, USA 2012 CT scanner. From the request cards, information regarding patient's clinical history, age, gender and other demographic data was collected. After images were acquired and analysed by radiologists and findings documented, they were retrieved from the radiologists' report book and categorised. The study was approved by the ethics committee of Federal Medical Centre Umuahia. Standard protocol and technique for brain CT were adopted. Patients' age and gender, type of intracranial finding, time and cause of injury were documented. Characteristics of head traumatic injury cases were analyzed by age and gender. Descriptive statistics (frequency and percentage) and confidential intervals of data collected were used. Statistical analyses were completed with Statistical Package for Social Sciences (SPSS Inc., Chicago, Illinois USA, Version 20.0) software.

RESULTS

After applying exclusion criteria, our sample comprised 242 patients (M = 163, 67.4%; mean age 32.6 ± 17.6 years), with age ranging from 1 to 86 years and the peak age range as 20–29 years. As Table 1 shows, the highest frequency of TBI occurred in the 20–29 age group (*n* = 54,

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22.3%), followed by the 30–39 (20.2%) and 40–49 (11.2%) age groups. Main reported causal factors of TBI were Road Traffic Accidents (RTA) (35.5%), falls (20.2%) and assault (15.7%); 35 cases (14.6%) had unspecified causes. Table 3 shows that most cases of RTA (34.9%) occurred in the age group of 20–29 years, fall occurred mostly in 30–39 age group (*n* = 19, 23.5%), and physical assault in the 10-19 age group (*n* = 13, 34.21%). Abnormal findings were reported for 205 patients (84.72%, 95% Confidential Interval [CI] 80.0 to 86.8). As shown by Table 4, eight different types of intracranial lesions were identified. Six patients had three co-existing findings and eleven patients two co-existing findings of intracranial lesions. Cerebral oedema was the most common finding observed in the study (*n* = 64, 24.44%, CI 19.03% to 29.85%), followed by subarachnoid haemorrhage (*n* = 41, 16.94%, CI 12.21% to 21.67%) and epidural haematoma (*n* = 26, 10.74%, CI 6.84% to 14.64%).

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Table 1. Age and gender distribution of patients with TBI (*n* = 242 patients).

Age group (years)	Males (n; %)	Females (n; %)	Total (n; %)
0–9	10 (4.1%)	12 (5.0%)	22 (9.1%)
10–19	14 (5.8%)	9 (3.7%)	23 (9.5%)
20–29	41 (17.0%)	13 (5.4%)	54 (22.3%)
30–39	37 (15.3%)	12 (5.0%)	49 (20.2%)
40–49	20 (8.3%)	7 (2.9%)	27 (11.2%)
50–59	16 (6.6%)	8 (3.3%)	24 (9.9%)
60–69	8 (3.3%)	8 (3.3%)	16 (6.6%)
70–79	11 (4.5%)	4 (1.6%)	15 (6.2%)
80 or above	6 (2.5%)	6 (2.4%)	12 (5.0%)
Total	163 (67.4%)	79 (32.6%)	242 (100%)

Table 2. Causes of TBI by gender (*n* = 242 patients).

Cause of TBI	Males	Females	Frequency (n; %)
Physical assault	17	21	38 (15.7%)
Road Traffic Accident	62	24	86 (35.5%)
Fall	56	25	81 (33.4%)
Gunshot	2	0	2 (0.8%)
Unspecified	26	9	35 (14.6%)
Total	163	79	242 (100%)

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Table 3. Causes of TBI by age group (*n* = 242 patients).

Age group	Physical assault	RTA	Fall	Unspecified	Gunshot	Total
0–9	8(21.05%)	5(5.8%)	3(3.7%)	5(12.7%)	0	22(9.1%)
10–19	13(34.21%)	12(14%)	9(11.1%)	3(9.1%)	0	23(9.5%)
20–29	7(18.24%)	30(34.9%)	14(17.3%)	3(9.1%)	2(100%)	54(22.3%)
30–39	5(13.16%)	20(23.3%)	19(23.5%)	4(10.9%)	0	43(20.2%)
40–49	4(10.52%)	8(9.3%)	17(21%)	3(7.3%)	0	31(11.2%)
50–59	1(0.02%)	5(5.8%)	10(12.3%)	2(3.6%)	0	17(9.9%)
60–69	0	4(4.7%)	5(6.2%)	4(12.7%)	0	16(6.6%)
70–79	0	3(3.5%)	3(3.7%)	5(16.4%)	0	15(6.2%)
80 or above	0	0	2(2.5%)	6(18.2%)	0	12(5.0%)
Total	38	86	81	35	2	242

Table 4. Types of intracranial CT brain findings (*n* = 242 patients).

CT Brain Findings	Prevalence (n; %)	95% Confidence Interval
Normal findings	37 (15.28%)	10.75% -19.81%
Cerebral oedema	64 (24.44%)	19.03% -29.85%
Epidural hematoma	26 (10.74%)	6.84% – 14.64%
Subdural hematoma	23 (9.50%)	5.81% - 13.19%
Subarachnoid haemorrhage	41 (16.94%)	12.21% - 21.67%
Intracerebral haematoma	16 (6.61%)	3.48% - 9.74%

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Cerebral contusion	38 (15.7%)	11.12% - 20.28%
Intraventricular haemorrhage	13 (5.37%)	2.48% - 8.12%
Midline shift	24 (9.92%)	9.808% - 10.032%

DISCUSSION

A total of 242 patients with a ratio of male/female as 2:1 were recruited in this descriptive study. This finding is consistent with past research suggesting that more males might suffer head trauma than females [7–9]. Probably, males are more prone to violence and aggression, which are risk factors to traumatic head injury. In our sample, the mean age of patients was 32.6 ± 17.6 years and about half of them (53.70%) were young adults, i.e. in the 20-49 age groups. This finding is consistent with findings of similar works [8, 9], suggesting that young people are more active, and engage in activities that lead to violence and aggression much more than old people.

This study showed also that the major cause of trauma was RTA (35.5%). This finding is in accordance with many past studies carried out in several regions of Nigeria [7, 8, 10–12]. Probably, this confirms the poor road conditions existing in our country, inadequate driver's license programmes, as well as dangerous behaviour by drivers, such as reckless manoeuvres and driving under the influence of alcohol.

Consistently with Ohaegbulam et al [8] that documented a high percentage of abnormal intracranial and extracranial findings as 80.1% and other all Nigerians scholars [7, 11, 13, 14], our study documented a high percentage as nearly 84% of positive intracranial CT findings in case of TBI as well, confirming the importance of CT in TBI early diagnosis and management.

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In this study, the most common positive intracranial CT finding was cerebral oedema, which was reported in about 24% of patients. This finding is similar to those by Ohaegbulam et al [8] and Gupta et al [9] showing a percentage of 24.6% and 63.4%, respectively. As the study by Ohaegbulam et al, we employed a small size sample as well.

Another intracranial CT finding reported in our study was extra-axial haemorrhage (n = 90, 37.19%), including subarachnoid haemorrhage as the most common type (n = 41, 16.94%).

This finding was also showed by many previous studies [8–11]. On the contrary, Ogunseyinde et al [13] reported subdural hematoma as being the most common type of intracranial bleeding, and Adeyekun et al [14] reported that intra-axial bleeding was the most common one. Patient selection bias, severity of traumatic head injury and time interval between trauma and CT investigation might have been responsible for these variations.

Generally speaking, intracerebral bleeding occurs frequently in trauma to the head and CT may detect and precisely localise the intracranial hematomas and brain contusions. Prompt and accurate diagnosis will lead to timely evacuations and other surgical interventions and prevent neurologic and metabolic sequelae.

The high yield of positive findings observed in our study supports the importance for using CT brain as a diagnostic tool in the early diagnosis and management of TBI. Unfortunately, this important diagnostic tool is still relatively unavailable in most hospitals in Nigeria [8] due to associated high costs and few health facilities available in our country.

All these factors may contribute to increase the mortality rates of TBI cases in Nigeria, as well as in other developing countries.

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The major causes of TBI reported by our study were RTA and physical violence. This might be attributed to an increasingly large number of vehicles travelling on impaired highways and cases of domestic and other types of violence fuelled by poverty and widespread social inequality. The Federal and State Government in Nigeria should enforce traffic laws and provide stricter measures for driving lessons and certification. It is also needed to control drivers by incentivizing governmental measures against alcohol consumption and high-speed cars and improve the poor road conditions.

Our study had some limitations. The retrospective nature of our research was the major limitation to this study due to recall bias and other drawbacks. Therefore, we could not correlate our radiological findings with Glasgow Coma Score and we selected only intracranial findings excluding different neurocranial findings such as skull fractures, scalp oedema and lacerations. Furthermore, we used a convenience and small size sample, collected from only one hospital located in one of the five Igbo states in Nigeria, and therefore, our findings are not generalizable to all Igbo states.

CONCLUSION

In this Nigeria-based study carried out on traumatic brain injury (TBI) cases among Igbo population at Federal Medical Centre, Umuahia Abia State, the most reported intracranial CT finding was cerebral oedema, with the most frequently reported causes of TBI as road traffic accidents and physical violence. This confirms the usefulness of CT brain in early screening of moderate to severe traumatic head injury cases and calls for economic investments in Nigeria to

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decrease road accidents rates and provide hospitals with CT scanning equipment for early diagnosis and management of TBI. However, poverty in Nigeria has been resulting in a scarcity of CT scan and other radiological services as well as in socio-economical conditions that put at high risk of physical accidents. Due to poor knowledge of CT technology in Nigeria and scarcity of public awareness campaigns, international non-governamental organizations should play an important role by supporting the government efforts with a reduction in the cost of scanning. As suggested by past research [8], they could assist indigent patients to pay for their CT as well. This might be particularly important in emergency setting and might decrease the mortality rates due to TBI in the country. However, the Federal and State Government in Nigeria should enforce traffic laws and improve the poor road conditions as well.

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