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Original Research Article

Relationship between Degree of Midline Shift on Computed Tomographic Imaging and Glasgow Coma Scale at Presentation in Head Injury Patients in Sokoto, Nigeria

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Abstract: ***Background***: Head injury is a major cause of death and disability worldwide. Computed tomography (CT) scan is the most commonly used imaging modality in evaluation of head injury. Midline shift (MLS) indicates increased intracranial pressure and mass effect. The Glasgow coma scale (GCS) is a tool commonly used to established severity of head injury. ***Aim and Objective***: The study is aim at assessing the relationship of degree of midline shift on CT scans and the GCS. ***Methods***: This is a prospective cross-sectional study conducted on 231 patients with head injury who underwent non contrast cranial CT at the radiology department, Usmanu Danfodiyo University Teaching Hospital, Sokoto from January to December 2024. The midline shift on CT was categorized into shift <5 mm and ≥5 mm. Head injury using GCS was classified as mild (13-15), moderate (9-12), and severe (3-8). The data was analyzed using SPSS version 20. ***Results***: The majority of patients were male with a male to female ratio of 5.8:1. The patients in the age group of 21 to 30 years predominate in the study. Fifty seven (57) patients had midline shift ≥5mm while 20 patients had midline shift <5mm on CT. The head injury categories on GCS were severe (49.3%), moderate (34.2%) and mild (16.5%). There was statistically significant relationship between midline shift on CT and severity of injury (p = 0.001). ***Conclusion***: The study shows a statistically significant relationship between midline shift on CT and GCS at presentation among patients with head injury in Sokoto, Nigeria.

Keywords: Head Injury, Computed Tomography, Midline Shift, Glasgow Coma Scale.

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INTRODUCTION

Head injury is any injury to the scalp, skull, meninges, or brain that result in structural or functional damage. It is one of the most prevalent health issues in the world today, with a high increasing incidence particularly among young adult where it contributes significantly to morbidity and mortality [1].

Head injury has associated medical and socioeconomic consequences for victims, their families and community at large. The burden of head injury remains a global problem [1], particularly in low income and middle income nations like Nigeria, where out of pocket expenses remain a major source of health care financing despite ongoing efforts toward universal health insurance coverage [2].

In Sokoto, north- western Nigeria road traffic accident is commonly the leading cause of head injuries and the incidence is high in men3.However, regional variations exist in the cause and pattern of head injury. In conflict prone, economically disadvantage and densely populated urban areas where interpersonal aggression is high, assault may constitute major cause of head injuries [1]. Nonetheless most Nigerian studies show road traffic accident as common cause of head injuries [1].

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Midline shift (MLS) of the brain is a potentially fatal condition that requires prompt diagnosis and intervention [4, 5]. It mainly results from increase intracranial pressure following road traffic accident and is considered one radiological feature of head injury severity. The severity of head injury can be determined by analyzing the CT scan result using the midline shift (MLS) parameter [6].

Computed tomography scan remains the imaging modality of choice in the evaluation of head injury due to its quick image acquisition time, which is especially helpful when dealing with severe injuries [1-8].

The Glasgow coma scale (GCS) is one of the most widely used tools for determining the severity of head injury and allows for the clinical classification of head injury into three categories; mild, moderate and severe head injury. However, its use may be limited in patients who are intubated or under the influence of alcohol, sedation, or psychoactive substance [3-9]. In such cases, radiological assessment using CT scan parameters such as midline shift is an objective alternative in the evaluation of head injury severity [10].

This study is aimed at assessing degree of midline shift on the CT scan and to determine the relationship with Glasgow coma scale in patients with head injury in Sokoto, Nigeria.

MATERIAL AND METHODS

Study Design: This study is a prospective cross sectional descriptive study to determine degree of midline shift on computed tomography among the 231 adult patients presented with traumatic head injury.

Study Area: The study was performed at Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, Nigeria. The hospital serves as a major referral center serving Sokoto and neighboring state in north-western region. Informed and signed consent was obtained from the patients or the relatives in case of an unconscious patient.

Study Population: The study population comprises of all adult patients with head injury who were referred to Radiology Department and underwent non-contrast cranial CT scan during the study period, from 1st January to 31st December, 2024.

Materials:

The GE Brightspeed 4-slice spiral Computed Tomographic scanner manufactured 2007, Hospital radiology request forms and patients' records. Structured questionnaire and statistical package for social sciences (SPSS) version 20 were used.

Inclusion Criteria:

All adult head injury patients who had initial cranial computed tomography scan and Glasgow coma scale score at presentation within 48 hours of injury.

Exclusion Criteria:

Patients with previous intracranial surgery, intracranial tumors, congenital brain anomaly and those with a history of alcoholism were excluded.

Ethical approval for this study was obtained from the ethics and research committee of the hospital (UDUTH/HERC/2013/NO.170).

Methods:

Axial images at 5mm intervals were acquired from the vertex to the base of the skull in supine position. Midline shift was measured on the axial slice demonstrating the greatest displacement. A line was drawn along the anatomical midline from the anterior to the posterior falx cerebri and the maximum perpendicular distance from this line to the displaced septum pellucidum was measured and recorded in millimeters (fig1).

The degree of midline shift was divided into two categories; midline shift less than 5mm and midline shift greater than or equal 5mm. Severity of head injury is classified into 3 subgroups; mild degree (GCS=13-15), moderate degree (GCS=9-12), severe degree (GCS=3-8).

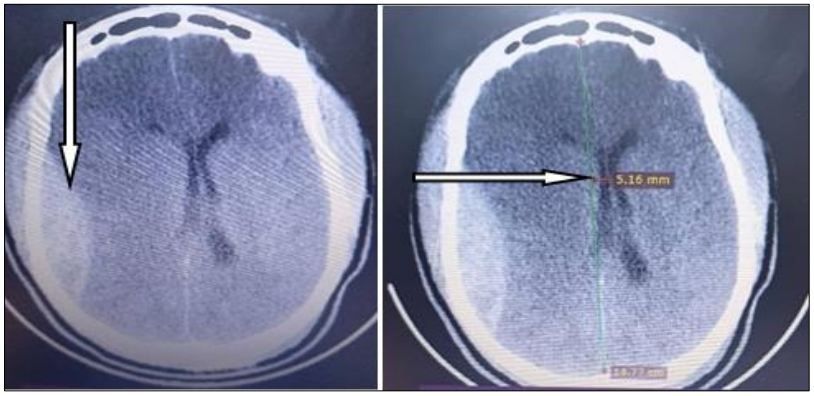

Figure 1: Non contrast cranial CT at the level of the lateral ventricle showing a right parietal acute epidural haematoma (vertical arrow) and left side midline shift (arrow).

Data Collection and Statistical Analysis

The collected data was obtained using a structured questionnaire and entered into a data sheet and analyzed using the statistical package for social sciences (SPSS) version 20. Fisher's exact test was use to find the relationship between the degree of midline shift and the GCS. The Chi- square test was used to determine association between socio- demographic variables and the statistical significance was set at 0.05.

RESULTS

A total of 231 patients with head injury were included in this study. The age distribution of the participant ranges from 19 to 70 years. The largest proportion of the patients (66, 28.6%) were in the 21-30 years age group. Majority of the patients were male (197, 85.3%) with male to female ratio of 5.8:1 as shown in table 1.

Of the 231 patients in the study, 114(49.3%) had severe head injury, 79(34.2%) had moderate head injury and 38(16.5%) had mild head injury base on the Glasgow coma scale assessment (table 2).

With regards to midline shift, 77(33.3%) patients were found to have midline shift on CT. Midline shift was observed in 61 (53.5%) of the 144 patients with severe head injury and 16 (20.3%) of the 79 patients with moderate head injury, while no midline shift was demonstrated observed in all the 38 patients with mild head injury. Among the 77 patients with midline shift 20 (26.0%) had a shift of less than 5mm, comprising 16 patients with moderate head injury and 4 patients with severe head injury. The remaining 57 patients (74.0%) with midline shift had measurement of 5mm and above and were all recorded in patients with severe head injury (Table 3). There was strong statistically significant association between the degree of midline shift and severity of head injury (table 3 and 4).

The socio-demographic factors; age, gender, marital and religious status show no statistically significant association with severity of head injury (table 5).

Table1: Socio-demographic distributions of study population

Variable	Frequency N=231	Percentage (%)
Age group (in year)		
≤20	22	9.5
21-30	66	28.6
31-40	59	25.5
41-50	42	18.2
51-60	24	10.4
>60	18	7.8
Sex		
Male	197	85.3
Female	34	14.7
Marital status		
Single	92	39.8
Married	138	59.8
Widow	1	0.4
Religion		
Islam	217	93.9
Christianity	14	6.1

Table2: Severity of head injury based on GCS

Severity of head injury	Frequency	Percentage (%)
Mild (GCS=13-15)	38	16.5
Moderate (GCS=9-12)	79	34.2
Severe (GCS 3-8)	114	49.3

Table 3: Distribution of CT midline shift according to head injury severity

Midline shift	Mild (n=38)	Moderate (n=79)	Severe (n=114)	Total
No midline shift	38	63	53	154
<5mm	0	16	4	20
≥5mm	0	0	57	57
Total	38	79	114	231

Table 4: Association between midline shift and severity of head injury using GCS

Head injury severity	Patients with midline shift	Percentage within severity group
Mild	0/38	0%
Moderate	16/79	20.3%
Severe	61/114	53.5%
Total		**33.3%**

Fishers exact P<0.001

Table 5: Cross tabulation of socio-demographic variable with severity of head injury base on GCS

Variable	Severity base on GCS Mild Moderate Severe	Test statistic
Age group (in year)		
≤ 20	2(5.3%) 12(15.1%) 8(7.0%)	X^2= 12.622 P= 0.246 df=10
21-30	9(23.7%) 21(26.6%) 36(31.6%)	
31-40	13(34.2%) 18(22.8%) 28(24.6%)	
41-50	9(23.7%) 12(15.2%) 21(15.2%)	
51-60	1(2.6%) 12(15.2%) 11(9.6%)	
>60	4(10.5%) 4(5.1%) 10(8.8%)	
Sex		
Male	31(81.6%) 69(87.3%) 97(85.1%)	X^2= 0.686 P= 0.710 df= 2
Female	7(18.4%) 10(12.7%) 17(14.9%)	
Marital status		
Single	14(36.8%) 30(38.0%) 48(42.1%)	Fisher's exact= 1.613 P=0.806 df= 4
Married	24(63.2%) 49(62.0%) 65(57.0%)	
Widow	0(0%)0(0%) 1(0.9%)	
Religion		
Islam	37(97%) 73(92.4%) 107(93.9%)	Fishers exact= 0.915 P=0.656 df= 4
Christianity	1(2.6%) 6(7.6%) 7(6.1%)	

DISCUSSION

In this study a total of 231 head injured patients were recruited. Severe head injury was the commonest clinical presentation accounted for 49.3% of all cases, followed by moderate head injury (34.2%) and then mild (16.5%) head injury. This predominance of severe head injured cases may be as a result of frequent referral of severe cases to the hospital of the study which is a tertiary referral hospital with an active regional neurosurgery center. Our finding is in agreement with that of the study by Ibrahim *et al*., which also reported a higher percentage of severe head injury when compared with mild and moderate head injury [11]. However, this is at variance the findings reported in some other studies in Nigeria and Turkey, in which mild head injury predominates [1-12].

In the index study, we found association between the degree of midline shift and severity of head injury using GCS (p = 0.001). Thus, cases with midline shift of ≥5mm were mostly severe head injured patients (53.5%), while midline shifts of <5mm predominates among moderate head injured patients (table 3 and 4). This observation is consistent with the report by Qasim *et al*., who identified midline shift as an important CT parameter for assessing the severity of head injury[8]. The higher proportion of midline shift in patients with severe injury may reflect more extensive intracranial pathology, including cerebral edema, intracranial hemorrhage and mass lesions capable of producing displacement of intracranial structure.

It is widely recognized that the degree of midline shift after head injury is an important indicator of severe head injury [7-9]. Substantial midline shift on the computed tomographic scan is frequently associated in the literature with unfavorable outcome or other adverse consequences of head injury [13]. Midline shift occurs when there is a displacement of the brain from the midline due to increased pressure leading to a compromised neurological function; thus, the bigger the shift the poorer the patient's neurological outcome [9]. Hence our findings indicate that greater midline shift is associated with lower GCS at presentation.

Our study agrees with the findings of previous studies that reported midline shift as an important predictor of head injury severity. These studies have shown that the magnitude of midline shift is a useful indicator of increased intracranial pressure and poorer patient outcome following head injury [5-14].

The findings of this study provide the clinical importance of careful radiological assessment in identifying magnitude of midline displacement on CT among patients with head injury and evaluating its relationship with the GCS. In low-and-middle-income countries where the availability of neurosurgical services is limited, the use of midline shift on CT to prioritize patients who need neurosurgical intervention is therefore appropriate.

CONCLUSION

Midline shift of the brain in head injury is a potentially fatal condition that requires prompt diagnosis and intervention. This study found that midline shift of 5mm or greater on CT is strongly associated with severe head injury on Glasgow coma scale.

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