

## HEAD COMPUTED TOMOGRAPHY SCAN FOR NONTRAUMATIC NEUROLOGICAL EMERGENCIES: PATTERN OF FINDINGS IN A NIGERIAN TERTIARY HOSPITAL

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### Abstract

**Background:** Neurologic emergencies are commonly associated with high rates of disability and mortality in developing nations like Nigeria, requiring rapid and accurate diagnosis and management. Computed tomography (CT) scan is an important imaging modality which is readily available in emergency settings, it can be applied rapidly to provide accurate diagnosis.

**Objectives:** To assess the pattern of findings on the head CT scan of adult patients presenting with non-traumatic neurological emergencies in Damaturu, north-eastern Nigeria.

**Methodology:** A retrospective study conducted at the Department of Radiology, Yobe State University Teaching Hospital (YSUTH), Damaturu, over five-year period from January 2019 to January 2023. The study involved adult patients evaluated for non-traumatic neurological emergencies and examined with a 160-slice Toshiba Aquillion prime CT scanner. Clinical details and CT reports were retrieved and Data were analysed using SPSS statistical software version 23.

**Results:** There were 358 patients, 202 (56.4%) males and 156 (43.6%) females. The mean age was  $51 \pm 19$  years and the majority were in 41-60 years aged group. The top three indications for head CT exam was stroke (58.0%), seizure disorder (8.1%) and persistent headache (7.5%). CT scan findings were positive in 268 (75.1%) and the remaining 90 (24.9%) were negative. One hundred and seventy-five (65.3%) of those with positive CT were confirmed stroke cases. This was followed by cerebral atrophy in 31 (11.6%) and brain tumours in 17 (6.3%), being the two most common CT findings after stroke in this study.

**Conclusion:** The study show positive CT findings among the majority of patient studied with stroke being the most common finding. Therefore stroke is the most prevalent non-traumatic neurological emergency in this study.

**Keywords:** non-traumatic, neurologic emergencies, computed tomography

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## Introduction

Neurologic emergencies such as acute stroke, status epilepticus, subarachnoid hemorrhage, neuromuscular weakness, and spinal cord injury arise frequently and, if not diagnosed and treated quickly, can have devastating results, with high rates of long-term disability and death.<sup>1</sup> The majority of neurological emergencies are life-threatening conditions that necessitate immediate diagnosis and treatment. If not recognized and treated early, they can have catastrophic effects, resulting in long-term impairment or death. Patients presenting to emergency departments (EDs) with neurological diseases should be examined as soon as possible and managed in a multidisciplinary manner, as some of these disorders are associated with other medical and non-medical conditions.<sup>2</sup> Neurological disorders comprise 9% of total emergency department (ED) admissions.<sup>1</sup> Study shows about 60% of non-contrast head computerized tomography (CT) are performed in non-trauma patients presenting in ED. These patients present with several clinical conditions, including acute neurological deficit (both transient and persistent), headache, seizures, altered state of consciousness, confusion, dizziness, vertigo, and syncope.<sup>3</sup> Neurological emergencies are among the most common reasons for seeking care in EDs. In these cases, brain CT scans are useful for evaluating acute intracranial disease and determining its severity, with the aim of screening patients who require immediate surgical treatment and distinguishing them from those for whom medical management and observation are sufficient.<sup>4</sup> CT is an important modality in the ED.<sup>5</sup> Head CT is a diagnostic tool frequently used in the ED setting, to evaluate patients with a wide range of suspected central nervous system disorders.<sup>3</sup> Since the development of CT in the 1970s, the use of CT studies has been

increasing exponentially. CT study use during a decade revealed that the proportion of CTs ordered in the ED increased by 81%.<sup>6</sup> The most common CT scan done in an emergency department is CT head, which falls under two categories i.e. post traumatic and non-traumatic CT head.<sup>7</sup> Multiple reasons could lead to warrant head CT scan (HCT) such as onset of a new focal neurology, failure to wake up after sedation, or probably most common an altered mental state (AMS).<sup>8</sup> A study conducted in Ethiopia revealed neurological emergencies accounted for 5.27% of the total medical emergencies. Hemiparesis, altered mental status, and seizures were the most common neurological presentations, accounting for 44%, 19.3%, and 13.1% of all cases, respectively. Cerebrovascular disorders (54%), HIV/AIDs related neurologic sequels (9%), meningitis (8.7%), and seizures (7%) were the most common neurologic disorders diagnosed.<sup>9</sup> Another study from southern Nigeria found that neurological emergencies accounted for 25.7% of the total medical emergencies. The most common diagnoses were stroke (52.5%), Meningitis (11.3%) and hypertensive encephalopathy (7.0%).<sup>10</sup> CT findings among patients with clinical diagnosis of stroke in Maiduguri, northeast Nigeria showed 64% were confirmed stroke cases and the remaining 36% were misdiagnoses of stroke, with normal finding in 23% and stroke mimics in the remaining 13%. At Yobe state University Teaching Hospital, a tertiary health institution, the profile of patients presenting with neurologic emergencies and their imaging pattern has not been studied prior to this time. This study is therefore aimed to assess the pattern of findings of neurologic emergencies among patients undergoing cranial CT exams in the emergency setting of our hospital for non-traumatic indications. It will also determine the prevalence of acute non-traumatic neurologic disease in cranial CT scans

requested from the emergency department as well as the most common reasons why brain imaging scans were requested. This will help to identify priorities among neurological patients and prepare the hospital to better management of such cases in an appropriate

## Methodology

The study was carried out among adult patients, 18-80years of age who underwent Head CT Scan for non-traumatic neurologic emergency indications. This was a retrospective study conducted from January 2019–January 2023 at Radiology Department of Yobe State University Teaching Hospital (YSUTH) Damaturu-Nigeria and involved adult patients 18-80years. Their request cards and case notes were assessed to obtain information on clinical indication for the exam, detailed demographics, additional clinical information and relevant results of investigations. We have excluded patients with incomplete records and those with images of poor diagnostic quality. In addition, all patients who had head CT examination other than for emergency non-traumatic indications, patients below 18years and above 80years of age were also excluded.

Ethical clearance was obtained from the Research Ethics committee of Yobe State University Teaching Hospital (YSUTH) Damaturu-Nigeria (reference number: YSUTH/MAC/EC/050; Approval date: 17th August, 2023).

All patients were scanned from the skull base to the vertex in supine position using Helical Multi-detector Computed Tomography machine – 160 slice CT scanner (Aquilion prime Model TSX-303A, Toshiba Medical Systems Corporation, 1385, Shimoshigami, Otawara-Shi, Japan, 2014). The justification for the examination confirmed and Patient placed in supine position on the CT table with the head supported on the head rest using immobilization pads with straps, to ensure

and cost-effective manner. The findings in this study will serve as a baseline for further researches and in planning health care policies and distribution of the available resources in our immediate environment.

correct head position. The laser beam used for indicating the starting and end point of the scan. Unnecessary irradiation of the lens avoided by examining at an angle parallel to the infra-orbitomeatal line. The couch with the patient introduced into the gantry where the tube rotates around the patient's head in the gantry. The examination done and images acquired using the appropriate exposure factors (70kv-100kv and 25mA-300mA). These images included the scanogram and axial slices with thickness of 5mm, followed by multiplanar reconstructed sagittal and coronal sections in bone window as well as 3D volume rendered images. Intravenous contrast medium administered where indicated. CT scan images retrieved and analyzed on the Radiologists diagnostic console Vitrea-vital imaging software, version 6.6.3. Copyright 2013. All native and reconstructed Images were saved on the departmental server for archiving. Images carefully studied, reports written immediately and forwarded on the Picture Archiving and Communication System (PACS). The expected CT findings included intracerebral hematoma (ICH), epidural hematoma (EDH), subdural hematoma (SDH), subarachnoid haemorrhage (SAH), cerebral oedema, cerebral contusion, mid line shift, The confidentiality of subjects was preserved by assigning numbers to each eligible subject in place of real names or hospital numbers, and the data was kept strictly confidential and safe.

Data collection and sorting was done manually and entered into an excel spread

sheet, sorted and clean. Exported into Statistical Package for Social Sciences (SPSS) version 22.0 software for analysis. Microsoft word was used for tables and excel for charts. Qualitative data was expressed in frequencies and percentages while quantitative data was described using the

measures of central tendency; (mean, median) and measures of variability; (range, standard deviation). Chi-square test or Fisher's exact test was used to determined significant association between qualitative variables. A P-value of 0.05 was considered significant.

## Results

Table 1: shows distribution of Clinical indications by sex

Clinical Indications	Sex		Total
	Male	Female	
Stroke	113	95	208
	31.6%	26.5%	58.1%
Seizure Disorder	22	7	29
	6.1%	2.0%	8.1%
Hypertensive Encephalopathy	3	2	5
	.8%	.6%	1.4%
Visual Disturbance	3	2	5
	.8%	.6%	1.4%
TIA	1	2	3
	.3%	.6%	.8%
Headache	16	11	27
	4.5%	3.1%	7.5%
Altered Mental State	3	3	6
	.8%	.8%	1.7%
Visual Disturbances	4	1	5
	1.1%	.3%	1.4%
Cranial Nerve Palsy	2	1	3
	.6%	.3%	.8%
Loss Of Consciousness	7	9	16
	2.0%	2.5%	4.5%
ICSOL	6	1	7
	1.7%	.3%	2.0%
Others lesions	13	15	28
	3.6%	4.2%	7.8%
Multiple symptoms	9	7	16
	2.5%	2.0%	4.5%
Total	202	156	358
	56.4%	43.6%	100.0%

There were 358 patients, 202 (56.4%) males and 156 (43.6%) females studied. Their mean age was  $51 \pm 19$  years and the majority were in 41-60 years aged group. The top three clinical indications for head CT exam was stroke (58.0%), seizure disorder (8.1%) and persistent headache (7.5%). CT scan findings were positive in 268 (75.1%) and the remaining 90 (24.9%) were negative. Significant number of these patients (48.0%) were hypertensive. One hundred and three (28.8%) do not have any form of comorbidity, while the remaining patients presented with various forms of comorbidities such as DM, malignancy and other chronic diseases. One hundred and seventy-five (65.3%) of those with positive CT were confirmed stroke cases. This is followed by cerebral atrophy in 31 (11.6%) and brain tumours in 17 (6.3%), being the two most common CT findings after stroke in this study. The most frequent form of stroke recorded in this study was cerebral infarct in 141 (39.4%). Majority of these patients, 62 (17.3%) with this finding are seen among 61-100 years age group.

Table 2: shows distribution of Clinical indications distribution by CT findings

Clinical Indications	Brain Lesions		Total
	Negative CT	Positive CT	
<i>Stroke</i>	14	194	208
	3.9%	54.2%	58.1%
Seizure Disorder	19	10	29
	5.3%	2.8%	8.1%
Hypertensive Encephalopathy	3	2	5
	.8%	.6%	1.4%
Visual Disturbance	3	2	5
	.8%	.6%	1.4%
TIA	1	2	3
	.3%	.6%	.8%
Headache	22	5	27
	6.1%	1.4%	7.5%
Altered Mental State	2	4	6
	.6%	1.1%	1.7%
VDS	3	2	5
	.8%	.6%	1.4%
Cranial Nerve Palsy	1	2	3
	.3%	.6%	.8%
Loss Of Consciousness	3	13	16
	.8%	3.6%	4.5%
ICSOL	0	7	7
	0.0%	2.0%	2.0%
Others	13	15	28
	3.6%	4.2%	7.8%
Compound abnormalities	6	10	16
	1.7%	2.8%	4.5%
<b>Total</b>	90	268	358
	25.1%	74.9%	100.0%

Table 3: shows distribution of CT findings by patients Age group

Comorbidity	Brain Lesions		Total
	Negative CT	Positive CT	
None	54	49	103
	15.1%	13.7%	28.8%
<i>Hypertension</i>	10	162	172
	2.8%	45.3%	48.0%
DM	1	14	15
	.3%	3.9%	4.2%
Hypertension/DM	0	9	9
	0.0%	2.5%	2.5%
Epilepsy	10	00	14
	2.8%	1.1%	3.9%
Malignancy	2	5	7
	.6%	1.4%	2.0%
CKD	0	6	6
	0.0%	1.7%	1.7%
Heart Failure	1	3	4
	.3%	.8%	1.1%
Others	12	16	28
	3.4%	4.5%	7.8%
<b>Total</b>	90	268	358
	25.1%	74.9%	100.0%

Table 4: shows distribution of CT findings by patients Age group

CT FINDINGS	Age Group			Total
	15-40	41-60	61-100	
Normal CT Findings	57 15.9%	25 7.0%	8 2.2%	90 25.1%
Cerebral Infarct	25 7.0%	54 15.1%	62 17.3%	141 39.4%
Parenchymal Haemorrhage	7 2.0%	14 3.9%	12 3.4%	33 9.2%
IVH	0 0.0%	3 .8%	0 0.0%	3 .8%
SAH	0 0.0%	1 .3%	0 0.0%	1 .3%
SDH	1 .3%	3 .8%	4 1.1%	8 2.2%
Combined Haemorrhages	1 .3%	2 .6%	2 .6%	5 1.4%
Haem. And Infarct	0 0.0%	1 .3%	4 1.1%	5 1.4%
Brain Abscess	2 .6%	2 .6%	0 0.0%	4 1.1%
Meningitis	2 .6%	0 0.0%	0 0.0%	2 .6%
Encephalitis	0 0.0%	1 .3%	1 .3%	2 .6%
SOL	6 1.7%	7 2.0%	4 1.1%	17 4.7%
Atrophy	3 .8%	17 4.7%	11 3.1%	31 8.7%
no significant abnormality	8 2.2%	3 .8%	5 1.4%	16 4.5%
Total	112 31.3%	133 37.2%	113 31.6%	358 100.0%

## Discussion

Our study shows that 56.4% patients for emergent CT are males while female subjects comprised 43.6%. This corresponds to the group with higher prevalence of stroke. Number of males is more than females for most clinical indications of emergent CT. This may be due to relative predominance of male population in our country or attributable to higher comorbidity among male patients. This is similar to what was found by Alpaslan

that 52% percent of the patients in there study were male.<sup>11</sup> The patients' mean age of was  $51 \pm 19$ , with the most of the patients among 41-60 years of age group. The mean patients' age and gender distribution of the study population is consistent with previous studies.<sup>2</sup>

CT scan is a readily available, easily accessible, cost effective and non-invasive modality of choice. These features made it suitable for evaluation of neurological emergencies in our setting. The aim of emergency imaging is diagnosing the cause of the symptoms of the patient for urgent management which can be medical or surgical as the case may be. The commonest head CT findings done for non-traumatic indications in our hospital was ischemic infarct, age-related cerebral atrophy and brain tumours. Some cases of acute ischemic infarct were associated with haemorrhage, though less common. For the purposes of our study, other findings—such as nonspecific white matter hypodensities seen on emergent head CT—have been classified as non-significant abnormalities because they may not affect treatment.

Most studies of head CT in emergency setting focus on trauma patients, comparatively fewer studies examined nontrauma patients. These studies are demonstrate that head CT examinations are of high diagnostic yield, nearly all patients with abnormal CT findings also had abnormal neurologic examination findings.<sup>12</sup> This is found to be true in our study which demonstrated high positive CT findings in about 75% of patient, and nearly all patients presented with abnormal neurologic examination findings.

The higher proportion of hypertension (48.0%) as comorbidity in this study may be due to high prevalence of primary hypertension among Africans. In another



study(13), 66.3% of the hypertensive patients presented with ischemic stroke which is similarly an important comorbidity as in our study.

Table 1 shows that stroke (58.0%), seizure disorder (8.1%) and persistent headache (7.5%) are major clinical indications for emergent CT. Hypertensive encephalopathy, LOC, and visual disturbance also forms major indication for emergent CT. Table 2 shows that 48.0% of total head CT shows presence of hypertension as a comorbidity out of which only 2.8% shows no significant abnormality on CT scan. This is possible because of the increasing frequency of uncontrolled hypertension, as well as other risk factors.<sup>14</sup> The most common abnormality is stroke in 175 which constitutes 65.3% of those with positive CT. cerebral atrophy in 31 (11.6%) and brain tumours in 17 (6.3%), being the two most common CT findings after stroke in this study. Cerebral infarct which is 39.4% followed by Parenchymal Haemorrhage which is 9.2%. Haemorrhage and Infarct form only 1.4% each of total head CT findings. This finding is in agreement with previous studies that reported a higher prevalence of ischemic than hemorrhagic stroke in southwestern Nigeria.<sup>14</sup>

Our study shows that 17.3% of total cerebral infarct occurs among patient age group above 60 years of age. A study by Adamu et al shows relatively lower age range of 50–79 years having the highest frequency of ischaemic infarct with few cases under the age of 40 years.<sup>13</sup>

Our study shows negative CT findings among patients with seizure indication. This is against findings in a study where CT findings show encephalomalatic/gliotic changes, and ICH.<sup>15</sup>

The use of brain CT to investigate recurrent headaches is supported by our findings. CT

scans had a very low diagnostic yield when there was no comorbidity.

## Conclusion

The study show positive CT findings among the majority of patient studied with stroke being the most common finding. Therefore stroke is the most prevalent non-traumatic neurological emergency in this study.

## Conflict of Interest

The authors declare no conflict of interest.

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