

## Original Article

# The Pattern of Significant Lesions Found in Computerized Tomography Scan of Recurrent Seizure Patients at a Center in Enugu, Nigeria

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## INTRODUCTION

Seizures are among the most common reasons for neurologic consultations and investigations.<sup>[1]</sup> Worldwide, 5%–10% of the population will have at least one seizure in their lifetime.<sup>[2]</sup> In the African continent, seizures are common with a lifetime prevalence of 3.7% reported in some populations.<sup>[3]</sup> Brain imaging is recommended as an initial investigation for adult new-onset seizures.<sup>[4,5]</sup> In the absence of magnetic resonance imaging, computerized tomography (CT) scanning of the brain is a reliable and cheaper alternative. Data on the effectiveness of brain CT in identifying patients with treatable lesions, however, are conflicting.<sup>[6]</sup> This retrospective study assessed the usefulness of routine CT of the brain performed in

## ABSTRACT

**Introduction:** Seizures are common reasons for neurologic consultations and investigations. In the absence of magnetic resonance imaging, computerized tomography scanning of the brain is a reliable and cheaper alternative. Little is known about the pattern of brain lesions in patients with recurrent seizures in Nigeria.

**Objectives:** To determine the pattern of significant intracerebral lesions in patients presenting with recurrent seizures in a tertiary hospital in Enugu. **Methods:** All the medical and computer tomography records of patients with a clinical diagnosis of recurrent seizures were reviewed. The study duration was 11 years (January 2003 to December 2013). Relevant data were obtained and statistical analysis was done using SPSS version 19 and GraphPad Prism 6. **Results:** The diagnostic yield of CT was 55.1%. Twenty (9.3%) individuals had two lesions each. The significant findings were tumors (20.4%), encephalomalacia (18.9%) and strokes (7.7% (ischemic stroke, 4.1%, intracerebral hemorrhage, 3.1%, subarachnoid hemorrhage/intraventricular hemorrhage, 0.5%). Hydrocephalus (HCP) was found in 18 (9.2%) cases, and 30% of them occurred together with other lesions. The diagnostic yield increased with age reaching 84.4% from the age of 60 years. Only patients with encephalomalacia were statistically older than those with normal imaging. **Conclusion:** Computed tomography scan has a high diagnostic yield, especially in elderly patients with recurrent generalized seizures. Brain tumors, encephalomalacia, and HCP are most common causes of recurrent seizures in the adults.

**KEYWORDS:** *Computed tomography, Nigeria, recurrent seizures, space-occupying lesions, strokes*

patients presenting to the hospital with seizures without other neurological findings or history suggestive of their causes.

## METHODS

This study was conducted at the radiology unit of Memfys Hospital for Neurosurgery, Enugu. The hospital is a private tertiary institution that has a wide catchment area that includes the south-east, south-south, and north-central zones of Nigeria.

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All the medical and CT records of patients with a clinical diagnosis of seizure disorder were reviewed. Patients were referred by doctors from private or public primary, secondary, and tertiary hospitals. To exclude patients with possible secondary seizure disorders, those with history suggestive of causes of seizure were excluded from the study. The patients were seen as outpatients, and in cases where patients were admitted, history and examination findings suggestive of a possible cause of ailment were sought from the case notes, and if present, such cases were also excluded from the study. Patients >20 years were excluded from the study. If the patient's age or sex was not clearly stated, he or she was also excluded from the study.

Brain CT was performed at various intervals from the onset of ailment and was reported by a qualified radiologist. The written reports were reviewed and categorized based on their possibility of causing seizures.<sup>[4]</sup> If the possibility was high, it was considered significant and if not, as normal. Significant findings were reported as brain tumors, infarction, intracerebral hemorrhage (ICH), subdural hematoma (SDH), encephalomalacia (emacia), focal cerebral atrophy, arteriovenous malformation (AVM), aneurysms (ANS), subarachnoid hemorrhage (SAH), intraventricular hemorrhage (IVH), and hydrocephalus (HCP). The study was reviewed and approved by the hospital's Ethics Committee. The study included patients managed between January 2003 and December 2013 (11 years). Relevant data were obtained, and statistical analysis was done using SPSS version 21 (IBM Corporation, New York, USA) and GraphPad Prism version 6.00 for Windows, (GraphPad Software, La Jolla California USA).

## RESULTS

A total of 196 CT reports (males, 135 [68.9%];

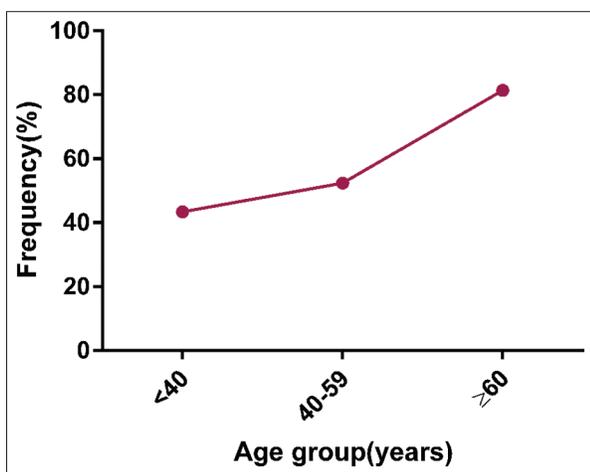


Figure 1: Diagnostic yield of computerized tomography by age

females, 129 [31.1%]) that met the inclusion criteria were reviewed. The mean age of the patients was  $46.8 \pm 18.6$  years (range: 20–104 years), similar in males ( $47.6 \pm 18.9$  years) and females ( $45.1 \pm 18.6$  years),  $P = 0.36$ . The age and sex distribution of the population studied is shown in Table 1.

The mean age of participants with 2 significant brain lesions on CT (mean  $54.2 \pm 21.3$ ) was also similar to those with one (mean  $46.1 \pm 18.2$ ),  $P = 0.06$ .

## Computerized tomography findings

Significant findings were reported in a total of 108 (55.1%) cases. Twenty (9.3%) individuals had two lesions each. Significant findings on CT are shown in Table 2. Tumors (20.4%), encephalomalacia, (18.9%) and strokes (7.7%, ischemic stroke, 4.1%, ICH, 3.1%, SAH/IVH, 0.5%) were the most common findings. HCP was found in 18 (9.2%) cases, and 30% of them occurred together with other lesions. Positive CT findings increased with age reaching 84.4% from the age of 60 years [Table 2 and Figure 1]. The median and mean ages of occurrence of different lesions are shown in Table 3. Only patients with encephalomalacia were statistically older than those with normal imaging.

Table 1: Age and sex distribution of patients

	<40	40-59	≥60	Total
Males	53 (39.3)	48 (35.6)	34 (25.2)	135 (68.9)
Females	30 (49.2)	15 (24.6)	16 (26.2)	61 (31.1)
Total	83 (42.3)	63 (32.1)	50 (25.5)	196 (100)

Table 2: Age distribution of neuroimaging results

CT finding	<40	40-59	≥60	Total*
Normal	47 (56.6)	30 (47.6)	11 (18.6)	88 (44.9)
Tumors	16 (19.3)	19 (30.2)	5 (8.5)	40 (20.4)
Encephalomalacia	9 (10.8)	5 (7.9)	23 (39)	37 (18.9)
Hydrocephalus	5 (6)	6 (9.5)	7 (11.9)	18 (9.2)
Subdural hematoma	1 (1.2)	2 (3.2)	5 (8.4)	8 (8.2)
Ischemic stroke	3 (3.6)	3 (4.7)	3 (5.1)	9 (4.1)
Intracerebral hemorrhage	2 (2.4)	-	4 (6.8)	6 (3.1)
Arteriovenous malformation/aneurysms	6 (7.2)	1 (1.6)	-	7 (3.6)
Subarachnoid/intraventricular hemorrhage	1 (1.2)	-	-	1 (0.5)
Epidural hematoma	-	-	1 (1.7)	1 (0.5)
Total	90 (45.9)	66 (33.7)	59 (30.1)	215†

\*Percentage of the number of lesions. CT=Computerized tomography

**Table 3: Median and mean ages of findings**

	Median age	Mean age±SD	P*
Normal	37.5	40.3±16.4	-
Tumors	41.5	43.8±14.6	0.98
Encephalomalacia	71	60.7±20.2	<0.001
Hydrocephalus	51	54.5±17.5	0.027
Subdural hematoma	56	55.4±12.4	0.12
Intracerebral hemorrhage	61.5	56±19.9	0.4
Ischemic stroke	50	46.7±21.1	0.98

\*P value for comparison to mean age of participants with normal CT

## DISCUSSION

Imaging modalities such as CT are useful to clinicians, especially in resource-poor settings where more sensitive modalities such as MRI are lacking or are not affordable. In such circumstances, appropriate use of CT enhances the detection of underlying epileptogenic foci and can evaluate such etiologies. The use of established guidelines may improve the diagnostic yield of CT, thereby increasing the cost-benefit ratio. Because of different criteria for patient selection, the age group of patients, experience of radiologists as well as the sensitivity of the software used, the percentage of focal lesions detected with CT reported in the literature varied from 6% to 39.4%<sup>[6-9]</sup>

The diagnostic yield of CT in this study was 55.1%. The most common lesions detected were tumors (20.4%), encephalomalacia 42 (18.9%), strokes 13 (7.7%). As in other studies,<sup>[9,10]</sup> tumors are common significant neurological finding in this study. Although about 4% of epilepsy patients may develop brain tumors over their lifetime, the incidence of seizures in patients with brain tumors may be as high as 30%–100% depending on the tumor type and the rate of growth.<sup>[11]</sup> The high rate found in this study may be due several reasons. First, all patients who presented with recurrent seizures were included whether or not they were known epilepsy patients. Second, all the patients were referred from different centers and not necessarily by neurologists and neurosurgeons. The diagnostic accuracy of neurologists in differentiating neurological disorders is much higher than nonneurologists.<sup>[12]</sup>

In general, the findings in this study are similar to those of some studies and different from others. In Nigeria, Oguniyi *et al.*<sup>[13]</sup> found a slightly higher frequency of normal CT scans (54.7%) in a review of CT of adolescents and adult epileptics. The most common abnormalities, they found were cerebral atrophy (21%) and space-occupying lesions (17.3%). In another study conducted among Saudi patients with idiopathic epilepsy,<sup>[14]</sup> 54% had abnormal CT. These previous studies

included cerebral atrophy. In the index study, generalized cerebral atrophy was considered an insignificant finding. We reviewed all cases of acute recurrent seizures who were not necessarily epileptics. In a recent study among pediatric patients in Enugu, structural lesion was identified in 53.4% while lesions that may benefit from surgery were identified in 27.7% of all cases.<sup>[15]</sup>

Encephalomalacia was found in 18.9% of the patients and is the second most common finding in this study. Causes of encephalomalacia vary in the different age groups<sup>[13]</sup> and have been associated with intractable seizures.<sup>[16,17]</sup> Previous studies from Southeast Nigeria reported a rate of 3.7–5.6% among seizure patients.<sup>[9,15]</sup> The differences between the index study and these previous studies may be related to the selection criteria.

HCP was the third most common finding in this study representing about 9.2% of the cases. The role of HCP in epilepsy is controversial, especially in older participants but not in children where epilepsy is reported to be frequent in the shunt-treated HCP (20%).<sup>[17]</sup> HCP may also occur as a complication of meningitis, and other CNS infections which are common causes of seizures hence may represent an indirect marker of such disorders. A considerable proportion of HCP in this study coexisted with other lesions (6/18 (33.3%)), suggesting that they may be incidental findings.

Strokes were seen in 7.7% of the scans. Patients with stroke may represent cases of acute or subacute events unlike encephalomalacia which may include older cases. Early seizures occur in 2%–33% of acute and late seizures in 3%–69%<sup>[18]</sup> ischemic strokes. Seizures occur in about 3%–6.4% of ischemic stroke survivors within a year and 54%–66% of them go on develop epilepsy.<sup>[19,20]</sup> Seizures, however, are more likely to occur following an ICH and SAH than IS.<sup>[21-24]</sup> The higher number of ICH screened in this study may be because ICH strokes are usually more dramatic and are more likely to be admitted and investigated.

SDH is a recognized risk factor for posttraumatic seizures and epilepsy,<sup>[25,26]</sup> especially in the elderly.<sup>[27]</sup> As expected most of the SDH patients (5/8 [62.5%]) were 60 years and older. Most seizures in people with SDH will occur early in SDH<sup>[28]</sup> and may present in the form of status epilepticus.<sup>[28]</sup> In patients with epilepsy, increasing frequency of seizures may occur with the development of SDH and may be misdiagnosed.<sup>[29]</sup>

The frequency of vascular malformation (ANS and AVMs) was 3.6%. Seizures are an important manifestation of cerebral AVMs.<sup>[30,31]</sup> Factors such as cortical location may predict the epileptogenicity of an AVM.<sup>[31]</sup> Seizures are uncommon with ANS, and when

they do occur, they are frequently large and situated on the middle cerebral artery.<sup>[32]</sup>

The implications of this study on health care deserve attention. First, there may be a large number of misdiagnosis of symptomatic seizures in resource-poor areas of the continent. Second, this study suggests that there may be positive cost implications of CT imaging in seizure patients in areas where MRI is not readily available. This calls for the need to bring down the cost of the procedure. Third, since early scanning revealed a diagnosis of possible surgical importance in about 51.5% of the patients referred for neuroimaging, this study supports the recommendation that brain scan should be done after a repeat seizure event in every adult. Finally, the results may also reflect the poorly organized referral system seen in many developing countries. The implication of which may include increased cost due to avoidable investigation including CT in primary idiopathic seizure disorders.

This study has some limitations including those of retrospective studies. Because the clinical examination was performed by medical officers outside our center who were not neurologists, clinical clues to positive findings on computed tomography may have been missed. The surgical outcome in these patients was not explored which would have buttressed the cost-benefit ratio. The sensitivity of a more comprehensive neurological examination may, therefore, have been underestimated.

## CONCLUSION

Computed tomography scan has a high diagnostic yield, especially in elderly patients with recurrent seizures. Brain tumors, encephalomalacia, and HCP are most common causes of recurrent seizures in the adults. Computed tomography should be used routinely in adult patients with more than two episodes of new-onset generalized seizures.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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