ORIGINAL ARTICLE

Acute stroke in Jos University Teaching Hospital: Cranial computed tomographic findings and accuracy of the clinical diagnosis

Yetunde Folake Taiwo, Emmanuel Owoicho Igoh[1], Charles Chibuzor Ani, Stephen Daniel Pam, Kenneth Yakubu[2], Femi Olu Taiwo[3]

Departments of Radiology and [2]Family Medicine, University of Jos, Departments of [1]Radiology and [3]Orthopaedics, Jos University Teaching Hospital, Jos, Nigeria

ABSTRACT

Background: Cranial computed tomography (CT) is an invaluable tool useful in promptly differentiating hemorrhagic from ischemic stroke. However, due to the cost of CT, there has been a reliance on the World Health Organization (WHO) clinical diagnosis of stroke in some low-resource settings. **Objective:** The aim of the present study is to determine the pattern of acute stroke as seen on CT and to determine the accuracy of the clinical diagnosis using the WHO method. **Materials and Methods:** This was a cross-sectional descriptive study conducted from September 2014 to June 2015. We included 150 consecutive patients aged 18 years and above with acute stroke. Initial physician diagnosis using the WHO method was obtained, followed by a radiological evaluation using CT. The Statistical Package for the Social Sciences version 20.0 with results represented in simple proportions and percentages. Statistical level of significance was set at $P \leq 0.05$. **Results:** The mean age (standard deviation) was 57.97 (14.2) years with females making up 50.7% (76/150). Ischemic stroke was found to be the more common type of acute stroke (69.3%) (104/150) with the parietal lobe being the site most commonly affected by both strokes types. The positive predictive and negative predictive values of the WHO clinical diagnosis for ischemic and hemorrhagic strokes were 79.13% and 68.97% and 68.97% and 79.13%, respectively. **Conclusions:** A low accuracy in the WHO clinical diagnosis of stroke was observed. Ischemic stroke is the more common stroke and parietal lobe the most commonly affected site.

Keywords: Computed tomography, Nigeria, parietal lobe, stroke

INTRODUCTION

Stroke is a leading cause of morbidity and mortality in Nigeria and the most prevalent neurological reason for hospitalization worldwide.[1,2] Stroke can be ischemic or hemorrhagic, this distinction is an important part of acute stroke triage and directs care toward tailored intervention.[3] Although computed tomography (CT) is useful in the initial evaluation of stroke, financial accessibility is still a problem for many patients and hence the routine use of the World Health Organization (WHO) clinical approach. We sought to describe the patterns of acute stroke by CT as well as determine if clinical diagnoses were reliably predictive.

MATERIALS AND METHODS

This was a hospital-based cross-sectional descriptive study conducted at the Radiology Department of Jos

Corresponding Author: Dr. Yetunde Folake Taiwo, Department of Radiology, University of Jos, Jos, Nigeria. E-mail: yetuexj@yahoo.com

Received: 11-Jun-2018 **Accepted:** 13-Dec-2018 **Published:** 20-Jun-2019

Access this article online	
Quick Response Code:	Website: www.smjonline.org
	DOI: 10.4103/smj.smj_31_18

Cite this article as: Taiwo YF, Igoh EO, Ani CC, Pam SD, Yakubu K, Taiwo FO. Acute stroke in Jos University Teaching Hospital: Cranial computed tomographic findings and accuracy of the clinical diagnosis. Sahel Med J 2019;22:71-6.

University Teaching Hospital (JUTH) from September 2014 to June 2015. The projected sample size required to answer the set objectives at 95% confidence level, and power of 80% was calculated from the formula:[4] $n = Z^2p\ (1 - p)/d^2$ (where n = the desired sample size, Z = the standard normal deviate set at 1.96 which corresponds to 95% confidence level, and P = the proportion in the target population estimated to have a particular characteristic. The proportion of stroke in Nigeria was estimated to be about 8.51%[5] ([i.e., 0.0851] d = degree of accuracy desired, set at [0.05]). This yielded a sample size of 120. Considering the cost of doing a CT, 25% was set as the expected nonresponse rate, yielding a minimum sample size of 150.

Patients aged ≥18 years with the WHO clinical diagnosis of stroke of <7 days were included in the study. Those presenting with a history of repeat stroke and those with causes of focal neurologic deficit other than stroke (after CT was done) were excluded from the study.

The lead author reviewed all potential patients and recruited consecutively, all those who met the inclusion criteria. A structured self-designed questionnaire was used to obtain relevant biodata from the patients or their relatives where the patient was unconscious. All scans were done by the lead author using a made in the USA four-slice General Electric (Bright Speed) series CT scanner year 2006/2007, model number XG001G-JS-001-GAN. Axial sections were taken from the base of the skull to the vertex with 2.5-mm slice thickness for the base of the skull and 5 mm for the rest of the skull. Between 40 ml and 60 ml of intravascular Ultravist-300 (iopromide – 300 mgI/ml) (depending on the measured weight of the patient), contrast was given after viewing the initial images. Postcontrast images were generated for only ischemic stroke patients provided the ictus was >48 h before CT scan. Sagittal and coronal reformatted images were used to corroborate the axial images in the evaluation of the patient.

The CT scan images were reviewed by two other radiologists of at least 5-year experience, and consensus was achieved for every image.

Data Analysis

The collected data were analyzed using the Statistical Package for the Social Sciences version 20.0 (IBM SPSS, Chicago Illinois, USA). Proportions and frequencies were used to describe the occurrence of specific radiological findings and brain sites affected. Categorical variables were compared using Chi-squared test and the means between two groups were compared using Student's t-test. Positive predictive value (PPV) was used to determine if the clinical diagnoses of stroke were predictive of the patterns as determined by CT. Statistical level of significance was set at $P < 0.05$.

Ethical considerations

Approval was sought and obtained from the Ethical Committee of JUTH with clearance reference number JUTH/DCS/ADM/127/XIX/5905 March 21, 2014. A written informed consent was obtained from all the participants (for those who are conscious) and from their next of kin for those who were unconscious. The procedures performed were required for routine management of patients and in conformity with 2013 Helsinki Declaration and guidelines.

RESULTS

A total of 150 acute stroke patients who met the inclusion criteria were studied. This comprised 74 males (49.3%) and 76 females (50.7%). The predominant age group was 41–60 years (45.3%), followed closely by 61–80 years (37.3%). The ages of the patients ranged between 18 and

Table 1: Age and sex distribution of acute stroke patients

Variables	Sex		Total (%)	Mean value±SD	Minimum value	Maximum value	*P*
	Male frequency (%)	Female frequency (%)					
Age group (years)							
≤20	1 (0.7)	1 (0.7)	2 (1.4)				
21-40	3 (2.0)	14 (9.3)	17 (11.3)				
41-60	37 (24.6)	31 (20.6)	68 (45.3)				
61-80	31 (20.6)	25 (16.6)	56 (37.3)				
≥81	2 (1.3)	5 (3.3)	7 (4.6)				
Total	74 (49.3)	76 (50.7)	150 (100.0)				0.870
Age (years)				57.97±14.21	18	90	
Age (male)				58.96±12.56	18	86	
Age (female)				57.01±15.68	23	90	

SD: Standard deviation

90 years with an overall mean and standard deviation of 57.97 ± 14.21 years [Table 1].

The initial assessment of acute stroke by the referring physician using the WHO classification showed that most of the patients had ischemic stroke (76.7%, 115/150) [Table 2].

Using the WHO method of the clinical diagnosis, the PPV and sensitivity were low for both hemorrhagic and ischemic stroke. However, the negative predictive values (NPVs) and specificity were higher for hemorrhagic stroke as compared to that of ischemic stroke. P =0.001 was observed [Table 3].

Early CT signs of acute ischemic stroke were observed in only 5 (3.3%) patients with multiple signs seen in each patient. Obscuration of lentiform nucleus was the most common early finding seen in 4 (28.6%) patients followed by hypoattenuation of insular ribbon and cortical hypodensity/effacement observed in 3 (21.4%) patients [Table 4, Figures 1 and 2].

Table 2: Distribution of the clinical World Health Organization diagnosis of acute stroke patients by the referring physician

Type of stroke	Number of patients (%)
Ischemic	115 (76.7)
Hemorrhagic	29 (19.3)
Uncertain diagnosis	6 (4.0)
Total	150 (100)

Table 3: Relationship between clinical diagnosis and cranial computed tomography diagnosis of acute stroke

Clinical diagnosis of stroke	CT findings of stroke		Total (%)
	Ischemic	Hemorrhagic	
Ischemic	91	24	115 (79.9)
Hemorrhagic	9	20	29 (20.1)
Total (%)	100 (69.4)	44 (30.6)	144 (100)

χ^2=25.248; P=0.001. No impression was made by the referring physician in six patients. Ischemic stroke: PPV=79.13%, NPV=68.97%, sensitivity=91%, specificity=45.46%; Hemorrhagic stroke: PPV=68.97%, NPV=79.13%, sensitivity=45.46%, specificity=91%. PPV: Positive predictive value; NPV: Negative predictive value; CT: Computed tomography

Table 4: Distribution of early signs of ischemic stroke finding on computed tomography

Early signs	Frequency (%)
Obscuration of the lentiform nucleus	4 (28.6)
Hypoattenuation of insula ribbon	3 (21.4)
Cortical hypodensity/effacement	3 (21.4)
Hyperdense middle cerebral artery sign	2 (14.3)
Hemispheric sulcus effacement	2 (14.3)
Total	14 (100)

Only five patients had early signs of ischemic stroke, Multiple findings were seen in each patient

CT findings showed that ischemic stroke was seen in more than two-thirds (69.3%) of the patients compared to hemorrhagic stroke seen in 46 (30.7%) patients with P = 0.001 [Figures 3 and 4]. Ischemic stroke was seen to be the more common type of stroke in both males and females whereas hemorrhagic stroke was noted to be more common in men [Table 5].

The most common site affected by stroke was observed to be the parietal lobe in 76 (21.5%) patients with ischemic stroke seen in 57 (22.7%) patients and hemorrhagic stroke seen in 19 (18.5%) patients. This was closely followed by temporal lobe 51 (14.4%) with ischemic stroke constituting 36 (14.3%) patients and 15 (14.6%) patients for hemorrhagic stroke.

Majority of patients 86 (57.3%) were observed to have multiple sites affected [Table 6].

The right hemisphere was noted to be more commonly affected by both types of stroke [Table 7].

Table 5: Classification of acute stroke by sex as seen on brain computed tomography

Gender	Ischemic (%)	Hemorrhagic (%)	Total (%)	*P*
Male	48 (32.0)	26 (17.3)	74 (49.3)	
Female	56 (37.3)	20 (13.3)	76 (50.7)	
Total	104 (69.3)	46 (30.7)	150 (100.0)	0.001
P	0.433	0.376	0.870	

Table 6: Distribution of sites affected by acute stroke

Sites affected	Type of acute stroke		Total (%)
	Ischemic (%)	Hemorrhagic (%)	
Frontal lobe	31 (12.3)	4 (3.9)	35 (9.9)
Parietal lobe	57 (22.7)	19 (18.5)	76 (21.5)
Temporal	36 (14.3)	15 (14.6)	51 (14.4)
Occipital	26 (10.3)	5 (4.9)	31 (8.7)
Subcortical	1 (0.4)	1 (1.0)	2 (0.6)
Putamen	25 (10.0)	13 (12.6)	38 (10.7)
Internal capsule	21 (8.4)	7 (6.8)	28 (7.9)
Caudate	31 (12.3)	12 (11.6)	43 (12.1)
Thalamus	3 (1.2)	10 (9.7)	13 (3.7)
Mid brain	4 (1.6)	7 (6.8)	11 (3.1)
Pons	6 (2.4)	5 (4.8)	11 (3.1)
Medulla	8 (3.2)	5 (4.8)	13 (3.7)
Cerebella	2 (0.8)	0 (0)	2 (0.6)

Majority of patients 86 (57.3%) were observed to have multiple sites affected

Table 7: Distribution of hemisphere affected by acute stroke

Hemisphere affected	Ischemic stroke (%)	Hemorrhagic stroke (%)	Total (%)
Right hemisphere	46 (44.7)	24 (55.8)	70 (47.9)
Left hemisphere	34 (33.0)	15 (34.9)	49 (33.6)
Both hemispheres	23 (22.3)	4 (9.3)	27 (18.5)
Total	103 (100)	43 (100)	146 (100)

Brain stem alone was affected in 4 (1 ischemic and 3 hemorrhagic) stroke patients

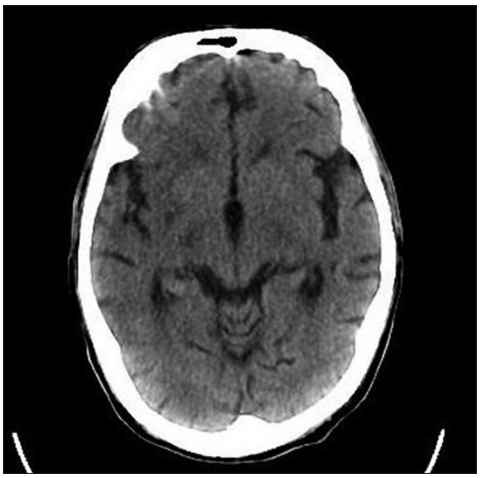

Figure 1: Loss of gray-white matter differentiation and hypoattenuation at the right insular cortex (loss of insular ribbon sign) and lentiform nucleus

Figure 2: Hyperdense left middle cerebral artery

Figure 3: Acute right parietal lobe intracerebral hemorrhage with effacement of the surrounding sulci, gyri, and right lateral ventricle with midline shift

Figure 4: Left middle cerebral artery infarction affecting the left frontal and parietal lobes

DISCUSSION

This study revealed a slightly higher incidence in females constituting 50.7%, this is similar to the finding in Southwest Nigeria where an incidence of 52.5% was seen in women.[6] Contrary findings of male preponderance have, however, been found in other studies done in Nigeria.[7-11] The study found that more females were seen in the extremes of ages, and men were still more in the age groups that are more commonly affected by stroke. The higher frequency of acute stroke in women found in this study may be due to a changing lifestyle, where women are more involved in meeting the economic needs of the family, thereby getting engaged in stressful economically empowering practices. An increasing health-seeking attitude and better enlightenment of women who tend to live longer than men and generally now have higher educational qualifications and financial empowerment may also explain the increasing patronage of health services compared to the past where women were relegated to the background and at the mercy of their husbands for such decisions to be made.

The mean age of patients in this study was 57.9 years which falls within the age group commonly affected by stroke, a finding similar to what has been observed in many studies done in Nigeria and parts of Africa.[6,7,10,12,13] This is also in consonance with what has been observed in most parts of the world.[14]

The WHO method of the clinical diagnosis of acute stroke is routinely used in JUTH. Anecdotal findings by the author during this study revealed that only 50% of acute stroke patients had CT done due to the high cost. The predictive assessment of the type of acute stroke using clinical assessment is a very integral part of the initial management of the patients. Our findings showed that the physicians were able to correctly diagnose ischemic

stroke in the majority of patients but were not able to correctly exclude hemorrhagic stroke in a significant percentage of patients. We were not able to find any study in Nigeria that used the WHO method of clinical assessment; however, a hospital-based study in Northeast Nigeria showed that Allen's test had a sensitivity of 70% and specificity of 64% for the diagnosis of hemorrhage and Siriraj stroke score had sensitivity and specificity values of 68% and 64%, respectively.[15] A study done in Southwest Nigeria on the accuracy of Siriraj stroke score method of the clinical diagnosis also found it not to be sufficiently sensitive in differentiating between the types of stroke.[16] Other studies comparing the effectiveness of Siriraj stroke score with CT had sensitivity, specificity, PPV, and NPVs of 78.87%, 91.13%, 88.88%, and 82.75% for hemorrhagic strokes and 81.08%, 88.73%, 88.88%, and 80.76% for ischemic strokes, respectively.[17] From the findings of this study in JUTH and studies done in other parts of the country, it is clear that the clinical diagnosis alone cannot be relied on to make an accurate diagnosis of acute stroke.

In this CT study, intracerebral ischemia was more common 104 (69.3%) than hemorrhage 46 (30.7%). This finding is in agreement with most studies conducted in Nigeria where ischemic stroke was found to be the more common type of stroke.[7,8,11] A much higher value of 81.3% was seen in a study in Calabar, a finding similar to what is obtainable in the most parts of the world.[10,14] The study in Ghana, however, found hemorrhagic stroke to be the more common type of stroke in that locality,[18] the reason for this difference needs to be further studied as it is clearly different from what has been observed in many studies. It may be due to peculiarities in that environment or a particular lifestyle that predisposes to hemorrhagic stroke.

Subarachnoid hemorrhage accounted for 3.3% of the patients in this study, similar to a finding of 3.4% in North Central Nigeria and the report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee of acute stroke that reported a frequency of 3%.[8,14]

The right hemisphere was noted to be more commonly affected by both types of stroke in this study. This is at variance with a study in Southwest Nigeria where infarcts were found to occur equally in both hemispheres, and hemorrhagic lesions were significantly more common on the left side, the observers thought it to be due to the dominant hemisphere being more commonly affected by hemorrhagic stroke.[7] The study in Calabar also found the left cerebral hemisphere to be more affected.[10] Studies in Ghana and in the Central African Republic were similar to the finding in Southwest Nigeria.[13,18] The reason for this variance still needs to be studied.

The sites most commonly affected by hemorrhagic stroke in this study were the parietal 18.5% followed by the temporal lobes 14.6% while the cerebellum was not affected by hemorrhagic stroke. A study done in Abuja, North Central Nigeria, also found lobar hemorrhage to be the most common at 35.1%, followed by the basal ganglia at 28.7%, thalami at 18.1%, and pons at 9.6%.[8] These findings were at variance with studies done in India on hemorrhagic stroke where the most common sites affected were ganglionic at 70.6% and the thalamus at 16.8%.[19] These findings also vary with the findings noted in Turkey where the most common site affected by hemorrhagic stroke was the thalamus at 38% followed by putamen at 28%.[20] This shows the existence of variation in the sites commonly affected by hemorrhagic stroke as seen in different geographical areas. The reason for this should be looked into.

This study found parietal (22.7%) and temporal lobes (14.3%) to be the sites most commonly affected by ischemic stroke. The study in Calabar also found the parietal lobe to be more affected; although, a distinction between hemorrhagic and ischemic stroke was not made.[10] This might suggest a common occurrence of ischemic stroke patterns in Nigeria.

Early signs of acute stroke were seen in only 5 (3.3%) patients with obscuration of the lentiform nucleus being the most common sign seen. This tells of failure to present to the hospital early enough for interventional procedures to be utilized in the care of these patients. Studies done in Nigeria have not looked into acute ischemic stroke patients presenting within the first few hours as is done in other parts of the world. The critical period of stroke triage when intervention using thrombolytic drugs can be used in ischemic stroke seems impracticable in Nigeria due to delay in presentation and scarcity of neuroimaging facilities. This delay in the presentation may be due to financial constraints, or lack of enlightenment about stroke and its life-altering nature once nothing is done within the first few hours.

CONCLUSIONS

The present study revealed an increasing frequency of stroke in women with ischemic stroke being the more

common type. Clinical diagnosis of stroke alone cannot be entirely relied on as evidenced by its low-predictive values. The low accuracy in the WHO clinical diagnosis of stroke observed reiterates the need for the use of CT in the initial evaluation of stroke patients. With a robust insurance system such as may be offered by the National Health Insurance Scheme, financial accessibility can be ensured. Advocacy aimed at waivers and institutional support for early CT scan in cases of suspected stroke should be vigorously pursued.

Acknowledgment

The authors would like to acknowledge and appreciate Mr. Philip Jalo for his statistical analysis and support in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Bello TO, Aremu AA, Mustapha AF, Olugbenga-Bello AI. Cranial computerised tomographic assessment of cerebrovascular disease in Osogbo, Nigeria. West Afr J Med 2010;29:323-6.
2. Asefa G, Meseret S. CT and clinical correlation of stroke diagnosis, pattern and clinical outcome among stroke patients visting Tikur Anbessa Hospital. Ethiop Med J 2010;48:117-22.
3. Rowley HA. The four Ps of acute stroke imaging: Parenchyma, pipes, perfusion, and penumbra. AJNR Am J Neuroradiol 2001;22:599-601.
4. Araoye MO, editor. Sample size determination. A Research Methodology with Statistics for Health and Social Sciences. 1st ed. Ilorin: Sawmill Publishers; 2003. p. 115-29.
5. Onwuchekwa AC, Tobin-West C, Babatunde S. Prevalence and risk factors for stroke in an adult population in a rural community in the Niger Delta, South-South Nigeria. J Stroke Cerebrovasc Dis 2014;23:505-10.
6. Desalu OO, Wahab KW, Fawale B, Olarenwaju TO, Busari OA, Adekoya AO, *et al*. A review of stroke admissions at a tertiary hospital in rural Southwestern Nigeria. Ann Afr Med 2011;10:80-5.
7. Ogunseyinde AO, Atalabi OM. Cranial computerized tomography in the evaluation of stroke in Ibadan. Niger J Clin Pract 2003;6:81-3.
8. Alkali NH, Bwala SA, Akano AO, Osi-Ogbu O, Alabi P, Ayeni OA, *et al*. Stroke risk factors, subtypes, and 30-day case fatality in Abuja, Nigeria. Niger Med J 2013;54:129-35.
9. Oyinloye O, Nzeh D, Adesiyun O, Ibrahim M, Akande H, Sanya E, *et al*. Neuroimaging of young adults with stroke in Ilorin Nigeria. Ann Afr Med 2015;14:82-8.
10. Ikpeme AA, Bassey DE, Oku AO, Ephraim PE. Computerized tomography findings of cerebrovascular disease in adults in Calabar, Nigeria. West Afr J Radiol 2014;21:12-6.
11. Yunusa GH, Saidu SA, Ma'aji SM, Danfulani M. Pattern of computerized tomography of the brain findings in stroke patients in Sokoto, Northwestern Nigeria. Ann Afr Med 2014;13:217-20.
12. Femi OL, Mansur N. Factors associated with death and predictors of one-month mortality from stroke in Kano, Northwestern Nigeria. J Neurosci Rural Pract 2013;4:S56-61.
13. Tshikwela ML, Longo-Mbenza B. Spontaneous intracerebral hemorrhage: Clinical and computed tomography findings in predicting in-hospital mortality in central Africans. J Neurosci Rural Pract 2012;3:115-20.
14. Thom T, Haase N, Rosamond W, Howard VJ, Rumsfeld J, Manolio T, *et al*. Heart disease and stroke statistics-2006 update: A report from the American Heart Association Statistics Committee and stroke statistics subcommittee. Circulation 2006;113:85-151.
15. Salawu F, Umar I, Danburam A. Comparison of two hospital stroke scores with computerized tomography in ascertaining stroke type among Nigerians. Ann Afr Med 2009;8:14-8.
16. Ogun SA, Oluwole SO, Oluremi A, Fatade AO, Ojini F, Odusote KA. Accuracy of the Siriraj stroke score in differentiating cerebral haemorrhage and infarction in African Nigerians. Afr J Neurol Sci 2001;20:21-6.
17. Nyodu T, Singh K, Singh J, Kenny S, Singh C, Singh MK. A comparism of clinical diagnosis with computed tomography findings in stroke patients. J Med Soc 2013;27:216-21.
18. Obajimi MO, Nyame PK, Jumah KB, Wiredu EK. Spontaneous intracranial haemorrhage: Computed tomographic patterns in Accra. West Afr J Med 2002;21:60-2.
19. Bhatia R, Singh H, Singh S, Padma MV, Prasad K, Tripathi M, *et al*. A prospective study of in-hospital mortality and discharge outcome in spontaneous intracerebral hemorrhage. Neurol India 2013;61:244-8.
20. Kumral E, Ozkaya B, Sagduyu A, Sirin H, Vardarli E, Pehlivan M, *et al*. The ege stroke registry: A hospital-based study in the Aegean Region, Izmir, Turkey. Analysis of 2,000 stroke patients. Cerebrovasc Dis 1998;8:278-88.