Original Article

Pattern, Risk Factors, and Outcome of Acute Stroke in a Nigerian University Teaching Hospital: A 1-Year Review

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Abstract

Background: This study aimed to document the pattern, risk factors, in-hospital outcomes, and stroke mortality in a hospital over one year. **Materials and Methods:** Acute stroke patients admitted at the Lagos State University Teaching Hospital between October 2019 and September 2020 had their records reviewed. Information including age, sex, risk factors, stroke type, access to neuroimaging, and the in-hospital outcome was extracted and analyzed. **Results:** A total of 230 patient records were included in this study. The proportion of intracerebral hemorrhage (ICH) was 44.8%, while ischemic stroke was 52.2%. Only 9.1% of ischemic stroke cases had an onset-to-arrival time of fewer than nine hours, with just three thrombolytic therapy given. The 30-day mortality was 28.7%, lesser among younger patients and patients managed in the stroke unit. **Conclusion:** The hospital incidence of ICH was close to that of ischemic stroke. Mortality data confirms the importance of management in a stroke unit.

Keywords: Nigeria, outcome, pattern, risk factors, stroke

Introduction

The incidence and burden of stroke in Africa and the rest of the world have risen steadily.[1,2] Globally, stroke is the second leading cause of death, next to ischemic heart disease.[3] In the last half-century, the occurrence of stroke in low-to-middle-income countries has doubled.[4,5] The estimated pooled incidence of stroke in Nigeria is 26/100,000 person-years.[6] Hospital-based studies in Nigeria documented that stroke is the leading reason for neurological admissions, accounting for over 60% of presenting cases.[7-10] Ogun *et al*., in a 10-year retrospective review, found that stroke accounted for 2.4% of all patients presenting at the emergency room.[7,11] In 2017, stroke was the ninth leading cause of death in Nigeria of all ages, rising from the 10th leading cause in the 2007 data.[12]

Historically, ischemic stroke is more common than hemorrhagic stroke. The former was responsible for as high as 80% of the reported stroke cases.[13,14] In the 1970s, Osuntokun *et al*.[15] found the incidence of hemorrhagic stroke to be 27% at a Southwestern Nigerian tertiary hospital. Ogun *et al*.[11] found hemorrhagic stroke incidence to be 45% in the same region between 1993 and 2003. Data from the INTERSTROKE study[16] for African countries, which included Nigeria, found the proportion of hemorrhagic stroke to be 34% in acute first-time stroke cases. The relatively high mortality associated with intracerebral hemorrhage (ICH) has been postulated as the cause of the underestimation of its incidence.[17,18]

This study aimed to document the pattern, risk factors, in-hospital outcomes, and acute stroke mortality presenting to the hospital over a one-year timeline.

Materials and Methods

Study design

The study is a hospital-based, analytical, cross-sectional study.

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Setting

This study was executed at the Lagos State University Teaching Hospital (LASUTH), a major referral centre in Nigeria's South Western region. The medical emergency department admits, on average, three hundred patients each month. The hospital has a dedicated 10-bedded stroke unit with dedicated staff. The staff includes neurologists, neurosurgeons, stroke nurses, physiotherapists, occupational therapists, speech therapists, neuropsychiatrists, psychologists, and medical social workers.

Participants

The study population included patients presenting with acute stroke at LASUTH between October 2019 and September 2020. After reviewing the retrieved case files, cases that met the 2013 American Heart Association/American Stroke Association criteria were included in the study. Stroke was defined as "a sudden-onset, rapidly developing focal neurological deficit of vascular origin, involving the brain, retina, or spinal cord."[19] Cases were further categorised into the ischemic and hemorrhagic types based on neuroimaging findings or using the World Health Organization clinical criteria where neuroimaging was not done.[20] The stroke's anatomical location was based on neuroimaging findings, where available or clinical findings. Patients with stroke mimics (subdural hematoma, bleeding into a brain tumor, cerebral abscess) and patients with old strokes admitted with other acute medical diagnoses that may be associated with a stroke recrudescence were excluded from this study.

Records were anonymized, the security of collected data was ensured, and the LASUTH health research ethics committee approved the study.

Stroke proforma

Case files of stroke patients admitted during the study were retrieved, and relevant information was extracted into a stroke proforma [Appendix 1]. The proforma included relevant information such as a unique case identifier, age, sex, duration to presentation, duration to outcome, length of hospitalization, stroke type, risk factors, access to neuroimaging, anatomical location of the stroke, and modified Rankin Score at discharge.

Variables

Risk factor definitions

Hypertension was identified based on a previous diagnosis of high blood pressure by a physician or persistent blood pressure elevation above 140/90 mmHg. Obesity referred to a body mass index more than or equal to 30 kg/m.^{2} Dyslipidemia was based on documented abnormalities in the high-density lipoprotein (<40 mg/dl), low-density lipoprotein (>140 mg/dl), triglycerides (>150 mg/dl), total cholesterol (>200 mg/dl), or a previous diagnosis of dyslipidemia on treatment. Diabetes mellitus was identified in previously diagnosed patients and on treatment or fasting blood glucose more than or equal to 7 mmol/l.

Modified Rankin scale

The modified Rankin Scale (mRS) is a universally accepted functional stroke scale covering outcomes from no symptoms to death.[21] The scale is, however, limited by subjective variability between observers.[22] The scores were rated as 0 – no symptoms; 1 – symptoms but no disability; 2 – slight disability; 3 – moderate disability but can walk without assistance; 4 – moderate disability but cannot walk without aid; 5 – severe disability; and 6 – death.[23]

Statistical methods

Data analysis was done using the Statistical Package for the Social Sciences (SPSS), version 23 (SPSS Inc., Chicago, IL, USA). Nominal variables were represented using frequencies and percentages, while numerical variables were represented using mean and standard deviation. The difference between categorical variables was tested using Chi-square analysis, while that of numerical variables was tested using *t*-test or analysis of variance, as applicable. Association between different factors and 30-day mortality was tested using binary logistic regression analysis. A $P < 0.05$ was considered statistically significant.

Results

From the medical emergency admission records between October 2019 and September 2020, acute stroke accounted for 26.2% of all medical admissions. Seventeen percent of the stroke cases were managed in the stroke unit, while the rest were treated in the general medical wards. The medical records for 230 patients (32.1%) were found and included in the study. The mean age at presentation was 59.9 ± 12 years, with significantly lower age in male patients (58.3 ± 12 years) than female patients (62.3 ± 11.6 years); $P = 0.013$. Most of the patients (60%) were 45–65 years old, while stroke in the young (age below 45 years) accounted for 10%. There were 94 female patients and 136 male patients, with a female-to-male ratio of 1:1.45.

The leading modifiable risk factor identified in this study was hypertension (89.6%), followed by dyslipidemia (28.7%) and alcohol consumption (26.1%). The other identified risk factors are shown in Table 1. Eight acute stroke patients returned a positive SARS-CoV-2 test in the final six months of the study period. Seventy-five patients (32.6%) had a single identified risk factor, while 154 patients (67%) had multiple risk factors. One patient had no identifiable risk factors as at their last follow-up visit. There was a single case of stroke associated with Takayasu's arteritis.

One hundred and twenty patients (52.2%) had an ischemic stroke, followed by ICH in 103 patients (44.8%), while subarachnoid hemorrhage (SAH) was seen in only six patients (2.6%) of the cases. There was a case of cerebral venous thrombosis during the study period. Most ICH cases were subcortical, while the ischemic strokes were in the cortical regions [Figure 1]. Younger patients ($P < 0.001$) and male patients ($P = 0.015$) had significantly higher diagnoses of ICH and SAH [Figure 2].

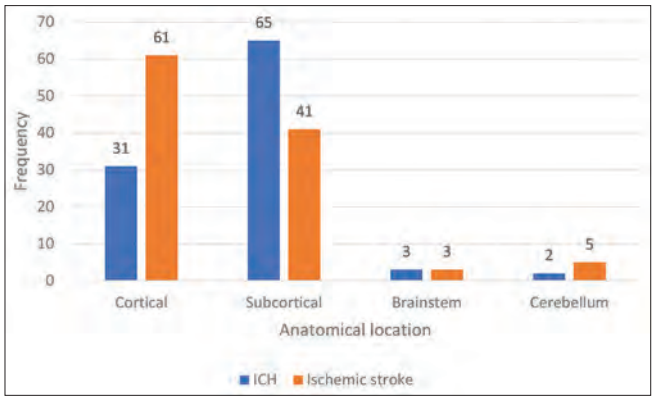

Figure 1: Anatomical location of stroke subtypes

Table 1: Frequency of identified modifiable stroke risk factors (*n*=230)

Risk factors	Frequency (%)	95% CI
Hypertension	206 (89.6)	85.1-93.0
Dyslipidemia	66 (28.7)	23.1-34.8
Alcohol	60 (26.1)	20.7-32.1
Diabetes mellitus	55 (23.9)	18.7-29.7
Previous stroke	47 (20.4)	15.6-26.0
Smoking	19 (8.3)	5.2-12.4
Heart disease	6 (2.6)	1.1-5.3
Atrial fibrillation	5 (2.2)	0.8-4.8
HIV	4 (1.7)	0.6-4.1
Sickle cell disease	3 (1.3)	0.3-3.5
Obesity	2 (0.9)	0.1-2.8
Carotid atherosclerosis	1 (0.4)	0.0-2.1
Connective tissue disease	1 (0.4)	0.0-2.1

CI: Confidence interval

Forty-four patients (19.1%) did not do neuroimaging during their admission [Figure 3], inclusive of 30 patients (68.2%) with ICH. Twelve of these patients who did not do any neuroimaging (27.3%) died within 24 h of presentation, while cumulatively, 26 of them (59.1%) died within seven days of admission. Among the patients with ischemic stroke, 11 (9.1%) had an onset-to-arrival time of fewer than nine hours, and all of them had a computerized tomography (CT) scan of the brain. Only three of the 11 patients who arrived within nine hours of symptom onset had thrombolytic therapy. Cumulatively, 30 (25%) of the ischemic stroke patients were admitted within 24 h of symptom onset, and 25 of them had neuroimaging done.

Nineteen patients left against medical advice and were, therefore, not included in the outcome and mortality analyses. Sixty-six patients (28.7%) died within 30 days of hospital admission, with 14 (6.1%) deaths within the 1st 24 h and cumulatively, 55 (23.9%) within seven days of admission. Twelve out of the 14 deaths within 24 h were cases of ICH. Age-specific 30-day mortality was significantly higher among patients above 65 years (45.9%) than those below 45 years and 45–65 years [Table 2]. The 30-day mortality was significantly higher among patients not managed in the stroke unit [Table 2].

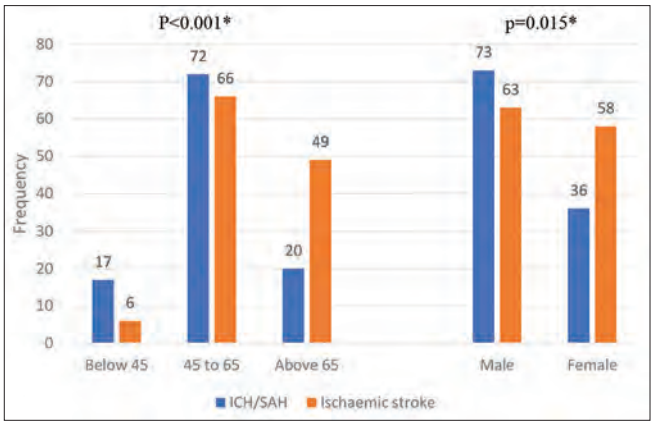

Figure 2: Stroke types by age groups and gender

The overall median (interquartile range) mRS at discharge was 4 (3–6), with significantly worse scores among older patients (P = 0.004) and patients not managed in the stroke unit [Figure 4].

Discussion

This study showed that acute stroke was responsible for approximately one out of every four medical admissions, demonstrating that stroke was a leading cause of hospital medical admissions. This proportion was markedly higher than Desalu *et al*.[24] found in a rural setting in southwest Nigeria who documented 4.5%. The overall incidence of a stroke may be lower in a rural environment than in an urban one, or the health-seeking behaviors may be different. Studies from urban teaching hospitals in Nigeria found that stroke accounted for 9%–12% of medical admissions.[7,9] The dissimilarities with this study's findings could be related to the timing. The other studies reviewed admissions data between 1995 and 2007. This difference is congruent with the rising incidence of stroke in Africa.[2] This study found a male preponderance among the acute stroke cases, similar to other studies' findings.[25-29] Male sex is an established non modifable risk factor for stroke;[30] therefore, the hospital sex ratio may mirror that of the community.

Hypertension was the leading modifiable risk factor in this study, similar to the findings from several other studies in Africa and the rest of the world.[14,24,31-35] The link between hypertension and both ischemic and hemorrhagic stroke is well established, with the treatment of hypertension a cornerstone of stroke prevention, reducing the incidence of stroke by up to 40%.[36-38] The proportion of dyslipidemia documented in this study was higher than Desalu *et al*.[24] found and lower than the case–control study by Owolabi *et al*.[34] The proportion of measured risk factors such as lipid profile are likely underestimated since this study was a review of old medical records where the lipid profile results may be missing.

Classically, ischemic stroke has been reported to be more common than ICH,[15,39] especially in community-based studies. However, some hospital-based studies have reported roughly

Table 2: Variables associated with 30-day mortality

Factors	30 days deaths, frequency (%)	OR (95% CI)	*P*
Age group			
Above 65	28 (45.9)	1.88 (1.14-3.11)	0.014*
45-65	32 (25.2)		
Below 45	6 (26.1)		
Gender			
Male	39 (30.5)	0.96 (0.51-1.81)	0.752
Female	27 (31.4)		
Recurrent stroke			
Yes	16 (41.3)	1.70 (0.77-3.67)	0.149
No	50 (29.1)		
Multiple risk factors			
Yes	44 (31.2)	0.99 (0.53-1.84)	0.974
No	22 (31.4)		
Stroke type			
ICH/SAH	37 (37.0)	1.66 (0.89-3.12)	0.090
Ischemic stroke	29 (26.1)		
Managed in the stroke unit			
Yes	12 (20.3)	0.46 (0.21-0.99)	0.035*
No	54 (35.5)		

*P Significant at < 0.05, CI: Confidence interval, ICH: Intracerebral hemorrhage, SAH: Subarachnoid hemorrhage, OR: Odds ratio

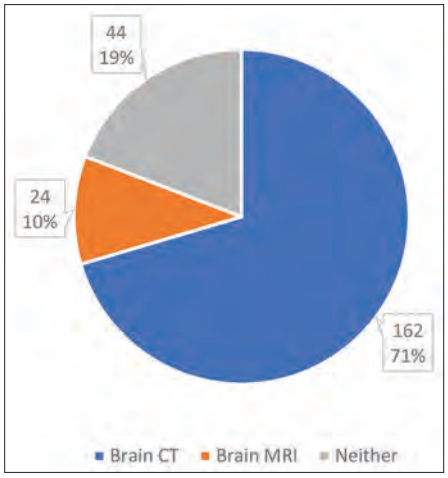

Figure 3: Access to neuroimaging

Figure 4: Median modified rankin scale at discharge, $P = 0.018$

equal frequency of ICH and ischemic strokes.[11,40] This study also found a similar frequency between the stroke types. In their research, Ogun *et al*.[11] had suggested a possible shift in paradigm regarding the pattern of stroke, with an increase in the frequency of ICH. It is also possible that due to the severity of ICH, patients with this stroke type were more likely to present at a tertiary center where this study was carried out than if they had a relatively less severe ischemic stroke. The higher likelihood of sudden demise in ICH coupled with the low autopsy rate may also underestimate this stroke type incidence.[18,41] Africans have a higher risk of hypertension at a younger age due to an early predisposition to the pathogenetic factors of hypertension.[42] Consequently, the hypertensive ICH rate among Africans may be higher, especially as this study found that younger patients had higher ICH rates.

Access to neuroimaging, especially brain CT, was higher in this study than in some earlier Nigerian studies where access was either none or limited.[11,24,26] The study centre had a CT scan machine available, which likely improved accessibility. Possible reasons for not doing a brain CT included cost and early mortality. The proportion of ischemic stroke patients presented within the thrombolytic window was <20% recommended by the European Stroke Organisation.[43] Ogbole *et al*.,[44] in Southwest Nigeria, found that 7.2% of the patients with a stroke presented within 6 h of symptom onset, while 31% presented within 24 h.

The mortality among patients in this study was similar to that from other studies in Nigeria.[11,24,26,45] and Madagascar,[46] but higher than Brazil,[47] Japan,[48] Spain,[49] and Canada.[50] Multiple factors may be responsible for this difference including

socioeconomic status, quality of healthcare delivery, population health-seeking behaviour, and population genetic differences. This study found that age above 65 years was associated with worse outcomes and higher mortality, which tallied the findings from other studies in Nigeria.[11,26] Patients who were managed in the stroke unit had better outcomes compared with those managed in the general medical wards, which agrees with the recommendations for stroke management, where treatment in a stroke unit is crucial.[51,52]

Conclusion

This study found that stroke was a common indication for medical admissions, with hypertension as a leading risk factor. There was a high proportion of ICH comparable to that of ischemic stroke. The access to neuroimaging has improved, albeit the eligibility for and administration of thrombolytic therapy were markedly lower than recommended by the stroke management guidelines. In-hospital mortality was high, especially with older age and treatment outside the stroke unit.

This study, being a retrospective review of records, had some limitations. Many of the case files were missing and could not be included in the data analysis. This low yield of data may distort the accurate picture of stroke presentations at the hospital. Furthermore, the patients' assessment was not standardized because several different carers were involved in patient care during the assessed period. Finally, the measured risk factors were likely underreported as they were absent in some of the case files reviewed. A prospective, registry-based study will provide more reliable data regarding stroke patterns, risk factors, and in-hospital outcomes in this environment.

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Conflicts of interest

There are no conflicts of interest.

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Appendix 1 – Proforma

Age		
Sex	Male	Female
Duration to presentation	Below 9 hours	1 to 7 days
	9 to 24 hours	More than 7 days
Risk factors	Hypertension	Obesity
	Diabetes	Carotid atherosclerosis
	Dyslipidemia	Heart disease
	Smoking	Sickle cell disease
	Alcohol	HIV
	Atrial fibrillation	Previous stroke
	Arterovenous malformation	Anticoagulants
	Aneurysm	Oral contraceptives
	Connective tissue disease	Others
Duration of admission (days)		
Ward patient was managed	Stroke ward	General medical ward
Imaging done	Brain CT	No imaging done
	Brain MRI	
Stroke type	Intracerebral hemorrhage	Subarachnoid hemorrhage
	Ischemic stroke	Cerebral venous sinus thrombosis
Anatomical location	Cortical	Brainstem
	Subcortical	Cerebellar
Duration to death	Alive at discharge	8 to 30 days
	Less than 24 hours	More than 30 days
	1 to 7 days	Left against medical advice
mRS at discharge		