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Pattern of Stroke Admissions, Radiodiagnostic Compliance, and Outcomes in the Intensive Care Unit of a Tertiary Hospital, South-South, Nigeria

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Abstract

Background: Stroke patients form an integral part of patients admitted into the intensive care unit (ICU); and may need airway maintenance, supplemental oxygen and even endotracheal intubation for mechanical ventilation. **Method:** In this retrospective study, the medical records and radiological investigations of the patients were assessed. Also, their socio-demographics, and clinical diagnosis and background co-morbidities were noted. The radiological diagnosis post CT was used to determine the type of stroke for those compliant; while clinical assessment alone was used to determine the diagnosis in those who did not do CT. They were also classified into 2 groups: those requiring mechanical ventilation (for ICU care) and those without the need for mechanical ventilation (for high dependency Unit (HDU) care). The eventual clinical outcome was noted. **Result:** A total of eighty-eight cases, 67% (n = 59) were males and 33% (n = 29) females. 89.8% (n = 79) had hypertension, 3.4% (n = 3) had diabetes while 6.8% (n = 6) had both hypertension and diabetes. Of the hypertensives, 36.7% (n = 29) had hemorrhagic stroke and 66.3% (n = 50) had ischaemic stroke. 53.3% (n = 46) patients had High dependency Unit (HDU care while 47.7% (n = 42) were mechanically ventilated. Of the number in HDU, 51.5% (n = 17) were haemorrhagic, while 52.7% (n = 29) were ischaemic. Clinical diagnosis of ischemic stroke was done in 55 (62.5%) and hemorrhagic stroke in 37.5% (n = 33). Of the lot, only 19.3% (n = 17) of them did CT and 80.7% (n = 71) did not have CT done. None did MRI. Late presentation (beyond 24 hrs) was a common feature for most of the patients, for whom immediate cardio-respiratory support became necessary. Overall mortality rate was 62.5% (n = 55). 39.1% (n = 18) of the

HDU (46) patients died, while 88.1% (n = 37) of the ventilated (42) patients died. 56.6% (n = 26) were discharged from the HDU and 4.3% (n = 2) referred to another facility. Of the 42 patients on mechanical ventilation 88.1% (37) died, 9.5% (n = 4) discharged, and 2.4% (n = 1) referred to another health facility. **Summary:** Low neuroimaging compliance by Stroke patients in our environment and late presentation to hospital, impacts negatively on good outcome of the disease. This, coupled with the high cost of these facilities, makes their use unaffordable, suggesting a strong indication for comprehensive quality and affordable health care and health insurance in the country.

Keywords

1. Introduction

World Health Organization data suggests that 15 million persons suffer stroke yearly worldwide, with 5 million (33.3%) mortality [1]. In Nigeria, 1.14 per thousand persons have stroke, with a 30 days fatality of 40% [2]. Stroke patients form an integral part of patients admitted into the intensive care unit (ICU). The number of stroke admissions into the ICU is higher in health facilities which do not have a dedicated "stroke ward". Critical care provided while on admission in the ICU for this group of patients includes airway maintenance, provision of supplemental oxygen, even endotracheal intubation and mechanical ventilation and intensive blood pressure control [3] [4]. The role of these different types of supportive care in improving the outcomes in these patients cannot be over emphasized especially for patients who have multiple co-morbidities like diabetes mellitus, hypertension, and renal impairment. Cardiovascular disease is also associated with acute stroke and the patients are likely to have abnormal ECG changes [5]. Stroke management may mandatorily require other forms of organ and systemic support, hence the need for prompt admission into the ICU.

Computed tomography (CT) and Magnetic resonance imaging (MRI) are the prime cross sectional imaging diagnostic tools in the diagnosis of stroke [6], the choice of which depends on a few factors such as patient biodata, medical history and the presenting symptomatology of the stroke. The initial choice of imaging done for a suspected stroke patient is also determined by the prevailing standard operating protocol of stroke of the health facility. Reporting software has been developed that has provided accurate interpretations of imaging features in stroke subtypes. CT has been reported to have sensitivity as high as 95% in the diagnosis of intracerebral hemorrhage [7]. Spiral CT angiography detects occluded and ectatic vessels [6]. Early Ischaemia which may be difficult to detect

with CT, is easily detected with MRI within a few hours of the onset of the ischaemic process; hence MRI is more sensitive than CT in early hyperacute ischaemic stroke [8] [9]. Furthermore, MRI can easily differentiate the age and different types of intraparenchymal haemorrhage or swelling. Despite the advantages of MRI in being multiplanar and with excellent soft tissue characterization, the need for MRI compatible monitors and tools, long scan time for acquisition of images and the need for sedation make MRI a more challenging tool for the critically ill patient in comparison to CT [10] [11].

Early admission into the ICU and availability of optimal equipment for support of these high-risk groups of patients while in the ICU is critical for favourable outcome. Clinical outcomes and prognosis can be greatly improved upon by early access to radio diagnostic imaging modalities, therapeutic procedures, and intensive supportive measures. Imaging helps to differentiate thrombotic from haemorrhagic stroke, as each has a different pathway of care. Imaging also plays an invaluable role as it helps in definitive treatment and provides options of interventional care [12] [13]. In this retrospective cross-sectional study, we reviewed the records of patients who were managed for stroke in our centre with the aim to determine the pattern of access to brain imaging (CT and MRI scans) and how it affected the outcome of the patients in our centre, where conservative management was the mainstay of care in the absence of facilities for interventional therapy.

2. Subjects and Method

This was a retrospective cross-sectional descriptive study in which the records of stroke patients admitted into the ICU were reviewed. The facility is a 6-bedded facility. Medical, surgical, and neurological patients are admitted and managed in the unit. The unit is run by a group of anaesthetists and nurses in the department of Anaesthesiology of the hospital. They cater for the needs of patients from all the geographical zones of the state as well as the neighboring states of Edo, Ondo, Bayelsa and Ekiti.

This study involved consecutive patients with stroke that presented to the hospital and were subsequently admitted and managed in the ICU over a 10-year period. In this study presentation outside the golden hour and even beyond 24 hrs without thrombolytic therapy or thrombectomy is considered as late presentation.

Ethical Consideration: Ethical approval was sought from the hospital HERC before commencement of the study. Permission to access patients' records was sought from the hospital management.

There was no need to obtain consent from the patients since it was the case notes and reports of the imaging carried out that was retrospectively accessed. However, confidentiality was strictly adhered to. Names of the patients were not written on the data spreadsheet, instead study numbers were assigned as identifiers.

Inclusion criteria: All adult stroke patients with complete information ad-

mitted in the ICU from 2011-2020.

Exclusion criteria: Patients less than 18 years admitted for stroke. Adult patients admitted for stroke who have incomplete or missing records.

Sampling: The records (case notes and reports of imaging) of the consecutive adult patients admitted into the ICU during the period under review were retrieved from the medical records and the Picture archiving and communicating systems (PACS) unit of Radiology and evaluated. The socio-demographic characteristics (age, sex, marital status, ethnicity, educational status) and biodata (weight and height) were collated. The provisional diagnoses at admission, the type of imaging done, and the radiological diagnosis made; the type of stroke, the time interval from the onset of the symptoms of stroke to presentation to the hospital (1 hr to 24 hrs), type of management instituted, and final outcome of the patient were the information collated.

Data Analysis: Data was analyzed using IBM SPSS version 22.0. Results were presented in statements, figures, and tables as appropriate. Test of association was done as required with statistical significance set at $p < 0.05$.

3. Result

Incidence-age and Sex variability

A total of eighty-eight cases were recorded over the 10-year period comprising of 67% (n = 59) males and 33% (n = 29) females. The ages were categorized, and incidence in each age group noted in 20 - 29 yrs. (3.4%), 30 - 39 yrs. (4.5%), 40 - 49 yrs. (15.9%), 50 - 59 yrs. (17.0%), 60 - 69 yrs. (27.3%), 70 - 79 yrs. (21.6%), 80 - 89 yrs. (8.0%), and 90 - 99 yrs. (2.3%) age groups. The peak incidence was in the 60 - 69 yrs. age group, closely followed by the 70 - 79 yrs. age group (Table 1).

Ethnic preponderance

Ethnic predominance was those from Urhobo 54.5% (n = 48) extraction followed by the Ibo 13.6% (n = 12) and Itsekiris 13.6% (12) each. The Isokos and Ijaws had least incidence of 6.8% (n = 6) each (Table 1).

4. Comorbidity

89.8% (n = 79) had hypertension, 3.4% (n = 3) had diabetes while 6.8% (n = 6) had both hypertension and diabetes. Of the hypertensives 36.7% (n = 29) had hemorrhagic stroke and 66.3% (n = 50) had ischaemic stroke. 33.3% (n = 2) had hemorrhagic and 66.7% (n = 4) ischaemic of the group that combined comorbidities of hypertension and diabetes.66.7% (n = 2) hemorrhagic and 33.3% (n = 1) of the group that had only diabetes as the comorbidity.

Severity

53.3% (n = 46) patients had HDU care while 47.7% (n = 42) were mechanically ventilated. Of the number in HDU 51.5% (n = 17) were haemorrhagic, while 52.7% (n = 29) were ischaemic. Out of the lot needing mechanical ventilation with GCS less than nine, 48.5% (n = 16) were haemorrhagic and 42.3% (n = 26) were ischaemic

Table 1. Statistical analysis of variables.

	Died	%	Improved and discharged home	%	Referred	%	Transferred	%
Ward								
HDU	18	39.1	9	19.6	2	4.3	17	37
ICU	37	88.1	1	2.4	1	2.4	3	7.1
Associated condition								
Diabetes mellitus	2	66.7	0	0	0	0	1	33.3
Hypertension	51	64.6	8	10.1	1	1.3	19	24.1
Hypertension & Diabetes mellitus	2	33.3	2	33.3	2	33.3	0	0
Investigation done								
Not Done	47	66.2	5	7	3	4.2	16	22.5
Done	8	47.1	5	29.4	0	0	17	23.5
Age group								
20 - 29	2	66.7	0	0	0	0	1	33.3
30 - 39	3	75	0	0	0	0	1	25
40 - 49	8	57.1	4	28.6	1	7.1	1	7.1
50 - 59	8	53.3	1	6.7	1	6.7	5	33.3
60 - 69	17	70.8	2	8.3	1	4.2	4	16.7
70 - 79	9	47.4	3	15.8	0	0	7	36.8
80 - 89	6	85.7	0	0	0	0	1	14.3
90 - 99	2	100	0	0	0	0	0	0
Sex								
Male	37	62.7	9	15.3	1	1.7	12	20.3
Female	18	62.1	1	3.4	2	6.9	8	27.6
Ethnicity								
Igbo	5	41.7	2	16.7	0	0	5	41.7
Ijaw	6	100	0	0	0	0	0	0
Isoko	4	66.7	2	33.3	0	0	0	0
Itsekiri	7	58.3	0	0	1	8.3	4	33.3
Urhobo	31	64.6	5	10.4	2	4.2	10	20.8
Others	2	50.0	1	25.0	0	0	1	25.0
Diagnosis								
Ischaemic stroke	36	65.5	6	10.9	2	3.6	11	20.0
Haemorrhagic stroke	14	57.6	4	12.1	1	3.0	9	27.3

CT imaging done. Clinical diagnosis of ischemic stroke was done in 62.5% (n = 55) and hemorrhagic stroke in 37.5% (n = 33). Of the lot, only 19.3% (n = 17) of them did brain CT. 80.7% (n = 71) did not have CT done. None did MRI and only 3 patients had CT from referral centres. All others were done in our facility *i.e.*, 14 out of 17. Only one patient did a repeat CT while on admission in the ICU. From CT confirmation, 10 were haemorrhage while 7 were ischemic. None of the patients arrived our facility within 24 hrs of onset of symptoms. Non had thrombectomy from referral centre

Mortality

Overall mortality rate of was 62.5%. 39.1% (n = 18) of the HDU (46) patients died, while 88.1% (n = 37) of the ventilated (42) patients died. 56.6% (n = 26) were discharged from the HDU and 4.3% (n = 2) referred to another facility. Of the 42 patients on mechanical ventilation 88.1% (37) died, 9.5% (n = 4) discharged, and 2.4% (n = 1) referred another health facility.

66.7% (n = 2) of purely diabetes related stroke patient (total number 3) died with 33.3% (n = 1) discharged to the ward. Hypertension related deaths were 64.6% (n = 51) of the total 79 purely hypertensives without Diabetes. 10.1% (n = 8) discharged home and 24.1 (n = 19) sent to the ward, making it 34.2% (n = 27). One patient was referred to another health facility. Hypertension was related to higher incidence and mortality in these patients $p < 0.05$. In the patients with DM and hypertension combination, mortality was 33.3% (n = 2).33.3% (n = 2) were discharged, and 33.3% (n = 2) referred.

Mortality was 65.5% (n = 36) from a total of 55 patients with ischaemic stroke.10.9% (n = 6) were discharged, 3.6% (n = 2) referred and 20% (n = 11) sent to the ward; making it 30.9% (n = 17) discharged from the ICU. Mortality for haemorrhagic stroke was 57.6% (n = 14). 12.1% (n = 4) were discharged home, 27.3% (n = 9) sent to the ward and 3% (n = 1), referred to another health facility.

5. Discussion

Incidence of stroke in developing counties is fast taking on an epidemic proportion. About 60% of global stroke occurs in low- and middle-income countries. This raises the need for a more clinically sound and diagnostic support in the care of these patients; that have been shown to improve early diagnosis and reduce their morbidity and mortality indices [14]. In this study, a total of eighty-eight cases were recorded over the 10 - year period on ICU admission comprising of 67% (n = 59) males and 33% (n = 29) (**Figure 1**) females in consonance with global trends [14]. The peak incidence was in the 60 - 69 age group, closely followed by the 70 - 79 age group. The mean age of admission was 60.1 with a SD of 15.4 (60 ± 15.4). Total ICU admission was 873. The stroke patients formed 10.10% (**Table 2**).

Ethnic predominance was I those from Urhobo extraction 54.5% (n = 48), followed by the Ibo 13.6% (n = 12) and Itsekiris 13.6% (**Table 1**/**Figure 2**). The

SEX DISTRIBUTION
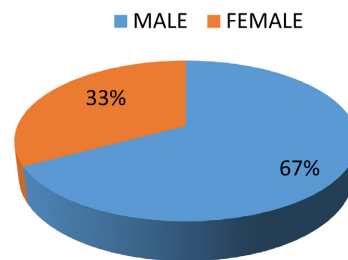
Figure 1. Sex distribution.

ETHNICITY DISTRIBUTION
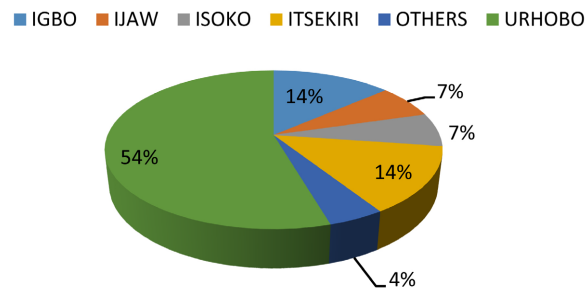
Figure 2. Ethnic distribution.

Table 2. Chi square analysis.

VARIABLE	CHI SQUARE	P-VALUE	INFERENCE
INVESTIGATION * OUTCOME	7.568	0.560	ACCEPT NULL HYPOTHESIS
ASSOCIATED CONDITION * OUTCOME	22.374	0.001	REJECT NULL HYPOTHESIS
WARD * OUTCOME	22.963	0.000	**REJECT NULL HYPOTHESIS**
ETHNIC * OUTCOME	15.139	0.441	ACCEPT NULL HYPOTHESIS
AGE * OUTCOME	16.066	0.766	ACCEPT NULL HYPOTHESIS
SEX * OUTCOME	4.379	0.223	ACCEPT NULL HYPOTHESIS
DIAGNOSIS * OUTCOME	0.734	0.865	ACCEPT NULL HYPOTHESIS
INVESTIGATION * DIAGNOSIS	7.568	0.560	ACCEPT NULL HYPOTHESIS
ASSOCIATED CONDITION * DIAGNOSIS	1.154	0.561	ACCEPT NULL HYPOTHESIS
WARD * DIAGNOSIS	22.963	0.000	**REJECT NULL HYPOTHESIS**
ETHNIC * DIAGNOSIS	0.533	0.991	ACCEPT NULL HYPOTHESIS
SEX * DIAGNOSIS	0.168	0.621	ACCEPT NULL HYPOTHESIS
AGE * DIAGNOSIS	4.859	0.667	ACCEPT NULL HYPOTHESIS

Isokos and Ijaws had least incidence of 6.8% (n = 6) each. This preponderance of the Urhobo tribe was due to the location of the hospital being predominantly of the tribe. There is no proven link to tribal predisposition and occurrence of stroke among Nigerians; though there is global variation in stroke suggesting ethnic and genetic components and environmental factors like easy access to this kind of specialized care [15] [16] [17] [18] [19].

The comorbidities associated with stroke in Sub Saharan Africa are hypertension and diabetes with a higher association with hypertension unlike in the developed countries where other diseases like diabetes, hyperlipidemias, and cardio-emboli are more common. [20] 89.8% (n = 79) of our patients had hypertension, 3.4% (n = 3) had diabetes while 6.8% (n = 6) had both hypertension and diabetes (Table 1). Hypertension was related to higher presentation and mortality in these patients p < 0.05.

Studies in the United States show that 82% of strokes were ischaemic [21]. This is also reflected in our pattern in this study with preponderance of ischaemic stroke. Clinical diagnosis of ischemic stroke was done in 55 (62.5%) and hemorrhagic stroke in 37.5% (n = 33). Of the lot, only 19.3% (n = 17) of them did CT scan. The importance of differentiation is helpful in definitive diagnosis which is helped by CT confirmation; though it is known that ischaemic strokes can develop haemorrhagic components in the evolution of the disease (Haemorrhagic transformation of ischaemic stroke) [14]. Repeat CT can help determine the progression and aid the care of the patient [22]. Other neurodiagnostic modalities known to improve the care of stroke patients are MRI, and CT angiography. MRI is an advancement on CT or CT angiography [23] though none of our patients did MRI [24] [25] [26] [27].

In our study, stroke patients formed 11.23% of the ICU admissions. 53.3% (n = 46) patients had HDU care while 47.7% (n = 42) were mechanically ventilated (Figure 3). Of the number in HDU 51% - 5% (n = 17) were haemorrhagic, while 52.7% (n = 29) were ischaemic. Out of the lot needing mechanical ventilation with GCS less than nine, 48.5% (n = 16) were haemorrhagic and 42.3% (n = 26) were ischaemic. Though severity may be more of the location of the vessel and scope or a real size, than the classification (haemorrhagic or ischaemic (haemorrhagic or ischaemic). The low level of compliance with CT and late presentation made us guarded with the use thrombolytic therapy, which is only used

WARDS ADMISSION

HDU ■ ICU

48%

52%
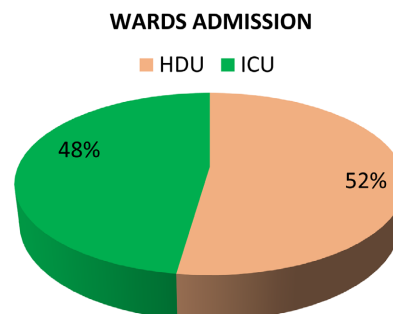
Figure 3. ICU/HDU differentiation.

in few developing countries, and mainly for the urban rich. Also early intervention in the ICU with intensive blood pressure management helps prevents secondary brain injury and enhance multiple organ support [27] [28]. Other presentations include seizures, that may progress to status epilepticus especially in haemorrhagic CVA. In patients with GCS less than 9, endotracheal intubation would be necessary for adequate cerebral oxygenation to bypass airway obstruction and prevent aspiration of gastric contents. Several studies however suggest improved outcomes with ICU admission [29] [30].

CT imaging is used in stroke scoring and prognostication. It's also useful where there is haemorrhagic transformation of ischaemic stroke and withholding of plasminogen activators. It is difficult to establish a direct relationship between radio-diagnostic compliance with outcome for 2 reasons. The first was late presentation where acute resuscitation and cardiorespiratory support in the ICU, with increased risks on movement to CT suites. Cost of CT scan itself was a second limiting factor for the patients.

Though overall mortality rate of was 62.5% (n = 55), 88.1% of the mechanically ventilated patients died as against 39.1% of those in HDU. The need for mechanical ventilation may have been a pointer to a higher severity of illness going by the GCS; and may also be a poor prognostic indicator since mechanical ventilation was not significantly helpful in these patients.

Mortality from haemorrhagic stroke has been found to have a relationship with the vessel involved size of haematoma (Increasing or reducing) and involvement of the ventricles: a process which is impossible to undertake in the absence of neuroimaging. Though severity scoring scales like APACHE and SAP are useful, they do not have radiological components, and to that extent may be limited in prognostication. These further buttress the importance of neuroimaging in the care of stroke patients [31] [32]. Though in this study we did not investigate cause of death; Stroke itself has been found to be a leading cause of death in a previous study amounting to 81.3% [33]. They cause central nervous system related causes like cardio-respiratory failure and brain herniation, Other extracranial causes could be pulmonary embolism, pneumonia, and sepsis. This underscores the need for early detection and treatment of stroke and these complications [34] [35].

6. Recommendations

It is necessary for the public to be educated on the early symptoms of Stroke and how to call for help, for prompt transfer to stroke centres. Also, well equipped, and effective prehospital care should bridge the gap of effective and prompt transfer to hospital.

Finally, there is need for the establishment of accessible regional stroke centres, where patients can present within the golden hour and get precise diagnostic and adequate specialist care. Such hospitals should be equipped with facilities for critical care and rehabilitation.

7. Conclusion

Stroke patients in our environment present to hospital, not early enough to make radio-diagnostic facilities impact meaningfully on the outcome of the disease. This, coupled with the high cost of these facilities, makes their use unaffordable, and clinicians must rely on their clinical diagnostic acumen, most of the time. This is an indication for a better organized health care system (primary, secondary, and tertiary) and comprehensive health insurance in the country.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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