ORIGINAL ARTICLE

EVALUATION OF THE COMPUTED TOMOGRAMS OF STROKE PATIENTS IN A TEACHING HOSPITAL IN NIGERIA

Akintunde Olusijibomi Akintomide[1], Samuel Archibong Efanga[1], Affiong Ifiop Ngaji[1], Simon Izuchukwu Ozomma[2]

Radiology Department, University of Calabar Teaching Hospital, Calabar, Cross River State, Nigeria[1]; Internal medicine Department, University of Calabar Teaching Hospital, Calabar, Cross River State, Nigeria[2]

ABSTRACT

Background: The incidence of stroke and its avertable mortalities have been on the rise in developing countries. This trend negatively impacts the socio-economic development of low- and middle-income countries. The study was therefore conducted to evaluate the cranial computerized tomography (CT) pattern in stroke patients in the University of Calabar Teaching Hospital (UCTH), Calabar.

Method: This was a retrospective, cross-sectional, observational study conducted at the Radiology department of UCTH within a 21-month period on cranial non-contrast CT findings of 94 patients diagnosed of acute stroke. Images were acquired using Somatom-go.Now, Siemens Healthcare GmbH, Henkestr. 12791052 Erlangen, Germany 2020, a 32-slice CT machine. The data obtained were analyzed using SPSS version 24.

Results: Ischemic stroke was more common (66, 70.21%) than hemorrhagic stroke (28, 29.79%). Most of the subjects were males (50, 53.19%) and within the 45 – 54 years age group (27, 28.72%). Majority of the stroke lesions were on the left hemisphere of the brain (55, 58.51%) and were unifocal (81, 86.17%). The most common anatomical site for ischemic stroke lesions and hemorrhagic stroke lesions were internal capsule (22, 22.68%) and thalamus (9, 25%) respectively. Anterior cerebral vascular territory was most affected (70, 74.47%) by stroke lesions.

Conclusion: Ischemic stroke is the commonest subtype of stroke in Calabar. The incidence of stroke is higher in males than females who are largely in their early middle age and commonly affects the left side of the brain.

Keywords: Computed tomography scan, Stroke, Ischemic, Hemorrhagic, Calabar.

INTRODUCTION

Based on the World Health Organization (WHO) clinical criteria, stroke can be defined as rapidly developing clinical signs of focal or global cerebral deficit, with symptoms lasting for 24 hours or longer or leading to death, with no apparent cause other than of vascular origin. Generally, it comprises of two subtypes which are; Ischemic stroke (The presence of a recent infarct in a clinically relevant area of the brain) and Hemorrhagic stroke (The presence of a bleed into the surrounding brain tissue due to the rupture of a weakened blood vessel). [1,2] The ischemic subtype and the hemorrhagic subtype account for 80 to 87% and 13 to 20% of all stroke cases. [3]

Over 6.5 million death and 113.2 million disability-adjusted life years (DAILY) were credited to stroke in 2013. [4] In 2019, stroke was identified as the 2nd leading cause of death and disability worldwide. Over the past 5 decades low- and middle-income countries have been greatly impacted adversely at a much greater pace, in terms of stroke incidence, prevalence, mortality and disability than in high-income countries. [5] Africans are more susceptible to contracting stroke than Caucasians. [6] The increasing burden of stroke in Nigeria has been attributed to the rising prevalence of cardiovascular risk factors, adoption of western lifestyle, demographic transition, low awareness of early stroke signs and symptoms, high cost and poor uptake of computed tomography scans and magnetic resonance imaging scans. These have culminated to a rising 30-days fatality in Nigeria. [1-4] It has been estimated by WHO that by 2030 about 80% of people afflicted with stroke will reside in low and middle-income countries and this will account for 7.9% of all mortality. [7]

The risk factors of stroke have been broadly divided into modifiable risk factors such as hypertension, diabetes, renal dysfunction, cigarette smoking, excess alcohol consumption, atrial fibrillation, polycythemia, obesity and diabetes mellitus and [7-9] non-modifiable risk factors which include age, gender, family history

and race/ethnicity. Stroke can be averted by lifestyle modification and controlling major risk factors. [10]

The effective management and prognosis of patients with stroke majorly relies on a precise diagnosis and determination of the exact subtype by an investigative tool. [1] The following imaging modalities are employed in the evaluation of patients with stroke; computerized tomography (CT) scan, magnetic resonance imaging (MRI) and catheter angiography. [3, 11, 12] However, non-contrast CT scan is recommended as the first-line imaging modality. [7] It is the most suitable for critically ill patients, like those with stroke who require exigent assessment, since it is sensitive, rapid (especially when multidetector CT scan machines are used), relatively available and has fewer contraindications compared to MRI. [13,14] The procedure rapidly determines the subtypes and stroke mimics, which is a pre-requisite before appropriate treatment commences. [9,15,16] Moreover, non-contrast CT scan is associated with a relatively low effective radiation dose of about 1.7 mSv which is considerably below the critical dose threshold for organ damage like cataract and hair loss. [7]

Even though stroke has become a major health concern in developing countries, there are few available data on stroke in Calabar, Nigeria. The findings of this study will serve as an update of present data, reference for future studies and will be employed by policy makers in the formulation of health programs for improved management of stroke cases. Therefore, this study was aimed at evaluating the cranial CT pattern in stroke patients in the University of Calabar Teaching Hospital, Calabar.

MATERIALS AND METHODS

This retrospective, cross sectional observatory study was conducted in a Nigerian University teaching hospital over a 21-month period beginning 1st March 2021 to 30th November 2022. The hospital is a tertiary referral health center, which serves Cross River State and several catchment areas including the neighbouring Republic of Cameroon.

Ethical approval was obtained from the institution's research ethics committee with patient information kept confidential. Inclusion criteria comprised all cases of acute stroke with or without loss of consciousness, that underwent non-enhanced cranial CT at the Department of Radiology in the hospital. Exclusion criteria comprised of patients with incomplete data, head trauma and an alternate CT scan-based diagnosis. Purposive sampling method was employed for the study and a sample size of 94 cases was obtained.

The clinical information, patient management, relevant demographic data and CT images were extracted from the CT register, medical records and the radiology information system (RIS) in the reporting work station. CT images of all cases seen within the study period were evaluated by two experienced Radiologists upon retrieval. Examination of cranial CT was done using Somatom-go.Now, a 32-slice CT scanner (manufactured in Germany by Siemens Healthcare GmbH, Henkestr. 12791052 Erlangen, in 2020) using a pitch factor of 0.55 ratio and slice thickness of 1.5mm. CT X-ray source parameters were KVP = 130kV and an Exposure of 191 mAs, with a variable lower effective exposure from skull base to vertex. Images were acquired in the axial plane and reformatted in sagittal and coronal planes.

The demographic characteristics of the patients and the radiological findings on cranial non-contrast CT were documented using proforma. Data was entered and analyzed using SPSS version 24.0, and presented using frequency tables and cross tables.

RESULTS

Data was obtained from ninety-four (94) cases of acute stroke, consisting of fifty (50) males and forty-four (44) females. The mean age of all the subjects was 58.15 ± 6.5 years, ranging from 30 to 85 years. The mean age of patients with hemorrhagic stroke was 53.93 years, while that for ischemic was 59.95 years. There were slightly more males than females in both subtypes. For ischemic stroke, 34 patients were males and 32 were females, while they were 16 males and 12 females respectively for hemorrhagic stroke

(Figure 1).

Majority of the cases were ischemic stroke (n=66, 70.21%) while hemorrhagic stroke cases accounted for 29.79% of the entire subjects (n=28). The highest number of stroke cases was seen in the 45 – 54 years age group (n=27, 28.72%) and it reduced successively per decade until the >85 years age group where the least number was seen (n=2, 2.13%). The highest number of males with ischemic stroke (n=12, 35.29%) and hemorrhagic stroke (n=6, 37.5%) were both within the 55 – 64 years age group while the highest number of females with ischemic stroke (n=10, 31.25%) and hemorrhagic stroke (n=8, 66.67%) were noted in the 65 – 74 years age group and the 45 – 54 years age group respectively. The highest number of cases with ischemic stroke and hemorrhagic stroke were found in the 55 – 64 years age group (n=19, 28.79%) and 45 – 54 years age group (n=13, 46.43%) respectively. At the other end of the spectrum, the least number of cases with ischemic stroke (n=2, 3.03%) and hemorrhagic stroke (n=0) were noted in the > 85 years age group (Table I).

Stroke lesions were mainly noted in the left cerebral hemisphere of the cases (n=55, 58.51%) with 37 ischemic lesions and 18 hemorrhagic lesions, followed by the right cerebral hemisphere (n=26, 27.66%) with 19 ischemic lesions and 7 hemorrhagic lesions while the brainstem (n=6, 6.38%) was the least. No hemorrhagic stroke lesion was observed in the brainstem. Anterior cerebral circulation, which is largely made up of the middle cerebral artery and contributions from the anterior cerebral artery, was more commonly affected in both stroke subtypes with 70 stroke lesions (74.47%) and this comprised of 52 ischemic lesions and 18 hemorrhagic lesions. The stroke lesions in the cases were mainly unifocal (n=81, 86.17%) consisting of 58 ischemic lesions and 23 hemorrhagic lesions. The stroke lesions were multiple in 13 cases (13.83%) with 8 ischemic lesions and 5 hemorrhagic lesions (Table II).

The commonest anatomical site for ischemic lesions and hemorrhagic lesions in the cases were internal capsule (n=22, 22.68%) and thalamus (n=9, 25%) respectively, followed by parietal lobe (n=15, 15.46%) and temporal lobe (n=7, 19.44%) respectively. The lentiform nucleus was the third site commonly affected with ischemic (n=14, 14.43%) and hemorrhagic (n=4, 11.11%). lesions generally. No stroke lesion was noted in the centrum semiovale (n=0) and only ischemic lesions were seen at the corona radiata (n=7, 7.22%) and the pons (n=6, 6.19%) (Table III).

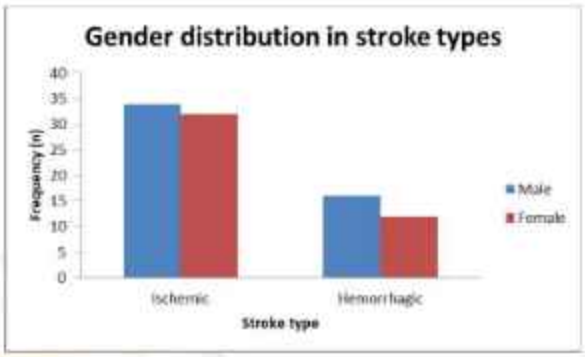

Figure 1. Gender frequency in both stoke types

Table I: **DEMOGRAPHIC CHARACTERISTICS OF STROKE PATIENTS**

AGE GROUP	MAJOR TYPES OF STROKE				
	ISCHEMIC		HEMORRHAGIC		
	MALE	FEMALE	MALE	FEMALE	TOTAL
30 - 44	3	4	2	2	**11**
45 -54	7	7	5	8	**27**
55 -64	12	7	6	0	**25**
65 -74	7	10	3	1	**21**
75 -84	3	4	0	1	**8**
> 85	2	0	0	0	**2**

Table II: **REGIONAL DISTRIBUTION OF STROKE LESIONS**

	MAJOR STROKE TYPES		
HEMISPHERE	**ISCHEMIC**	**HEMORRHAGIC**	**TOTAL**
RIGHT	19	7	**26**
LEFT	37	18	**55**
BILATERAL	4	3	**7**
BRAINSTEM	6	0	**3**
BLOOD CIRCULATION			
ANTEROR	52	18	**70**
POSTERIOR	14	10	**24**
LESIONS			
SINGLE	58	23	**81**
MULTIPLE	8	5	**13**

Table II: **REGIONAL DISTRIBUTION OF STROKE LESIONS**

SITE	ISCHEMIC	HEMORRHAGIC
FRONTAL	9	3
PARIETAL	15	4
TEMPORAL	7	7
OCCIPITAL	5	2
CEREBELLUM	2	2
CAUDATE NUCLUES	3	3
INTERNAL CAPSULE	22	2
LENTIFORM NUCLUES	14	4
THALAMUS	7	9
PONS	6	0
CORONA RADIATA	7	0
CENTRUM SEMIOVALE	0	0

DISCUSSION

In this study there was a slight male preponderance over females in terms of the incidence of stroke with the males making up 53.19% of the population while the females were 46.81%, resulting in a male to female ratio of 1.14:1. This finding was also reported in several studies; Jibo *et al.* [3] reported a 1.38:1 male to female ratio, Kathyayani *et al.* [17] and Dandena *et al.* [1] also noted a 1.63:1 ratio and 1.86:1 male to female ratio respectively. In contrast, Ominde *et al.* [18] observed that females were commonly afflicted with stroke with a female to male ratio of 1.63:1. This same trend was reported by Baduro *et al.* [19] and Ayehu *et al.* [10] who noted a female to male ratio of 1.15:1 and 1.14:1 respectively. The male predominance found in this study could possibly be due to the increased exposure of men to the risk factors for stroke such as socio-economic stress of the family, regularly undertaking demanding tasks at workplaces, excess alcohol consumption and cigarette smoking. [3,8,20]

About 70.21% of the studied cases had ischemic stroke whereas 28.72% had hemorrhagic stroke. These findings are in conformity with the global trend of the incidence of stroke subtypes. One of the highest preponderances was reported by Dahiru *et al.* [13] who observed an 84.7% and 15.3% incidence of ischemic and hemorrhagic stroke, respectively, in their study. In congruity, the findings of Mboizi *et al.* [7] (76.5% and 20.9%), Edzie *et al.* [21] (70.7% and 29.3%) and Fawi *et al.* [22] (62.5% and 37.5%) demonstrated the high incidence of ischemic stroke compared to hemorrhagic stroke in their studies. The high incidence of ischemic stroke is probably due to the fact that it has multiple associated risk factors while hypertension is attributed as the major cause of hemorrhagic stroke. [9]

This study shows that the highest incidence of stroke generally was among individuals aged between 45 and 54 years (28.72%). This report was in variance with studies done elsewhere as Ominde *et al.* [18] (33.04%), Ayehu *et al.* [10] (33.2%), Owolabi *et al.* [20] (23.10%) and Eze *et al.* [6] (40%) all observed that the incidence of stroke was commonest in the 60 – 69 years age group. This is because from the 6th decade of life blood vessels become atherosclerotic. [15] It has been reported that age is the strongest non-modifiable risk factor for ischemic stroke due to atherosclerosis and a high incidence of silent cerebrovascular disease. [7] In consonance with the index study, Dahiru *et al.* [13] observed that stroke was common in the 41 – 50 years age group (27%). The high incidence of stroke in younger age group might be as a result of habitual excessive alcohol consumption, cigarette smoking, excessive oral contraceptive use and stress of pressure at work and family (for those who marry early). [8] In addition, poor medical management of the diverse risk factors of stroke and non-compliance with recommended therapeutic regimens resulting from financial constraints have also been implicated. [13] The surge in the incidence of stroke in the younger generation creates a profoundly adverse impact on the productivity of the already dwindling economy of developing countries because of the massive impairment of the affected work-force. [21]

This study further observed that the incidence of ischemic stroke was highest in the 55 – 64 years age group (28.79%). However, Dandena *et al.* [1] observed that ischemic stroke was commonly seen in individuals above 65 years (72.63%). It was further shown in this study that the incidence of hemorrhagic stroke was highest in the 45 – 54 years age group (46.43%). In consonance with the findings of this study, Eze *et al.* [6] observed that hemorrhagic stroke cases were most seen in the 41 – 50 years age group (71%). In fact, Owolabi *et al.'s* [20] study demonstrated that hemorrhagic stroke is common in younger population as they showed

that its highest incidence was in the 31 – 40 years age group (26.53%). Nevertheless, several other reports opined that hemorrhagic strokes were common in the above 55 years age group. [1,3]

The most common side of stroke occurrence in this study was the left side (58.51%). In like manner, Jibo *et al.* [3] (62%), Ogunseyinde *et al.* [15] (61.7%), Adamu *et al.* [8] (>50%), Dahiru *et al.* [13] (49.4%) and Mboizi *et al.* [7] (45%), all reported a left side preponderance. This recurring trend is likely because since many people are right-handed, the left cerebral hemisphere is more frequently multi-tasked and active throughout the day and consequently more susceptible to stroke. [13] Differing from our findings, Chiewvit *et al.* [14] (56.7%) and Taiwo *et al.* [23] (47.9%) both noticed that the right side was the commonest side of stroke occurrence.

In this study it was observed that the most common vascular territory involved in the stroke cases was the anterior cerebral circulation (74.47%). The anterior cerebral circulation is made up largely the middle cerebral artery and to a lesser extent, the anterior cerebral artery. Plethora of studies such as those of Baduro *et al.* [19] (83.4%), Mboizi *et al.* [7] (76.7%) and Dahiru *et al.* [13] (62.2%) were in agreement with our report as they showed that the most common vascular territory was the middle cerebral artery. They opined that the middle cerebral artery vascular territory was the most common area affected because it is the largest and most direct branch formed from the terminal ends of the internal carotid arteries which makes it more prone to occlusion by emboli. [9]

Majority of the stroke lesions in this study were unifocal (86.17%). In alignment with our findings, Jibo *et al.* [3] (90%), Chiewvit *et al.* [14] (85.6%) and Dandena *et al.* [1] (97.6%) also observed that the stroke lesions in their studies were mainly unifocal.

The most common anatomical site for ischemic and hemorrhagic stroke lesions noticed in this study were internal capsule (22.68%) and thalamus (25%), respectively. While Dandena *et al.* [1] observed that the most common anatomical site for ischemic stroke was the cortical grey matter (70%), several reports such as those of Jibo *et al.* [3] (54%), Suthar *et al.* [24] (49%), Acharya *et al.* [16] (44%) and Edzie *et al.* [21] (43%), found out that the commonest anatomical site for hemorrhagic stroke was the basal ganglia. The likelihood of hemorrhagic events occurring in the basal ganglia is because of the increased susceptibility of branched lenticulostriate vessels to rupture during periods of raised blood pressure.

The results of this research were based on the exclusive findings of subjects in a single center which was a limitation of this study. In addition, the CT scan machine was also non-functional for two months during the study thus impacting on the sample size.

CONCLUSION

Ischemic stroke is the commonest subtype of stroke in Calabar. The incidence of stroke is higher in males than females and commoner in the left hemisphere. Amongst males, both stroke types are commonest between 55 – 64 years amongst males, while in females, ischemic and haemorrhagic strokes are commoner in the older and younger age groups respectively.

REFERENCES

1. Abdi Dandena A, Sinaga M, Yirga Y, Zelalem T. CT Scan Pattern of Stroke Patients at Jimma University Medical Center, South West Ethiopia. *Biomed J Sci Tech Res* 2020;29(4):22652. doi: 10.26717/BJSTR.2020.29.004835.
2. Njoku CH, Aduloju A. Stroke in Sokoto, Nigeria: A five-year retrospective study. Annals of African Medicine [Internet]. 2004 Nov 16;3(2):73–6. Available from: https://www.ajol.info/index.php/aam/article/view/8308.
3. Jibo U, Saleh MK, Tabari AM, Ismail A, Yahuza MA, Jibo AM, *et al.* Brain computed tomographic pattern and clinical presentation of patients with hypertensive hemorrhagic stroke at Aminu Kano Teaching Hospital, Kano, Nigeria. *J Radiat Med Trop* 2021;2:12-7.
4. Adeloye D, Ezejimofor M, Auta A, Mpazanje RG, Ezeigwe N, Ngige EN, *et al.* Estimating morbidity due to stroke in Nigeria: a

systematic review and meta-analysis. *J Neurol Sci*. 2019;402:136-144. doi:10.1016/j.jns.2019.05.020

5. Owolabi MO, Thrift AG, Martins S, Johnson W, Pandian J, Abd-Allah F, *et al*. The state of stroke services across the globe: Report of World Stroke Organization-World Health Organization surveys. *Int J Stroke*. 2021;16(8):889-901. doi:10.1177/17474930211019568
6. Eze CO, Agu CE, Kalu UA, Maduanusi CA, Nwali ST, Igwenyi C. The pattern and presentation of stroke in Federal Teaching Hospital Abakaliki (FETHA) South-East Nigeria. *Journal of Biology, Agriculture and Healthcare* 2013;3(11):141-144.
7. Vincent M, Sereke SG, Nassanga R, Robert M, Ameda F. Correlation between clinical and brain computed tomography findings of stroke patients: A cross-sectional study. *Health Sci Rep*. 2023;6(5):e1248. doi:10.1002/hsr2.1248
8. Adamu MY, Naimatu AT, Isyaku K, Idris SK, Lawal Y. Computed tomographic pattern of stroke among hypertensive and diabetic patients in Kano, Nigeria. *J Radiat Med Trop* 2021;2:24-30.
9. Kumar S. Hypertension and Hemorrhagic Stroke. *Hypertens J* 2017;3(2):89-93.
10. Ayehu GW, Yitbarek GY, Zewdie EA, Amsalu BT, Abie Y, Atlaw D, *et al*. Risk profile, clinical presentation, and determinants of stroke subtypes among patients with stroke admitted to public referral hospitals, Northwest Ethiopia in 2021: A cross-sectional study. *Front Neurol*. 2022;13:988677. doi:10.3389/fneur.2022.988677
11. Ugwuanyi DC, Sibeudu TF, Irole CP, Ogolodom MP, Nwagbara CT, Ibekwe AM, *et al*. Evaluation of common findings in brain computerized tomography (CT) scan: A single center study. *AIMS Neurosci*. 2020;7(3):311-318. Published 2020 Aug 13. doi:10.3934/Neuroscience.2020017
12. Nilsson OG, Lindgren A, Ståhl N, Brandt L, Säveland H. Incidence of intracerebral and subarachnoid haemorrhage in southern Sweden. *J Neurol Neurosurg Psychiatry*. 2000;69(5):601-607. doi:10.1136/jnnp.69.5.601
13. Dahiru MY, Umar HU, Aminu MCD, Usman AU, Sa'ad ST, Ibinaiye PO, *et al*. Computed tomographic pattern of stroke among adult patients in north-eastern Nigeria. *Pyramid J Med* [Internet]. 2021 Jul. 14 [cited 2023 Aug. 14];4(1). Available from: https://www.pagepress.org/medicine/pjm/article/view/50
14. Chiewvit P, Danchaivijitr N, Nilanont Y, Poungvarin N. Computed tomographic findings in non-traumatic hemorrhagic stroke. *J Med Assoc Thai*. 2009;92(1):73-86.
15. Ogunseyinde AO, Atalabi OM. Cranial computerized tomography in the evaluation of stroke patients in Ibadan. *Nigerian J Clin Pract*. 2003;6(2):81-83
16. Acharya S, Chaturvedi S. Significance of Computed Tomography in the Diagnosis of Cerebrovascular Accidents. *J Lumbini Med Coll* [Internet]. 30Jun.2014 [cited 15Aug.2023];2(1):18 -20. Available from: https://jlmc.edu.np/index.php/JLMC/article/view/49
17. Kathyayani MKM, Babu DV, Sreenivas S. Patient demographic, risk factors and seasonal variation in onset of stroke. *J Evid Based Med. Healthc* 2016;3(84),4582-4586. DOI:10.18410/jebmh/2016/969
18. Ominde BS, Ogeng'o JA, Misiani MK, Kariuki BN. Pattern of stroke in a rural Kenyan hospital. *Malawi Med J*. 2019;31(1):50-55. doi:10.4314/mmj.v31i1.9
19. Baduro Y, Ndala O, Buque DVH, Sebastiao F, Baco J, Arroz N, *et al*. Stroke in Maputo central hospital, Mozambique: a cross-sectional study 2014–18. *J Neurol Stroke*. 2022;12(3):50-55. DOI: 10.15406/jnsk.2022.12.00500
20. Owolabi LF, Nagoda M. Stroke in Developing Countries: Experience at Kano, Northwestern Nigeria. *Sudan Journal of Medical Sciences* [Internet]. 2012 [cited 2023 Aug 21];7(1). Available from: https://www.ajol.info/index.php/sjms/article/view/78138
21. Edzie EK, Dzefi-Tettey K, Gorleku P, Amankwa AT, Idun E, Brakohiapa EK, *et al*. Evaluation of the anatomical locations of stroke events from computed tomography

scan examinations in a tertiary facility in Ghana. *Cureus*. 2021;13(3):e14097. doi:10.7759/cureus.14097

22. Fawi GH, Corea F, Thabit MN, Abbas MA, Comi G. Southern Egypt Stroke Study: Case Fatality Rates in a Hospital-Based Setting. The Open General & Internal Medicine Journal [Internet]. 2009 Jun 5 [cited 2023 Aug 21];3(1). Available from: https://benthamopen.com/ABSTRACT/TOGMJ-3-40
23. 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;22:71-76.
24. Suthar NN, Patel KL, Saparia C, Parikh AP. Study of clinical and radiological profile and outcome in patients of intracranial hemorrhage. *Ann Afr Med*. 2016;15(2):69-77. doi:10.4103/1596-3519.176259