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Brain CT Patterns of Stroke Subtypes at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

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ABSTRACT

Background: Stroke is a leading cause of morbidity and mortality worldwide, with an increasing burden in low and middle-income countries, including Ethiopia. Neuroimaging plays a crucial role in the accurate diagnosis and classification of stroke, guiding clinical decision-making and treatment strategies. However, data on the specific brain CT patterns and stroke subtypes remain limited in Ethiopia. **Objective**: This study aims to determine the computed tomography (CT) patterns of stroke among patients undergoing neuroimaging at St. Paul's Hospital Millennium Medical College (SPHMMC), Addis Ababa, Ethiopia. **Methodology**: A retrospective cross-sectional study was conducted on 113 stroke patients who underwent brain CT at SPHMMC. Data was collected from the Radiology Information System (RIS) and patient records. **Results**: Among the 113 stroke patients, 59 (52.2%) had ischemic strokes, while 54 (47.8%) had hemorrhagic strokes. The basal ganglia were the most common site for hemorrhagic stroke (64.2%), whereas ischemic infarcts were predominantly observed in the cerebral cortex (54.2%). **Conclusion**: Ischemic stroke was found to be the predominant stroke type, with hemorrhagic strokes also occurring at a high rate. Further research incorporating clinical patterns and long-term outcomes is recommended to enhance stroke prevention and treatment strategies.

Key Words: Stroke, patterns, Ethiopia

INTRODUCTION

Stroke, or cerebrovascular accident, is defined as the abrupt onset of a neurologic deficit attributable to a focal vascular cause, with symptoms lasting more than 24 hours (1). The two major pathological processes underlying stroke are arterial occlusion, leading to cerebral ischemia or infarction, and arterial rupture, resulting in intracranial hemorrhage (2). Ischemic stroke occurs when an intracranial vessel is acutely occluded, reducing blood flow to the affected region. The extent of ischemia depends on collateral circulation, vascular anatomy, site of occlusion, and systemic blood pressure. Complete cessation of cerebral blood flow causes irreversible neuronal death within

4–10 minutes, while surrounding tissue in the ischemic penumbra may remain viable but functionally impaired (3).

Intracranial hemorrhage results from bleeding into or around the brain, producing symptoms through mass effect, toxic effects of blood, or raised intracranial pressure (4). Hemorrhagic strokes are categorized as intracerebral hemorrhage (ICH), due to bleeding into the parenchyma, or subarachnoid hemorrhage (SAH), due to bleeding into the subarachnoid space. Both forms are associated with high morbidity and mortality (5). Major risk factors for stroke include hypertension, smoking, excessive alcohol consumption, and hypercholesterolemia. Additional risk factors for ICH include advanced age, male sex, Asian ethnicity, chronic kidney disease, cerebral amyloid angiopathy, and cerebral microbleeds (6).

Globally, stroke is the second leading cause of death after ischemic heart disease (6). Much of this burden is attributable to modifiable atherosclerotic risk factors (7). While stroke incidence has declined in many high-income countries, rates in Africa, particularly of hemorrhagic stroke, have increased markedly over the past two decades (8). This rise reflects an epidemiological transition driven by urbanization, dietary changes, adoption of Western lifestyles, and demographic shifts such as increased life expectancy and population growth (9).

Non-contrast computed tomography (CT) is the primary imaging modality for acute stroke evaluation because of its wide availability and rapid acquisition, particularly in resource-limited settings where MRI is less accessible (10). CT findings evolve across three stages: acute (<24 hours), subacute (24 hours–5 days), and chronic (weeks). Acute stroke is characterized by cytotoxic edema, with early ischemic changes including loss of gray-white differentiation and sulcal effacement. A hyperdense thrombus may be visible in the proximal middle cerebral artery. Subacute stroke demonstrates vasogenic edema, hypoattenuation with well-defined margins, and maximal mass effect. Chronic stroke is associated with brain tissue loss and persistent hypoattenuation (11). Therefore, this study aimed to assess the incidence and pattern of stroke and the predictors among stroke patients in SPHMMC, Addis Ababa, Ethiopia.

METHODOLOGY

Study design: This was a retrospective cross-sectional study conducted at St. Paul's Millennium Medical College, Addis Ababa, Ethiopia. Data were collected from the medical records of 113 patients who underwent brain CT for suspected stroke between September 1, 2020, and March 31, 2021. A quantitative approach with a survey strategy was employed.

Study population and units: The source population included all patients who had a brain CT at St. Paul's Millennium Medical College during the study period. The study population comprised 113 patients with confirmed stroke on brain CT, who constituted the study units.

Data sources and data collection methods: Data were obtained from patient medical records and radiology information system (RIS) reports. A structured questionnaire (11 items) was developed in English to capture socio-demographic information, stroke type, and stroke location. Data were collected by the principal investigator and trained colleagues.

Inclusion criteria: Patients with recorded brain CT findings consistent with ischemic or hemorrhagic stroke.

Exclusion criteria: Patients' record files were incomplete concerning stroke types, and patients' demographic profiles were incorporated for this study. Files reporting Traumatic Hemorrhage.

Variables: Independent variables included socio-demographic characteristics and clinical data. Dependent variables were stroke type, site of hemorrhage, and site of infarction, identified through brain CT findings.

Data entry and analysis: Of the 2,020 patients who underwent head CT at the radiology unit during the study period, 113 were identified with stroke as the clinical indication. CT images were interpreted by a senior radiologist. Patient records were retrieved from the archives for demographic and clinical information, while imaging results were extracted from RIS. Data were entered into SPSS version 25.0 for analysis. Descriptive statistics were used to summarize findings.

RESULTS

Socio-demographic profile and stroke types

Of the 113 study participants, 60 (53%) were male and 53 (47%) were female. Hemorrhagic stroke was identified in 54 patients (47.8%), while ischemic stroke accounted for 59 cases (52.2%) (Table 1).

Site of hemorrhagic stroke

Among patients with hemorrhagic stroke, the basal ganglia were the most frequently affected site (64.2%), followed by the cerebral cortex (13.2%). Hemorrhage was located in the thalamus and other sites in 7.5% of cases each, while cerebellar hemorrhage was least common (1.9%) (Table 2).

Site of ischemic stroke

In ischemic stroke, the cerebral cortex was most frequently involved (54.2%). Multiple sites were affected in 22.0% of cases, followed by the basal ganglia (18.6%) and brainstem (5.1%) (Table 2).

Table 1: Distribution of stroke types among study participants (N = 113)

Type of Stroke	Frequency	Percent
Hemorrhage	54	47.8
Infarction	59	52.2
Total	113	100.0

Table 2: Distribution of stroke sites among patients with hemorrhagic and ischemic stroke

Site	Hemorrhagic stroke		Ischaemic stroke	
	Frequency	Percent	Frequency	Percent
Basal Ganglia	35	64.2	11	18.6
Thalamic	4	7.5		
Cerebral Cortex	7	13.2	32	54.2
Cerebellar Cortex	1	1.9		
Multiple Sites	3	5.7	13	22.0
Other Sites	4	7.5		
Brainstem			3	5.1
Total	**54**	**100.0**	**59**	**100.0**

DISCUSSION

This study found the prevalence of ischemic and hemorrhagic strokes to be 52.2% and 47.8%, respectively. These findings are comparable to reports from other African settings, where ischemic stroke generally predominates. A study in rural Kenya reported ischemic stroke in 67.4% and hemorrhagic stroke in 32.6% of cases (12). Another study from Khartoum Teaching Hospital, Sudan, similarly showed ischemic stroke at 66.4% and hemorrhagic stroke at 33.6% (13). In Ethiopia, studies from Gondar and Yirgalem also demonstrated higher proportions of ischemic stroke (57.7% and 62.1%, respectively) compared with hemorrhagic stroke (14, 15).

In contrast, some studies have reported a higher frequency of hemorrhagic stroke. In Tanzania, 60.1% of 148 stroke patients had hemorrhage (16). A study done at Jimma University found hemorrhagic stroke in 44.5% and ischemic stroke in 43.1% (17), Overall, however, most African studies report ischemic stroke as more common..

Regarding anatomical distribution, hemorrhagic stroke in this study most frequently involved the basal ganglia (64%), consistent with global evidence showing this site as the most common location for spontaneous intracranial hemorrhage (60–65%) (17). Similar results were observed in Ethiopia, where hemorrhage most often occurred in the basal ganglia (19). However, a study in Gondar reported relatively more thalamic hemorrhages (27.6%) (18).

Ischemic strokes in this study most often involved the cerebral cortex (54.2%), followed by multiple sites (22%), basal ganglia (18.6%), and brainstem (5.1%). Research done by Desta and Zewdu on CT patterns of stroke in Gondor showed similar Cerebral predominance of brain parenchymal ischemic stroke 55, 87.6%) and relatively lower percentage of basal ganglia infarction (9.4%) (18). Another comparable study done in Jimma University, Jimma, Ethiopia, showed the commonest location for ischemic stroke as cerebral hemispheres in 84(68.9%) patients, followed by basal ganglia (21.3%) (19).

CONCLUSION

Ischemic stroke was slightly more common than hemorrhagic stroke among patients undergoing brain CT at St. Paul's Hospital Millennium Medical College. The basal ganglia were the predominant site of hemorrhage, while ischemic infarcts were most frequently located in the cerebral cortex. Prospective, multicenter studies incorporating MRI findings, clinical profiles, and long-term outcomes are needed to better characterize stroke patterns and guide prevention and management strategies in Ethiopia.

Limitations

This study had several limitations. First, its retrospective cross-sectional design relied on existing medical records and radiology reports, which may have led to incomplete data capture and potential information bias. Second, it was conducted in a single tertiary hospital in Addis Ababa, limiting generalizability to other regions of Ethiopia. Third, only patients undergoing brain CT were included, excluding those diagnosed clinically or with MRI, which may underestimate true subtype distribution. Finally, long-term outcomes and risk factor control (e.g., hypertension management or recurrence) were not assessed, limiting conclusions about prognosis and treatment impact.

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Conflict of Interest: None

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