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Cerebrovascular accident and its clinico-radiological presentation in a tertiary care center

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ABSTRACT

Introduction: Stroke is a leading cause of death and disability worldwide. Accurate correlation of clinical symptoms with imaging findings is essential for prompt diagnosis and management.

Objective: To determine the incidence of ischemic and hemorrhagic stroke among admitted patients and evaluate the clinico-radiological correlation.

Methodology: A prospective observational study was conducted at the Department of Radiodiagnosis, Bir Hospital, NAMS, Kathmandu, from December 2024 to June 2025. A total of 150 patients with a clinical diagnosis of stroke who underwent CT imaging were included in the study. Clinical presentations, demographics, and imaging findings were analyzed and correlated.

Results: Among the 150 patients, 116 (77.3%) had ischemic stroke and 34 (22.7%) had hemorrhagic stroke. Hemiparesis was significantly more prevalent in ischemic stroke patients (92.2%) compared to hemorrhagic stroke patients (32.4%, $p < 0.001$). Altered sensorium (50.0% vs. 3.4%, $p < 0.001$), headache (50.0% vs. 8.6%, $p < 0.001$), vomiting (32.4% vs. 1.7%, $p < 0.001$), seizures (11.8% vs. 0.9%, $p = 0.02$), and loss of consciousness (58.8% vs. 3.4%, $p < 0.001$) were significantly more common in hemorrhagic stroke patients. The NIH Stroke Score >10 was high in both groups with no significant difference (97.4% ischemic vs. 100% hemorrhagic, $p = 0.48$).

Conclusion: The study highlights distinct clinical and radiological differences between ischemic and hemorrhagic strokes. Hemiparesis is predominantly associated with ischemic strokes, while altered sensorium, headache, vomiting, seizures, and loss of consciousness are more common in hemorrhagic strokes. Early clinical assessment combined with CT imaging remains vital.

Keywords: Cerebrovascular accident; Computed Tomography; Magnetic Resonance Imaging, Stroke

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INTRODUCTION

WHO defines stroke as the rapid onset of clinical symptoms indicating a focal disturbance of cerebral function, lasting over 24 hours or resulting in death, with no apparent cause other than vascular origin. Stroke is a leading cause of death and disability worldwide, first among neurological disorders in adults.[1,2]

Four main types of strokes are cerebral infarction, intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), and venous infarction. Cerebral infarction, usually affecting the middle cerebral artery, comprises over 75% of cases and appears hypodense on CT scans. The radiological hallmark of early infarction is

cytotoxic edema, manifesting as restricted diffusion on diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps. Furthermore, identifying a DWI-FLAIR mismatch serves as a critical biomarker to identify salvageable penumbra and guide thrombolysis in unknown-onset strokes, while susceptibility-weighted sequences (SWI/GRE) accurately detect intravascular thrombi and subtle hemorrhagic transformation.[3-5]

Non-contrast CT remains the cornerstone of initial stroke evaluation, efficiently distinguishing ischemic from hemorrhagic stroke. However, magnetic resonance imaging (MRI) offers superior diagnostic sensitivity in the hyperacute phase. Advanced modalities like MRI and 3D CTA significantly enhance diagnosis, with MRA proving specifically valuable for identifying early vascular abnormalities.[5,6] Ultimately, integrating these techniques into a multimodal approach leverages the unique strengths of each to ensure the most accurate assessment and optimal patient management. [5,8]

The study aimed to determine the incidence, along with the clinic-radiological spectrum of ischemic and hemorrhagic strokes among patients admitted to the National Academy of Medical Sciences (NAMS). This contributes to a better understanding of how these factors may influence stroke incidence and outcomes in the patients.

METHODOLOGY

This prospective observational study was conducted in the Department of Radiodiagnosis at Bir Hospital, National Academy of Medical Sciences (NAMS), Kathmandu, over six months from December 2024 to June 2025. All 150 patients admitted during the study period with a clinical diagnosis of stroke and referred for neuroimaging were included in the study. A convenient sampling technique was used to select participants who fulfilled the inclusion criteria.

The study included patients requiring radiological evaluation for a first-time stroke who presented with distinct acute neurological deficits (e.g., hemiparesis, altered consciousness) within 10 days of symptom onset. Conversely, patients were excluded if they had a history of transient ischemic attacks, prior strokes, or presented beyond the 10-day clinical window.

Demographic details, clinical history, presenting symptoms, and neurological examination findings were collected using structured formats. Clinical data were gathered through interviews, physical assessments, and review of medical records. All participants underwent non-contrast computed tomography (CT) of the head in a Philips Ingenuity- 128 slice Scanner. Magnetic Resonance Imaging (MRI) and Magnetic Resonance Angiography (MRA) were performed in Philips Achieva 1.5T machine, where additional imaging was clinically indicated. Stroke classification (ischemic or hemorrhagic) and lesion localization were determined based on radiological interpretation by the principal investigator.

During image evaluation, hemorrhagic stroke was identified by acute intraparenchymal, subarachnoid, or intraventricular hyperdensity on non-contrast CT, and by characteristic susceptibility artifacts on MRI gradient-echo (GRE) or susceptibility-weighted imaging (SWI) sequences. Conversely, early ischemic stroke on CT was defined by focal parenchymal hypodensity, loss of gray-white matter differentiation, sulcal effacement, or the hyperdense vessel sign. On MRI, acute ischemia was classified by the presence of restricted diffusion, manifesting as distinct hyperintensity on diffusion-weighted imaging (DWI) with corresponding hypointensity on apparent diffusion coefficient (ADC) maps. Additionally, a DWI-FLAIR mismatch was utilized to identify hyperacute ischemic lesions still within the therapeutic thrombolysis window.

Informed consent was obtained from all patients or their legal guardians before participation. Ethical approval for the study was obtained from the Institutional Review Board of the National Academy of Medical Sciences (reference number: 142/208283), and permission to conduct the study at the hospital was formally granted.

Patient confidentiality was strictly maintained, with all identifying information anonymized during data handling and analysis. Data were securely stored in both physical and electronic formats (Excel), accessible only to authorized study personnel.

The collected data were analysed by using statistical package for social sciences, IBM SPSS Statistics for Windows version 24 (IBM Corp., Armonk, N.Y., USA). Descriptive variables were described using frequency, percentage mean and standard deviation. Categorical variables were compared using the Chi-square test, and continuous variables were analyzed using independent sample t-tests.

RESULTS

The mean age of patients with ischemic stroke was 62.1 years (±9.7), while those with hemorrhagic stroke had

a mean age of 61.4 years (±11.3), with no significant difference between the two groups (p = 0.68). Regarding gender distribution, males accounted for 75 (64.7%) of ischemic stroke cases compared to 16 (47.1%) in hemorrhagic stroke, though this difference was not statistically significant (p = 0.07). 41(35.3%) females had ischemic stroke, and 18 (52.9%) of them had hemorrhagic stroke. Similarly, urban residence was slightly more common among hemorrhagic stroke patients (50.0%) compared to ischemic stroke patients (36.2%), but this difference was not statistically significant (p = 0.14). The prevalence of diabetes was similar between ischemic stroke, 25 patients (21.6%), and hemorrhagic stroke in 7 patients (20.6%) (p = 0.88). Likewise, hypertension was reported in 68 (58.6%) of ischemic and 19 (55.9%) of hemorrhagic stroke cases, with no significant difference (p = 0.78, Table 1).

Loss of consciousness was significantly more common in hemorrhagic stroke cases 20(58.8%) compared to ischemic stroke 4 (3.4%, p < 0.001) indicating statistically significant difference. Similarly, vomiting occurred more frequently in hemorrhagic stroke patients 11 (32.4%) than in ischemic stroke patients 2 (1.7%). This difference was highly significant (p < 0.001). However, the proportion of patients with a high NIH Stroke Score (>10) was equally high in both groups (97.4% in ischemic and 100% in hemorrhagic stroke), with no significant difference (p = 0.48).

Hemiparesis was significantly more prevalent among patients with ischemic stroke 107 (92.2%) compared to hemorrhagic stroke 11 (32.4%, p< 0.001. Likewise, clinical features such as headache (50.0% vs. 8.6%, p < 0.001), and seizures (11.8% vs. 0.9%, p = 0.02) were significantly more common in hemorrhagic stroke patients. Aphasia also demonstrated a statistically significant difference , being more frequently observed in hemorrhagic stroke patients 7 (20.6%) than ischemic stroke 8 (6.9%, p= 0.02, Table 2).

Hemiparesis was most frequently seen in patients with infarcts in the basal ganglia 23 (88.5%), ACA territory 7 (87.5%), and MCA territory 82 (81.2%). MCA stroke characteristically affects the face and arm more severely than the leg. Aphasia was most commonly associated with PCA territory infarcts 3 (33.3%), followed by basal ganglia 3 (11.5%) and posterior fossa 1 (16.7%) infarcts. Facial weakness was notably prevalent in basal ganglia infarcts 20 (76.9%) but was rare or absent in other locations. Visual symptoms were predominantly found in PCA territory infarcts 6 (66.7%), with very low occurrence in MCA, ACA, basal ganglia, and posterior fossa territories (Table 3).

Table 1: Demographic Comparison between Ischemic and Hemorrhagic Stroke Patients

Parameter	Ischemic Stroke (n=116) n(%)	Hemorrhagic Stroke (n=34) n (%)	p-value
Age (Mean±SD)	62.1 ± 9.7	61.4 ± 11.3	0.68*
Male	75 (64.7%)	16 (47.1%)	0.07†
Female	41 (35.3%)	18 (52.9%)	
Urban residence	42 (36.2%)	17 (50.0%)	0.14†
Diabetes present	25 (21.6%)	7 (20.6%)	0.88†
Hypertension present	68 (58.6%)	19 (55.9%)	0.78†

p-value significant ≤0.05, *= independent samples t-test, †=chi square test

Table 2: Clinical Characteristics of Ischemic vs Hemorrhagic Stroke

Clinical Feature	Ischemic Stroke n (%)	Hemorrhagic n (%)	p-value
Loss of Consciousness	4 (3.4%)	20 (58.8%)	<0.001†
Vomiting	2 (1.7%)	11 (32.4%)	<0.001†
NIH Stroke Score > 10	113 (97.4%)	34 (100%)	0.48†
Hemiparesis	107 (92.2%)	11 (32.4%)	< 0.001†
Aphasia	8 (6.9%)	7 (20.6%)	0.02†
Seizures	1 (0.9%)	4 (11.8%)	0.002†
Headache	10 (8.6%)	17 (50.0%)	< 0.001†

p-value significant ≤0.05, p-value highly significant ≤0.001, †= chi square test

Table 3: Distribution of Clinical features according to Infarct Location (n=150)

Infarct Location	Hemiparesis	Aphasia	Facial Weakness	Visual Symptoms
MCA territory	82 (81.2%)	8 (7.9%)	4 (4.0%)	1 (1.0%)
ACA territory	7 (87.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
PCA territory	3 (33.3%)	3 (33.3%)	0 (0.0%)	6 (66.7%)
Basal ganglia	23 (88.5%)	3 (11.5%)	20 (76.9%)	0 (0.0%)
Posterior fossa	3 (50.0%)	1 (16.7%)	0 (0.0%)	0 (0.0%)

Figure 1: Non-contrast Computed tomography showing ischemic stroke in the territory of the left anterior cerebral artery and middle cerebral artery

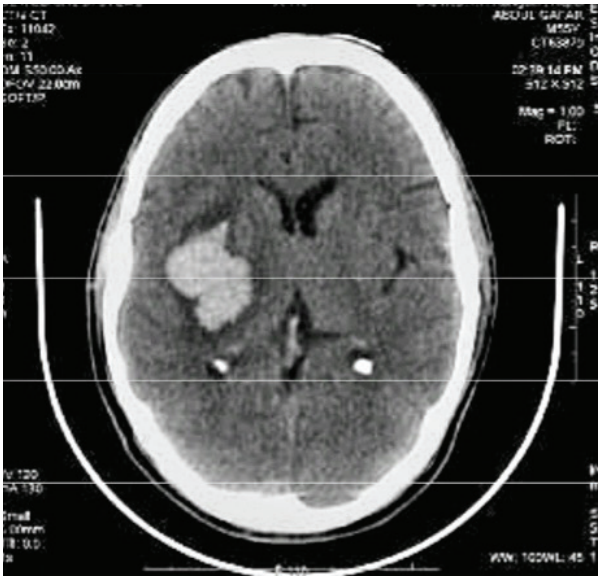

Figure 3: Non-contrast Computed tomography showing hemorrhagic stroke in the left gangliocapsular region.

Figure 2: Non-contrast Computed tomography showing ischemic stroke in the right gangliocapsular region

Figure 4: Non-contrast Computed tomography showing hemorrhagic stroke in mid brain.

DISCUSSION

In our study, ischemic strokes accounted for the majority of cases, consistent with the 65.4% ischemic stroke incidence reported in the other study. This finding aligns with global data, which indicates ischemic stroke is more prevalent than hemorrhagic stroke.[9] A study showed that Ischemic stroke constituted 62·4% of all incident strokes in 2019 (7·63 million [6·57–8·96]), while intracerebral hemorrhage constituted 27·9% (3·41 million [2·97–3·91]) and subarachnoid hemorrhage constituted 9·7% (1·18 million [1·01–1·39]).[10] Another study also supports these findings, with Ischemic stroke, hemorrhagic stroke, and subarachnoid hemorrhage accounting for 124 (45.9%), 34 (12.6%), and 4 (1.5%), respectively.[11] These findings highlight the distinct clinical presentations associated with different types of stroke, which may aid in initial bedside diagnosis and guide urgent neuroimaging decisions.

Similarly, our study showed distinct clinical-radiological patterns between ischemic and hemorrhagic strokes, which are consistent with findings from the study of Abdu H. et al. and stroke collaborators, 2019 .[9,11] Hemiparesis was significantly more prevalent in ischemic stroke patients (92.2%) compared to hemorrhagic stroke patients (32.4%) (p <0.001). This finding aligns with studies from South Asia, including Nepal and India, where ischemic strokes predominantly cause focal motor deficits due to artery occlusion and localized brain ischemia.[12-15] A study from Modi et al. revealed that the most common clinical finding was hemiparesis (87%), followed by speech abnormalities (41%).[16]

Conversely, features such as loss of consciousness (54.0% vs. 3.4%), headache (50.0% vs. 8.6%), and seizures (11.8% vs. 0.9%) were significantly more common in hemorrhagic stroke patients than ischemic stroke. These symptoms reflect the effects of intracranial bleeding, such as increased intracranial pressure and irritation of the brain parenchyma, which have been reported consistently in different studies.[14] Likewise, our study showed a clear correlation between infarct location and specific clinical features in stroke patients. Hemiparesis was most frequently observed in infarcts involving the basal ganglia (88.5%), ACA territory (87.5%), and MCA territory (81.2%), and facial weakness was notably frequent in basal ganglia infarcts (76.9%), which correlates with the involvement of corticobulbar fibers passing through this region. Other findings also showed that MCA territory infarcts (54%) and Basal ganglia complex bleed (57%) were the most common presentation in ischemic and hemorrhagic strokes respectively.[16] Other findings also indicated that the motor deficits are commonly associated with ischemic events.[9]

Similarly, another study also observed that stroke mostly occurred in the MCA vascular territory, while the least was the ACA vascular territory.[11] The preponderant involvement of the MCA is attributed to its relatively wide caliber, and the direct continuity of the MCA with the internal carotid artery makes it more susceptible to direct transmission of thrombus. The findings here show good congruence with results shown by the Alberta stroke program.[17]

Similarly, in our study, the demographic comparison between ischemic and hemorrhagic stroke patients showed no statistically significant differences in mean age, sex distribution, diabetes, hypertension prevalence, or urban residence, aligning well with findings in different populations. Similarly, a common finding from different studies was the predominance of stroke cases among individuals aged 45 years and above, highlighting age as a significant risk factor.[(9)] Similarly, in Kumasi Ghana, major stroke risk factors included hypertension (85%), physical inactivity (73%), and obesity (58%), with most patients having multiple poorly controlled risk factors. The in-patient fatality rate was high (43%), particularly in hemorrhagic strokes. Age was the strongest risk factor, with stroke incidence doubling every decade after age 55. Survivors often faced severe functional impairment.[18] Similarly, another study also highlights that those aged ≥65 years were associated with a worse ASPECTS score with AOR: 22.01, (95% CI: 1.58–306.09) and $p = 0.021$.[(7)] and the study from India also showed that ischemic Stroke and Hemorrhagic stroke mean ageswere 53.28±13.94 years and 56.35±11.73 years, respectively. [12]

In our study regarding gender distribution, males accounted for 64.7% of ischemic stroke cases compared to 47.1% in hemorrhagic stroke, though this difference was not statistically significant (p = 0.07). Females represented 35.3% of ischemic and 52.9% of hemorrhagic stroke patients, whereas in another study by Vincent et al., 141 (52.2%) were male, which is slightly lower than our findings.[11] A study from India reported a higher incidence of ischemic stroke in male patients, with 52 cases (65%), while in hemorrhagic stroke, 11 patients (55%) were male. However, the difference was not statistically significant. [11] even though the gender distribution often shows a male predominance in ischemic stroke and a relatively higher proportion of females in hemorrhagic

stroke, although statistical significance may be absent or vary by study. In our study, hypertension was present in 58.6% of ischemic and 55.9% of hemorrhagic stroke patients, closely matching the other study's findings of 39.8% and 23.4%, respectively.[9] Ischemic stroke had a higher mortality rate (15.3%) compared to hemorrhagic stroke (6.5%). Hypertension was the leading predictor of death in both stroke types.[9]

Similarly, our study highlights that loss of consciousness, vomiting, and seizures are more frequently associated with hemorrhagic strokes, while the severity of stroke as measured by NIHSS >10 does not differ significantly between the two types. This pattern reflects the effects of increased intracranial pressure and brain irritation caused by bleeding. Another study also showed that the clinical features limb weakness (55.2%), headache (41.1%), and loss of consciousness (39.3%) were associated with stroke findings on CT also Among the acute ischemic strokes, the majority of patients (73.2%) had a worse (0–7) ASPECT score.[11]

CONCLUSION

The study demonstrated that ischemic stroke was more common than hemorrhagic stroke. Hemiparesis was the most frequent feature in ischemic stroke, while loss of consciousness, vomiting, and altered sensorium were significantly associated with hemorrhagic stroke. CT imaging played a key role in confirming stroke type. Clinical features showed strong correlation with radiological findings, emphasizing the value of early imaging and clinical assessment in stroke management.

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