Original Article

Magnetic Resonance Imaging Findings in Acute Stroke Patients: Correlation with Clinical Outcomes

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Abstract

Background: Acute stroke is a major cause of death and long-term disability worldwide, with rising incidence in low- and middle-income countries. Magnetic resonance imaging (MRI) enables early detection of ischemic and hemorrhagic stroke and may provide prognostic information. However, prospective data correlating MRI findings with clinical outcomes in Bangladesh remain limited.

Objective: To assess magnetic resonance imaging findings in acute stroke patients and evaluate their correlation with clinical outcomes.

Methods: This prospective cohort study was conducted at the National Institute of Ophthalmology & Hospital from January to December 2025. A total of 80 purposively selected patients presenting within 72 hours of symptom onset underwent brain MRI. Imaging variables included stroke type, lesion size, vascular territory, cortical involvement, diffusion restriction, and hemorrhagic transformation. Data were analyzed using SPSS version 23.0. Statistical significance was set at $p<0.05$.

Results: Among the participants, 62 (**77.5**%) had ischemic stroke and **18** (**22.5**%) had hemorrhagic stroke. Larger lesions (>30 mm) were significantly associated with unfavorable outcomes (mRS ≥3) ($p=0.002$). Cortical involvement showed a significant relationship with higher NIHSS scores and poor recovery ($p=0.01$). Diffusion-weighted imaging abnormalities demonstrated a strong positive correlation with baseline NIHSS scores ($r=0.68$, $p<0.001$). Hemorrhagic transformation occurred in 6 (12%) ischemic cases and was significantly associated with poor prognosis ($p=0.03$).

Conclusion: MRI findings, particularly lesion size, cortical involvement, and diffusion restriction, significantly correlate with short-term clinical outcomes in acute stroke patients. Early MRI assessment may improve prognostication and management decisions.

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Introduction

Stroke is a leading cause of death and long-term disability worldwide, accounting for substantial morbidity, mortality, and socioeconomic burden.[1] Recent global estimates indicate that the incidence and prevalence of stroke continue to rise, particularly in low- and middle-income countries, where healthcare resources and access to advanced diagnostic modalities remain limited.[2] South Asia bears a disproportionate share of this burden, with increasing rates attributed to population aging, urbanization, and a high prevalence of vascular risk factors such as hypertension, diabetes mellitus, dyslipidemia, and smoking.[3,4] In Bangladesh, stroke represents a significant public health concern, contributing to considerable disability-adjusted life years and healthcare expenditure.[5] Acute stroke is broadly categorized into ischemic and hemorrhagic types, each with distinct pathophysiological mechanisms and management strategies.[6] Ischemic stroke, resulting from arterial occlusion, accounts for approximately 60–80% of cases, whereas intracerebral hemorrhage comprises a smaller but more fatal proportion.[7] Rapid and accurate differentiation between these subtypes is essential, as therapeutic interventions such as thrombolysis and mechanical thrombectomy are time-sensitive and primarily indicated for ischemic events.[8] Neuroimaging plays a central role in the evaluation of acute stroke. While computed tomography (CT) remains widely available and useful for detecting hemorrhage, magnetic resonance imaging (MRI) offers superior sensitivity in identifying early ischemic changes, small infarcts, and posterior circulation strokes.[9] Diffusion-weighted imaging (DWI), in particular, has emerged as a highly sensitive modality for detecting acute ischemia within minutes of symptom onset.[10] Furthermore, advanced MRI sequences, including fluid-attenuated inversion recovery (FLAIR), susceptibility-weighted imaging (SWI), and perfusion-weighted imaging (PWI), provide valuable information regarding infarct core, penumbra, hemorrhagic transformation, and microvascular integrity.[11] Beyond diagnosis, MRI findings have demonstrated prognostic significance. Lesion volume, cortical involvement, infarct location, and presence of hemorrhagic transformation have been associated with stroke severity and functional outcomes measured by scales such as the National Institutes of Health Stroke Scale (NIHSS) and the modified Rankin Scale (mRS).[12] Early identification of imaging markers linked to poor prognosis can guide clinical decision-making, optimize resource allocation, and inform rehabilitation planning.[13] Despite advances in neuroimaging, there remains limited prospective evidence from Bangladesh correlating MRI findings with short-term clinical outcomes in acute stroke patients. Most available data are derived from high-income settings, which may not reflect local demographic patterns, risk profiles, and healthcare infrastructure. Therefore, a prospective cohort study evaluating magnetic resonance imaging findings and their relationship with clinical outcomes in a tertiary care center in Dhaka is warranted. Such evidence may contribute to improved stroke management strategies and better prognostic assessment in the regional context.

Methods

This prospective cohort study was conducted at the National Institute of Ophthalmology & Hospital from January 2025 to December 2025. A total of 80 patients with clinically suspected acute stroke were enrolled using purposive sampling. Patients came with stroke symptoms to the Radiology & Imaging Department of National Institute of Ophthalmology and Hospital, for magnetic resonance imaging (MRI) within 72 hours of symptom onset were considered eligible for participation.

Inclusion criteria: Patients aged ≥18 years of either sex presenting with sudden-onset focal neurological deficits suggestive of acute stroke and confirmed by MRI were included. Only those who underwent MRI within 72 hours of symptom onset and provided written informed consent (from patient or attendant) were enrolled.

Exclusion criteria: Patients with a history of previous stroke with residual deficits, traumatic brain injury, brain tumors, central nervous system infections, demyelinating disorders, or contraindications to MRI (e.g., pacemaker, metallic implants) were excluded. Critically ill patients unable to complete imaging or follow-up assessments were also excluded.

Study procedure: Detailed clinical history, risk factors, and neurological examination findings were recorded. Stroke severity was assessed using the National Institutes of Health Stroke Scale (NIHSS) at admission. MRI sequences included diffusion-weighted imaging (DWI), FLAIR, T1-, T2-, and susceptibility-weighted imaging. Lesion size, type, vascular territory, cortical involvement, and hemorrhagic transformation were documented. Functional outcome was evaluated at 3 months using the modified Rankin Scale (mRS).

Data analysis: Data were entered and analyzed using SPSS version 23.0. Descriptive statistics were expressed as mean ±SD or frequency and percentage. Chi-square test, Pearson's correlation, and logistic regression analyses were applied. A p-value <0.05 was considered statistically significant.

Result

A total of 80 patients with acute stroke were enrolled in this study. The mean age of the participants was 61.4 ± 11.2 years, with the majority (35.0%) belonging to the 61–70 years age group. Male patients constituted 68.8% (n=55), while females accounted for 31.2% (n=25). Hypertension was the most common risk factor (68.8%), followed by diabetes mellitus (46.3%), dyslipidemia (32.5%), and smoking (38.8%). Regarding stroke type, 77.5% (n=62) of patients were diagnosed with ischemic stroke and 22.5% (n=18) with hemorrhagic stroke. Among ischemic strokes, the middle cerebral artery (MCA) territory was most frequently involved (56.0%), followed by the posterior circulation (22.0%) and the anterior cerebral artery territory (14.0%). Hemorrhagic strokes most commonly involved the basal ganglia (46.7%). MRI findings revealed that 40.0% of patients had lesion sizes greater than 30 mm, while 60.0% had lesions ≤30 mm. Cortical involvement was observed in 48.8% of cases. Diffusion-weighted imaging (DWI) restriction was present in all ischemic strokes and absent in primary hemorrhagic strokes. Hemorrhagic transformation occurred in 12.0% of ischemic stroke patients. At admission, 43.8% of patients had moderate stroke severity (NIHSS 5–15), while 31.2% had severe stroke (NIHSS >15). At 3-month follow-up, 41.3% of patients had unfavorable functional outcomes (modified Rankin Scale ≥3). Larger lesion size (>30 mm) was significantly associated with poor functional outcome compared to smaller lesions (62.5% vs. 27.1%, p=0.002). Cortical involvement also showed a significant association with unfavorable outcome (56.4% vs. 27.5%, p=0.010). A strong positive correlation was observed between lesion size and baseline NIHSS score (r=0.684, p<0.001). Hemorrhagic transformation was significantly associated with poor outcome (83.3% vs. 35.7%, p=0.030). Logistic regression analysis identified lesion size >30 mm (OR=3.42, p=0.004) and cortical involvement (OR=2.76, p=0.018) as independent predictors of unfavorable outcome.

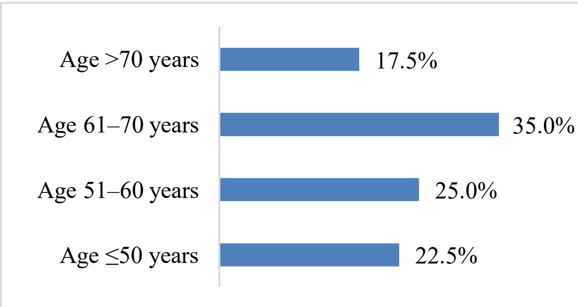

Figure 1. Age Distribution of Participants (N=80)

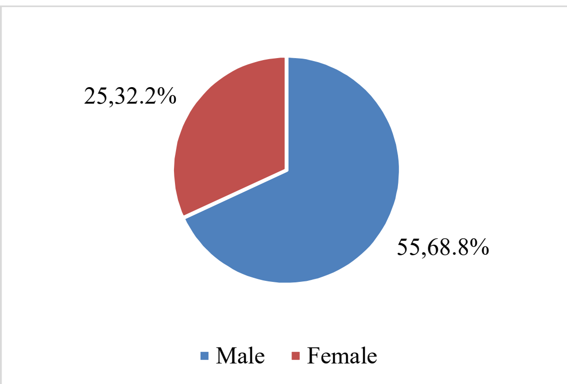

Figure 2. Gender Distribution of Participants

Table I: Distribution of vascular risk factors

Risk factor	n	%
Hypertension	55	68.8
Diabetes mellitus	37	46.3
Dyslipidemia	26	32.5
Smoking	31	38.8
Ischemic heart disease	14	17.5

Table II: MRI characteristics of stroke patients

MRI finding	n	%
Ischemic stroke	62	77.5
Hemorrhagic stroke	18	22.5
Lesion size >30 mm	32	40.0
Cortical involvement	39	48.8
HT*	6	7.5

HT: Hemorrhagic transformation, *Among ischemic stroke patients (n=50), †Percentage calculated from ischemic stroke cases

Table III: Association between lesion size and functional outcome

Lesion size	Favorable (mRS <3) n (%)	Unfavorable (mRS ≥3) n (%)
≤30 mm (n=48)	35 (72.9)	13 (27.1)
>30 mm (n=32)	12 (37.5)	20 (62.5)

p = 0.002, Chi-square test applied.

Table IV: Association between cortical involvement and functional outcome

Involvement	Favorable n (%)	Unfavorable n (%)
Present (n=39)	17 (43.6)	22 (56.4)
Absent (n=41)	30 (72.5)	11 (27.5)

p = 0.010, Chi-square test applied.

Table V: Logistic regression analysis for predictors of unfavorable outcome (mRS ≥3)

Variable	OR	p-value
Lesion size >30 mm	3.420	0.004
Cortical involvement	2.760	0.018
Hemorrhagic transformation	2.950	0.030

Binary logistic regression analysis applied.

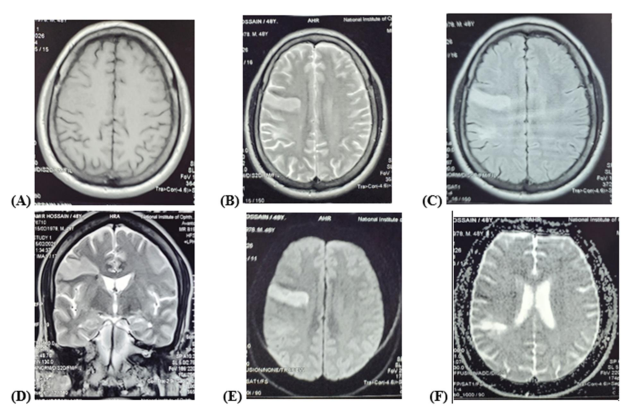

Figure 3. Case Of Acute Ischemic Stroke at Right Frontal Lobe, Lesion Isointense on T1WI, Hyperintense on T2WI & FLAIR, High Signal on DWI & Low Signal On ADC.

Discussion

The present prospective cohort study evaluated magnetic resonance imaging (MRI) findings in acute stroke patients and examined their correlation with short-term clinical outcomes. Our findings demonstrated that ischemic stroke constituted the majority (77.5%) of cases, with the middle cerebral artery territory most frequently involved. These observations are consistent with recent global and regional reports indicating that ischemic stroke accounts for approximately two-thirds of all stroke cases, particularly in low- and middle-income countries. [14,15] Hypertension emerged as the most prevalent risk factor (68.8%), followed by diabetes mellitus and smoking. This pattern aligns with contemporary epidemiological data highlighting hypertension as the single most important modifiable risk factor for both ischemic and hemorrhagic stroke.[16] South Asian populations, including Bangladesh, demonstrate a high burden of poorly controlled vascular risk factors, contributing to increased stroke incidence and severity. [17] In our study, larger lesion size (>30 mm) was significantly associated with unfavorable functional outcome (p=0.002), and logistic regression confirmed lesion size as an independent predictor (OR=3.420, p=0.004). These findings are supported by recent imaging-based studies demonstrating that infarct volume strongly correlates with baseline neurological deficit and long-term disability.[18,19] Larger infarcts reflect extensive neuronal damage and reduced collateral perfusion, which adversely affect recovery potential. The strong positive correlation observed between lesion size and baseline NIHSS score (r=0.684, p<0.001) further substantiates the prognostic value of early MRI quantification of infarct burden. Cortical involvement was another significant determinant of poor outcome in our cohort (p=0.010). Cortical strokes often disrupt higher cognitive and motor functions, leading to more pronounced disability compared to subcortical lesions. Similar associations between cortical infarction and unfavorable modified Rankin Scale (mRS) outcomes have been reported in multicenter imaging studies.[20] Advanced MRI techniques, particularly diffusion-weighted imaging (DWI), enable precise localization of cortical ischemia at an early stage, thereby facilitating risk stratification. Hemorrhagic transformation occurred in 12.0% of ischemic stroke cases and was significantly associated with poor prognosis (p=0.030). This complication has been increasingly recognized in the reperfusion era and is linked to blood–brain barrier disruption and large infarct core volume.[21] Previous prospective analyses have similarly demonstrated that hemorrhagic transformation predicts increased mortality and disability, particularly when associated with mass effect.[22] The proportion of patients with unfavorable functional outcome at 3 months (41.3%) in our study is comparable to findings from recent regional cohorts.[23] Early MRI-based predictors, including infarct size and cortical involvement, may therefore serve as practical markers to identify high-risk patients who may benefit from closer monitoring, aggressive secondary prevention, and early rehabilitation. Our findings reinforce the clinical utility of MRI not only as a diagnostic tool but also as a prognostic instrument in acute stroke management. Current international guidelines emphasize imaging-based decision-making for reperfusion therapy and outcome prediction.[24] In resource-limited settings such as Bangladesh, optimizing MRI utilization may enhance individualized care planning and improve functional recovery. Nevertheless, certain limitations must be acknowledged. The sample size was relatively small and derived from a single tertiary center, which may limit generalizability. Additionally, advanced perfusion imaging parameters were not quantitatively analyzed. Future multicenter studies incorporating larger cohorts and advanced imaging biomarkers are recommended to validate and expand upon these findings .[25]

Limitations

This study had several limitations, including a relatively small sample size and a single-center design at the National Institute of Ophthalmology & Hospital, which may limit generalizability. Additionally, advanced perfusion imaging parameters and long-term outcomes beyond three months were not assessed.

Conclusion

Magnetic resonance imaging findings—particularly lesion size, cortical involvement, and hemorrhagic transformation—demonstrate significant correlation with short-term functional outcomes in acute stroke patients. Early MRI evaluation facilitates accurate prognostication, risk stratification, and individualized management planning. Incorporating imaging-based predictors into routine clinical assessment may improve decision-making and optimize rehabilitation strategies, especially in resource-limited tertiary care settings in Bangladesh.

Recommendation

It is recommended that early magnetic resonance imaging be routinely performed in all eligible acute stroke patients to aid prognostication and management decisions. Larger multicenter studies incorporating advanced imaging modalities and longer follow-up periods are advised to validate and expand these findings.

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