



"ROLE OF MRI IN EVALUATION OF STROKE"

Krishn Nandania*

Post Graduate Student, Department Of Radiodiagnosis, GCS Medical College, Hospital And Research Institute, Ahmedabad *Corresponding Author

Ajay Upadhyay

Professor, Department Of Radiodiagnosis, GCS Medical College, Hospital And Research Institute, Ahmedabad

ABSTRACT

Background: Stroke is a leading cause of morbidity and mortality globally, with ischemic stroke being the most common subtype. Accurate and timely imaging is essential for diagnosis, classification, and management. Magnetic Resonance Imaging (MRI) offers superior sensitivity in identifying ischemic changes and vascular territories involved. **Objective:** To evaluate the role of MRI in assessing the territory of involved intracranial blood vessels in patients clinically suspected of stroke. **Methods:** This cross-sectional observational study included 30 patients with clinical signs of stroke who underwent MRI brain evaluation at the Department of Radiodiagnosis, GCS Medical College and Hospital, Ahmedabad, over a 12-month period. MRI scans were performed using a 1.5 Tesla system with standard stroke protocol sequences. Imaging findings were analyzed to determine stroke type and vascular territory involved. **Results:** The mean age of patients was 58.4 ± 13.2 years, with a male predominance (63.3%). Ischemic stroke was the most common type (70%), followed by intracerebral hemorrhage (20%) and cerebral venous thrombosis (10%). The middle cerebral artery (MCA) territory was the most frequently involved (50%), followed by posterior cerebral artery (20%), anterior cerebral artery (10%), and others. Diffusion-weighted imaging (DWI) and MR angiography (TOF-MRA) were instrumental in early lesion detection and vascular assessment. **Conclusion:** MRI is a non-invasive and radiation-free imaging modality that plays a critical role in the early and accurate diagnosis of stroke, particularly in localizing the vascular territory involved. Routine use of MRI in acute stroke cases can significantly enhance diagnostic accuracy and guide therapeutic decision-making.

KEYWORDS : Stroke, MRI, Ischemic stroke, Vascular territory, Middle cerebral artery, Diffusion-weighted imaging, MR angiography

INTRODUCTION

Stroke is a major public health concern and a leading cause of morbidity and mortality worldwide. It is characterized by the sudden loss of brain function due to an interruption in blood supply, either by occlusion (ischemic stroke) or rupture (hemorrhagic stroke) of cerebral vessels. Among these, ischemic strokes account for approximately 85% of all stroke cases globally [1].

Hemorrhagic types include primary intracerebral hemorrhage, non-traumatic subarachnoid hemorrhage, and less common forms like dural sinus and cerebral vein thrombosis.

Globally, according to the Global Burden of Disease Study 2019, stroke was the second-leading cause of death and the third-leading cause of disability-adjusted life years (DALYs) [2]. In India, the estimated age-adjusted annual incidence of stroke ranges from 116 to 163 per 100,000 population, with recent trends showing a rise in younger age groups [3]. Gujarat-specific data indicate a rising burden, with regional stroke registries reporting increasing admissions, especially in urban centers like Ahmedabad [4].

Imaging plays a pivotal role in the diagnosis, classification, and management of stroke. While CT scan remains the first-line imaging tool in emergency settings due to its availability and speed, MRI is superior in detecting acute ischemia, posterior circulation infarcts, and small lacunar infarcts, owing to its excellent soft-tissue contrast and sensitivity to early parenchymal changes [5,6]. MRI with diffusion-weighted imaging (DWI) and MR angiography can assess both brain parenchyma and vascular territories, providing a comprehensive evaluation without radiation exposure.

Despite its diagnostic superiority, the use of MRI in stroke evaluation remains underutilized in several centers, especially in resource-limited settings. This study is designed to assess the role of MRI in evaluating the territory of the involved intracranial blood vessels in patients clinically

suspected of stroke. Understanding stroke patterns on MRI can aid in precise localization, prompt treatment, and better outcomes.

Aims and Objectives: To evaluate the role of MRI in the assessment of the territory of involved intracranial blood vessels in patients with suspected stroke.

Justification and Future Aspects: This study is significant in the context of rising stroke incidence in India and the need for non-invasive, radiation-free, high-resolution imaging to guide management. The findings will contribute to better understanding of regional vascular involvement and may influence imaging protocols and treatment algorithms.

Materials And Methodology

This cross-sectional observational study was conducted in the Department of Radiodiagnosis, GCS Medical College, Hospital and Research Centre, Ahmedabad. The study duration spanned 12 months, from May 2023 to April 2024, after obtaining approval from the Institutional Ethics Committee.

The study population included patients of all age groups who presented with clinical signs suggestive of stroke, such as facial weakness, limb weakness, and slurring of speech, and were referred for MRI evaluation. A total of 30 patients were included in the study based on a predefined sampling approach.

The inclusion criteria comprised patients of any age and gender who presented with acute or subacute neurological deficits clinically suspected to be of vascular origin. The exclusion criteria included patients with contraindications to MRI, such as those with cardiac pacemakers, metallic surgical implants, aneurysm clips, prosthetic heart valves, or a known history of claustrophobia. Patients with known intracranial space-occupying lesions or prior history of stroke were also excluded to avoid diagnostic overlap.

Sample size calculation was based on a pilot estimate using the formula $n = 4pq/l^2$, considering a prevalence (p) of stroke detection using MRI as 85%, with 10% allowable error (l). Thus, $n = 4 \times 85 \times 15 / 10^2 = 51$. However, due to limited resources and the use of purposive sampling, a sample size of 30 patients was finalized.

MRI Brain scans were performed using a 1.5 Tesla GE SIGNA EXPLORER MRI scanner, equipped with a dedicated head coil. Standard stroke protocol sequences were obtained, including T1-weighted, T2-weighted, FLAIR, DWI, ADC mapping, GRE/SWI, TOF-MRA, and where necessary, post-contrast T1-weighted sequences. The imaging findings were systematically assessed for the presence, type, location, and territory of stroke, including involvement of anterior cerebral artery (ACA), middle cerebral artery (MCA), posterior cerebral artery (PCA), vertebrobasilar system, and their branches.

All data were documented in a structured format, and imaging findings were correlated with clinical presentation. Data analysis was carried out using Microsoft Excel and SPSS version 26. Categorical variables were expressed as frequencies and percentages. Continuous variables were summarized using mean and standard deviation. Chi-square test and Fisher's exact test were applied for categorical associations, with a p-value < 0.05 considered statistically significant.

Ethical considerations were strictly adhered to. All patients or their legal guardians provided informed written consent prior to participation.

RESULTS

In the present study, 30 patients clinically suspected of stroke underwent MRI evaluation to identify the vascular territory involved and characterize the stroke subtype.

The mean age of patients was 58.4 ± 13.2 years, with the majority of cases (60%) falling in the 51–70 years age group. There was a male predominance observed, with 19 (63.3%) males and 11 (36.7%) females, indicating a higher incidence of stroke in males.

Among the stroke types observed, ischemic stroke was the most frequent, seen in 21 patients (70%), followed by intracerebral hemorrhage (ICH) in 6 cases (20%), and cerebral venous thrombosis (CVT) in 3 patients (10%).

Diffusion-weighted imaging (DWI) played a crucial role in identifying acute ischemic lesions, which were hyperintense on DWI and hypointense on ADC sequences.

With regard to vascular territory, the middle cerebral artery (MCA) territory was the most commonly affected, involved in 15 patients (50%), followed by the posterior cerebral artery (PCA) territory in 6 cases (20%), anterior cerebral artery (ACA) in 3 cases (10%), basilar artery territory in 2 cases (6.7%), and multiple territories in 4 cases (13.3%).

GRE/SWI sequences helped identify microbleeds and hemorrhagic foci, particularly in patients with ICH and CVT. MR angiography (TOF-MRA) demonstrated arterial occlusion or reduced flow in respective vascular segments, supporting parenchymal findings.

Table 1A: Type of Strokes from Study Findings

Stroke Type	Frequency	Percentage
Ischemic Stroke	21	70.0%
Intracerebral Hemorrhage	6	20.0%
Cerebral Venous Thrombosis (CVT)	3	10.0%

Table 1B: Type of Strokes from Study Findings

Vascular Territory Involved	Frequency	Percentage
MCA Territory	15	50.0%
PCA Territory	6	20.0%
ACA Territory	3	10.0%
Basilar Artery	2	6.7%
Territory		
Multiple Territories	4	13.3%

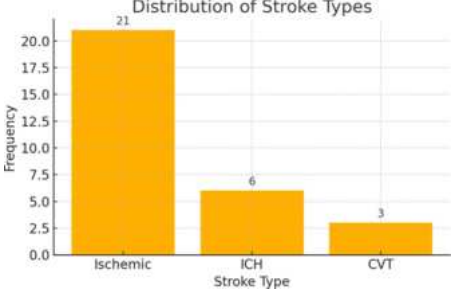
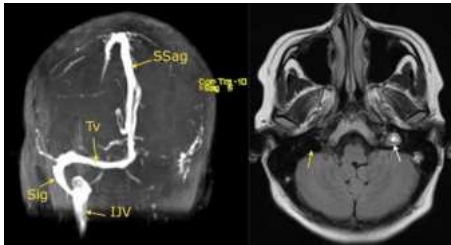
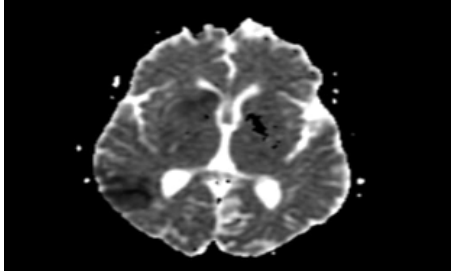


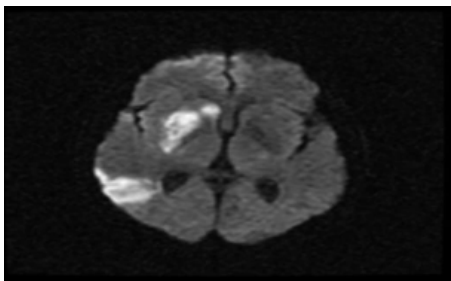
Figure 1: Distribution of Stroke Types among Study Participants



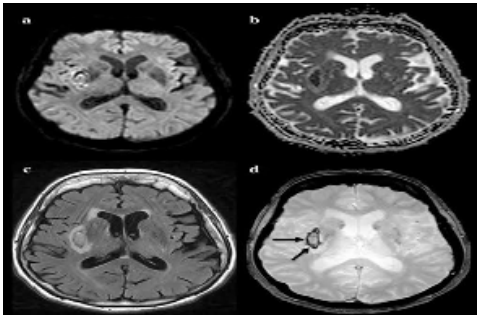
Central Venous Thrombosis



Ischemic Stroke (Apparent Diffusion coefficient image)



Ischemic stroke (diffusion weighted imaging)



Hemorrhagic stroke

DISCUSSION

In this study, MRI proved to be a valuable diagnostic modality in evaluating stroke, particularly in localizing the vascular territory involved and characterizing the stroke subtype. Among the 30 patients evaluated, ischemic stroke was the most common subtype (70%), followed by intracerebral hemorrhage (20%) and cerebral venous thrombosis (10%). The middle cerebral artery (MCA) territory was the most frequently involved vascular region (50%).

The predominance of ischemic stroke in our study is consistent with findings from previous epidemiological studies. Bhatnagar et al. (2015) reported ischemic strokes in 68–85% of cases among Indian patients, which aligns with our data [1]. Similarly, the Indian Stroke Clinical Trial Network (INSTRuCT) registry (2021) also highlighted ischemic stroke as the most prevalent type, especially in older males [2].

The male predominance observed in this study (63.3%) mirrors results from Pandian et al. (2013) who found a male-to-female ratio of approximately 1.7:1 in North India [3]. This gender disparity may be attributed to higher prevalence of hypertension, smoking, and diabetes among Indian males, along with gender-based differences in health-seeking behavior.

In terms of vascular territory, the MCA territory was affected in 50% of our cases, which is in accordance with studies by Mattle et al. (2005) and Lee et al. (2010), who both reported that MCA strokes account for nearly half of all ischemic events due to the size and perfusion area of the vessel [4,5].

The role of MRI, especially diffusion-weighted imaging (DWI), was crucial in early detection of ischemic changes. DWI has been shown to detect ischemic lesions within minutes of onset, far earlier than conventional MRI or CT. Tong et al. (1998) demonstrated that DWI could detect 96% of acute infarcts within the first 3 hours, making it indispensable in stroke imaging [6].

MR angiography (MRA) using Time-of-Flight (TOF) sequences further allowed non-invasive visualization of vascular occlusion. These findings supported those of Chalela et al. (2007), who highlighted the use of MRA in evaluating large vessel occlusion and aiding therapeutic decision-making [7]. Our study also corroborated the use of GRE/SWI sequences in identifying hemorrhagic transformation and microbleeds, consistent with findings from Kidwell et al. (2002) [8].

The small percentage of cerebral venous thrombosis (CVT) cases (10%) in our study showed typical findings of hemorrhagic infarcts with prominent cortical venous flow voids on GRE sequences, reinforcing the need for MRI in cases with atypical presentations. Rajput et al. (2018) emphasized the diagnostic superiority of MRI and MR venography in CVT detection, particularly in young females [9].

CONCLUSION

This study demonstrates that MRI is an essential and highly effective imaging modality in the evaluation of stroke. It enables early and accurate identification of ischemic and hemorrhagic strokes, delineation of the involved intracranial vascular territories, and detection of subtle parenchymal abnormalities that may be missed on CT. The combination of diffusion-weighted imaging, MR angiography, and susceptibility-weighted sequences offers a comprehensive non-invasive assessment without radiation exposure.

The most common type of stroke in our study population was ischemic stroke, with the middle cerebral artery territory being most frequently involved. These findings reinforce the importance of using MRI, especially in cases where clinical

presentation may be ambiguous or posterior circulation stroke is suspected.

Thus, MRI plays a pivotal role in timely diagnosis, localization, and management planning in patients with suspected stroke and should be considered the preferred imaging modality wherever available.

Limitations And Recommendations

Limitations:

1. Small sample size limits generalizability.
2. Single-center study may not reflect wider population.
3. No follow-up imaging was included to assess lesion evolution.
4. Clinical outcome scores were not correlated with imaging findings.
5. Vascular imaging was limited to TOF-MRA without contrast-based techniques.

Recommendations:

1. Conduct larger, multicentric studies for broader applicability.
2. Include follow-up imaging and clinical outcome correlations.
3. Consider contrast-enhanced MRA or DSA for detailed vascular mapping.
4. Promote routine use of MRI in stroke protocols.
5. Enhance MRI accessibility and training in peripheral healthcare centers.

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