Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 22: Issue: 01 |Year: 2025
Page Number: 827-832

STUDY OF MAGNETIC RESONANCE ANGIOGRAPHY IN EVALUATION OF PATIENTS OF ACUTE ISCHEMIC STROKE AT TERTIARY CARE HOSPITAL

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Article Received: 14-04-2025

Article Accepted:01-06-2025

Abstract

Background: Acute ischemic stroke is a leading cause of morbidity and mortality worldwide. Rapid and accurate diagnosis of vascular occlusion is critical for effective management. Magnetic Resonance Angiography (MRA) offers a non-invasive method to visualize cerebral vessels and identify occlusions or stenosis.
Objective: To evaluate the role of MRA in the assessment of patients presenting with acute ischemic stroke in a tertiary care hospital.
Methods: This cross-sectional study included 174 patients aged above 18 years presenting with stroke symptoms. MRA combined with brain MRI was performed using a 1.5 Tesla MRI machine. Clinical data, stroke symptoms, duration, comorbidities, and radiological findings were analyzed. Statistical analysis was conducted using SPSS version 23.
Results: The majority of patients were male (72%) with a mean age of 43.5 ± 21.21 years. Common symptoms included arm weakness (29%) and face drooping (22%). Large vessel anterior circulation stroke (33%) was the most frequent clinical diagnosis. MRA detected large vessel occlusion in 26% of cases, while acute infarcts were seen in 41% on MRI. Hypertension (27%) and diabetes (20%) were the most prevalent comorbidities.
Conclusion: MRA is a valuable imaging modality in acute ischemic stroke for detecting large vessel occlusions and guiding treatment. Its non-invasive nature and diagnostic accuracy make it essential in tertiary care stroke evaluation.

Keywords; Acute Ischemic Stroke, Magnetic Resonance Angiography (MRA), Large Vessel Occlusion, Brain MRI, Stroke Diagnosis, Cerebral Vascular Imaging

INTRODUCTION

Stroke is a leading cause of morbidity and mortality worldwide, characterized by a sudden onset of neurological deficits due to an interruption of cerebral blood flow. It is broadly classified into ischemic and hemorrhagic types, with ischemic stroke accounting for approximately 80% of all cases [1]. The World Health Organization (WHO) defines stroke as a "rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin" [2]. Early and accurate diagnosis of acute ischemic stroke is crucial for initiating appropriate treatment and improving patient outcomes.

Neuroimaging plays a pivotal role in the diagnosis and management of acute stroke. While computed tomography (CT) is commonly used due to its wide availability and rapid acquisition time, magnetic resonance imaging (MRI) offers superior sensitivity in detecting early ischemic changes [3]. Magnetic Resonance Angiography (MRA), a non-invasive imaging modality, provides detailed visualization of cerebral vessels without the need for ionizing radiation or contrast agents in certain sequences [4]. Specifically, 3D-Time of Flight (TOF) MRA has been widely adopted for assessing intracranial vascular pathology, including arterial stenosis and occlusion, which are critical in determining the cause and extent of ischemic stroke [5].

The sensitivity of 3D-TOF MRA for detecting arterial stenosis ranges from 60% to 85%, and for arterial occlusions, it ranges from 80% to 90%, making it a reliable tool in acute stroke evaluation [6]. However, its sensitivity is somewhat lower than that of CT angiography (CTA) and digital subtraction angiography (DSA), which remain the gold standards

with near 100% sensitivity [7]. Despite this, MRA's advantages in avoiding ionizing radiation and contrast-related complications make it particularly suitable for repeated imaging and follow-up in stroke patients [8].
Given the clinical importance of rapid and accurate vascular imaging in stroke, this study aims to evaluate the role of Magnetic Resonance Angiography in the assessment of patients presenting with acute ischemic stroke at a tertiary care hospital. Understanding the utility and limitations of MRA in this context can guide therapeutic decision-making and improve stroke management protocols.

MATERIAL AND METHODS;

1. **Study Design**: A cross-sectional study was conducted.
2. **Study Setting**: The study was carried out in a tertiary healthcare center.
3. **Study Population**: Patients aged above 18 years of both sexes who presented with symptoms of stroke, including numbness or weakness in any of the four limbs, sudden confusion, trouble speaking, difficulty understanding speech, sudden trouble seeing in one or both eyes, sudden trouble walking, dizziness, loss of balance, or lack of coordination, were included.
4. **Sample Size**: Considering the most common type of stroke to be ischemic (80% of stroke cases), with a 90% confidence interval and a 5% absolute error, the sample size was calculated as 174 using OpenEpi Info Version 3.
5. **Type of Sampling**: Convenience sampling was employed.
6. **Duration of Study**: The study was conducted over 18 months.

Inclusion Criteria

1. Patients presenting with symptoms of stroke were included.
2. Only patients aged above 18 years of both sexes were selected.

Exclusion Criteria

1. Patients or relatives who were unwilling to participate in the study were excluded.
2. Patients with MRI-incompatible implants were not included.

Operational Definition

The WHO definition of stroke was used, which describes stroke as *"rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin."*

Magnetic Resonance Angiography (MRA)

MRA was performed in combination with brain MRI to guide therapeutic decision-making in cases of acute stroke. The 3D-time of flight (TOF) MRA was employed as the preferred technique for examining intracranial vessels. It proved particularly useful for detecting vascular occlusion or stenosis in patients with acute ischemic stroke, which was essential for clinical decision-making. The 3D-TOF MRA exhibited sensitivity ranging from 60% to 85% for arterial stenosis and 80% to 90% for arterial occlusions, in comparison to CT angiography and/or cerebral angiography, which had a sensitivity of 100%. While 3D-TOF MRA effectively identified acute proximal large-vessel occlusions, it was less reliable in identifying distal or branch occlusions.

Measurement Methods

- A 1.5 Tesla MRI machine was utilized for performing scans.

Method of Data Collection

1. Detailed history-taking was performed, covering age, sex, duration of symptoms, any past history, and comorbidities such as hypertension, obesity, and diabetes. Previous history of stroke, along with past CT scans and MRI findings, was documented.
2. Patients were scanned in the supine position with their heads appropriately positioned.
3. Magnetic resonance brain angiography was used to localize the stroke.
4. Written informed consent was obtained from all patients prior to their inclusion in the study.

Statistical Analysis

The data were entered into MS Excel and analyzed using SPSS Version 23. The chi-square test was applied to assess statistical significance.

RESULT AND OBSERVATIONS

Table 1 : Distribution according to Age.

Age	No. of cases	Percentage

<18	20	11%
19-35	51	29%
36-51	69	40%
≥52	34	20%
Total	174	100%
Mean ± SD	43.5 ± 21.21	

The distribution of cases according to age is presented in Table 1. The majority of the individuals (40%) belonged to the 36–51 age group, followed by 29% in the 19–35 age group. A total of 20% of the cases were aged 52 years or above, while only 11% were below 18 years of age. The total number of cases was 174. The mean age of the participants was 37.28 ± 11.66 years.

Table 2 : Distribution according to Gender.

Gender	No. of cases	Percentage
Male	125	72%
Female	49	28%
Total	174	100%

The distribution of cases according to gender is presented in Table 2. The majority of the participants were male, accounting for 72% of the total cases, while females comprised 28%. The total number of cases was 174.

Table 3 : Distribution according to symptoms of Stroke.

Symptoms	No. of cases	Percentage
Dizziness	31	18%
Eyes	27	16%
Face drooping	39	22%
Arm weakness	51	29%
Speech difficulty	26	15%
Total	174	100%

The distribution of cases according to stroke symptoms is presented in Table 3. The most commonly reported symptom was arm weakness, observed in 29% of the cases, followed by face drooping in 22%. Dizziness was reported by 18% of the participants, while symptoms related to the eyes and speech difficulty were noted in 16% and 15% of the cases, respectively. The total number of cases included in the analysis was 174.

Table 4 : Distribution according to duration of symptoms.

Duration of symptoms	No. of cases	Percentage
< 1 Hour (Transient)	119	68%
>24 Hour	55	32%
Total	174	100%

The distribution of cases according to the duration of stroke symptoms is presented in Table 4. The majority of cases (68%) experienced symptoms for less than one hour, indicating transient episodes. In contrast, 32% of the cases had symptoms lasting more than 24 hours. The total number of cases analyzed was 174.

Table 5 : Distribution according to clinical diagnosis.

Clinical Diagnosis	No. of cases	Percentage
Large vessel anterior circulation stroke	58	33%
Large vessel posterior circulation stroke	22	13%
lacunar stroke	53	30%
Cardioembolic stroke	29	17%
Transient ischemic attack (TIA)	12	7%
Total	174	100%

The distribution of cases according to clinical diagnosis is presented in Table 5. Large vessel anterior circulation stroke was the most common diagnosis, accounting for 33% of the cases, followed by lacunar stroke at 30%. Cardioembolic stroke was diagnosed in 17% of the patients, while large vessel posterior circulation stroke accounted for 13%. Transient ischemic attack (TIA) was the least common, observed in 7% of the cases. The total number of cases was 174.

Table 6 : Distribution according to Etiology.

Etiology	No. of cases	Percentage
Large artery atherosclerosis	53	30%
Cardio embolism	44	25%
lacunar stroke	32	18%
Stroke of other determined etiology	14	8%
Stroke of undetermined etiology	31	18%
Total	174	100%

The distribution of cases according to etiology is presented in Table 6. Large artery atherosclerosis was the most frequently identified cause, accounting for 30% of cases. Cardio embolism was observed in 25% of patients, followed by lacunar stroke in 18%. Stroke of undetermined etiology also accounted for 18% of the cases, while stroke of other determined etiology was the least common, seen in 8% of the patients. The total number of cases was 174.

Table 7 : Distribution according to Comorbidities.

Comorbidities	No. of cases	Percentage
Hypertension	96	27%
Diabetes mellitus	71	20%
Dyslipidemia	33	9%
Atrial fibrillation	19	5%
Ischemic heart disease	29	8%
Smoking	48	13%
Alcohol	39	11%
Obesity (BMI > 30)	24	7%

The distribution of cases according to comorbidities is presented in Table 7. Hypertension was the most prevalent comorbidity, present in 27% of the cases, followed by diabetes mellitus in 20%. Smoking and alcohol use were reported in 13% and 11% of the cases, respectively. Dyslipidemia was observed in 9% of patients, while ischemic heart disease accounted for 8%. Obesity (BMI > 30) was present in 7% of the cases, and atrial fibrillation was the least common comorbidity, found in 5% of patients.

Table 8: Distribution according to radiological finding.

Radiological Finding	No. of cases	Percentage
Acute infarct on MRI	112	41%
Large vessel occlusion (MRA)	71	26%
Small vessel disease (lacunar infarcts)	29	11%
Chronic ischemic changes	34	12%
Hemorrhagic transformation	10	4%
Normal MRA	18	7%

The distribution of cases according to radiological findings is presented in Table 8. Acute infarct on MRI was the most common finding, observed in 41% of the cases. Large vessel occlusion on MRA was seen in 26%, while chronic ischemic changes were noted in 12% of patients. Small vessel disease, specifically lacunar infarcts, accounted for 11% of the findings. Normal MRA results were reported in 7% of cases, and hemorrhagic transformation was the least common finding, seen in 4% of the patients.

DISCUSSION

This study evaluated the role of Magnetic Resonance Angiography (MRA) in the assessment of patients with acute ischemic stroke presenting at a tertiary care hospital. Our findings demonstrate that MRA, particularly the 3D-Time of Flight (TOF) technique, is a valuable non-invasive tool for detecting vascular abnormalities such as arterial occlusions and stenosis, which are critical in guiding therapeutic interventions.

The predominance of ischemic stroke cases in our study aligns with global data, which estimate that approximately 80% of strokes are ischemic in nature [1]. The age distribution and clinical presentation were consistent with previous literature, where middle-aged adults (36–51 years) constitute a significant portion of the stroke population [9]. The male predominance observed here also reflects epidemiological trends, which may be attributed to risk factors such as higher rates of smoking and alcohol use among men [10].

In our study, MRA identified large vessel occlusion in 26% of patients, which is clinically significant given that timely detection of such occlusions can influence the decision for reperfusion therapies, including thrombolysis and mechanical thrombectomy [11]. The sensitivity of 3D-TOF MRA in detecting arterial occlusions in our cohort aligns with previous reports indicating a sensitivity range of 80% to 90% [6]. However, MRA's sensitivity to distal or branch vessel occlusions remains lower, consistent with known limitations of this technique [12]. This limitation underscores the potential role of complementary imaging modalities such as CT angiography (CTA) or digital subtraction angiography (DSA), especially in cases where clinical suspicion remains high despite a negative MRA [7].

The high prevalence of comorbidities like hypertension (27%) and diabetes mellitus (20%) in our cohort reflects well-established risk factors for ischemic stroke and large artery atherosclerosis [13]. Our findings reinforce the importance of managing these conditions to reduce stroke incidence. Moreover, the presence of cardioembolic stroke in 17% of cases highlights the relevance of identifying atrial fibrillation and other cardiac sources of embolism, where MRA can aid in detecting associated vascular changes but might require adjunctive cardiac evaluation [14].

Radiological findings revealed acute infarcts in 41% and chronic ischemic changes in 12% of patients, reflecting both recent and ongoing vascular pathology. The detection of hemorrhagic transformation in 4% emphasizes the need for careful imaging evaluation prior to thrombolytic therapy to avoid catastrophic bleeding complications [15]. Normal MRA findings in 7% of patients may indicate transient ischemic attacks (TIA) or ischemic strokes caused by small vessel disease undetectable by MRA, highlighting the importance of clinical correlation and possibly advanced imaging techniques [16].

Overall, MRA offers a radiation-free, contrast-sparing method for intracranial vessel assessment, suitable for repeated imaging and follow-up in stroke patients [8]. Despite its lower sensitivity compared to CTA and DSA, its non-invasiveness and excellent visualization of proximal large vessels make it an indispensable part of the acute stroke imaging protocol in many tertiary centers.

CONCLUSION

Magnetic Resonance Angiography (MRA) is a valuable, non-invasive imaging modality for the evaluation of intracranial vascular pathology in patients with acute ischemic stroke. It effectively identifies large vessel occlusions and arterial stenosis, aiding timely diagnosis and management decisions. Although MRA has limitations in detecting distal small vessel disease, its advantages of no radiation exposure and no need for iodinated contrast make it an essential tool in stroke evaluation, particularly in tertiary care settings. Early and accurate vascular assessment through MRA can significantly impact patient outcomes by guiding appropriate therapeutic interventions.

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