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Original Research Article

MAGNETIC RESONANCE ANGIOGRAPHY AND BRAIN ISCHEMIA IN PATIENTS WITH ACUTE STROKE

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Abstract: *This research investigates if Magnetic Resonance Angiography (MRA) can detect arterial disorders in patients with acute ischemic stroke with diffusion-positive infarction. The study was conducted at KRL Hospital in Islamabad from May 1, 2022, to September 30, 2022, after receiving ethical approval from the institutional review board. The study included participants between the ages of 45 and 60 of any gender who had symptoms of localized cerebral ischemia lasting less than 24 hours and were referred for MRI evaluation. Non-probability consecutive sampling was used to select participants. The Chi-square test compared MRA findings of vascular illness with MRI findings of brain parenchymal abnormalities. Out of 95 individuals, 89 (93.6%) showed a statistically significant correlation (p=0.001) between the arterial lesion and acute infarctions in the same region of the brain parenchyma on MRI. Only 6 (6.3%) of the 95 individuals showed a discrepancy between the location of the infarction on MRI and the results of the MRA. This study's findings suggest a significant positive association (95.34%) between MRA and MR diffusion restriction in acute ischemic strokes. This association supports the theory that an arterial vasculopathy is the underlying cause of the MR signal. However, in some cases, the discrepancy between MRA and infarction location might be due to an occlusive illness of an arterial branch that MRA did not detect.*

Keywords: MRA, Stroke, Brain Ischemia, Diagnosis

Introduction

One of the primary causes of mortality and disability is ischemic stroke. Several initiatives have been launched in recent years to improve the effectiveness of treatments for acute ischemic stroke. Acute ischemic stroke may only be treated with thrombolytic therapy if administered within three to four and a half hours after the onset of symptoms. Current studies are examining the therapeutic window and its use in thrombolysis. Selecting an appropriate patient for the indication is crucial after weighing the risks and advantages of thrombolysis (Hacke, 2007; Members et al., 2010). While CT scans without contrast are rapid and reliable for finding signs of brain bleeding, they are not sensitive enough to pick up on ischemia alterations in the first few hours after they occur. Its sensitivity is between 40 and 60 percent in the first six hours after activation. Before performing diffusion-weighted imaging (DWI), a high-resolution MRI sequence, on areas with low blood flow, a CT scan is performed (Kang et al., 2012; Lin and Liebeskind, 2016).

In the case of an acute ischemic stroke, "time is brain" in terms of diagnosis and treatment. When the MCA is blocked, 9 million neurons die every minute. Ischemic strokes may mostly be diagnosed by brain imaging. Imaging the brain helps distinguish between subacute and chronic brain injuries. It is essential in choosing who will benefit from thrombolysis or thrombectomy. Assessment of acute ischemic stroke has been the primary focus of imaging studies in recent years (Kang et al., 2012).

When comparing MRI with CT for the diagnosis of an acute ischemic stroke, MRI is more sensitive and specific. Ischemic stroke may be diagnosed more quickly and more accurately using rapid non-contrast MRI compared to CT, according to the study's findings. The diagnostic efficacy of non-contrast CT and MRI for acute cerebral bleeding was similar. To rule out hemorrhagic stroke, which cannot be treated with clot-busting medicines, non-contrast CT has been the gold standard in emergency stroke therapy. Infarcts may usually be diagnosed during the first 24 hours in around 80% of instances. MRI may diagnose ischemic stroke during the first few hours following symptom onset. The acute phase of therapeutic planning for ischemic stroke may benefit from the use of multimodal MRI. Diffusion-perfusion mismatch and other MRI imaging findings help define the stroke's cause, which in turn affects prognosis and is crucial for selecting the most effective therapy. MRI's lesion mismatch profile provides information on the age of the ischemic lesion or information on salvageable tissue, both of which help weigh the risks and advantages of thrombolysis (Albers et al., 2006; Kang et al., 2012). The goal of this research is to determine whether individuals with acute ischemic stroke also have arterial disorders detectable by Magnetic Resonance Angiography (MRA) and diffusion-positive infarction.

Methodology

After the ethical approval from the institutional review board, this cross-sectional study was conducted at KRL Hospital, Islamabad, from May 1, 2022, to September 30, 2022. Through non-probability consecutive sampling, this study included participants between ages 35-60 years, of either gender, with symptoms of localized cerebral ischemia of less than 24 hours in length and were referred for MRI evaluation. Participants with Patients with impaired coagulation function, severe renal impairment or metabolic

deficiencies, and intracranial tumors were excluded from the study. All imaging was performed using a 1.5 T MR whole body system (Phillips) with diffusion-weighted imaging multislice, echo planar imaging, and p-values ranging from 0 to 1000 s/mm2. At the same time that diffusion-weighted pictures were taken, a quick (7-minute) 3-dimensional Time-of-Flight method was employed to collect images of the inside of the head near the circle of Willis for intracranial MRA. Two experienced radiologists assessed the MRAs without knowing the patient's clinical status or the diffusion-weighted image data. Occlusions and stenosis were the two main types of lesions found by MRA. Arterial lesion was defined as any stenosis or occlusion seen on MRA. The Chi-square test compared MRA findings of vascular illness with MRI findings of brain parenchymal abnormalities. Significant results were defined as having a p-value of ≤0.05.

Results

One hundred thirty participants were recruited for the present study that fulfilled the inclusion criteria. In 95 (73.1%) of the 130 participants, MRA revealed arterial blockage, whereas in 35 (26.9%), no lesion was seen (Table 1). 50 (52.6%) people had a problem with their left arteries, another 40 (42.1%) had a problem with their right arteries, and the remaining 5 (5%) had issues on both sides of their bodies (Table 2). Out of 95 individuals, 89 (93.6%) showed a statistically significant p0.001 correlation between the arterial lesion and the acute infarctions in the same region of brain parenchyma on MRI. Discordance between MRA and infarction location was identified in 6(6.3%) of 95 individuals. In 5 cases, MRA revealed right-sided stenosis but contralateral infract. In two instances, an infarct was evident on the right side despite an abnormal MRA on the left. Fifty-three individuals had blockages in their middle cerebral arteries. The posterior cerebral arteries were diseased in 30 individuals. The anterior cerebral artery was lesioned in 7 cases, whereas the vertebrobasilar arteries were affected in 30. (Figure 1, 2)

Table 1: Participant Overview

Category	Number of Participants
Total Participants	130
Participants with Blockages	95 (73.1%)
Participants with No Lesions	35 (26.9%)

Table 2: Arterial Blockages and Locations

Arterial Location	Number of Participants
Left Arteries	50 (52.6%)
Right Arteries	40 (42.1%)
Both Sides	5 (5%)

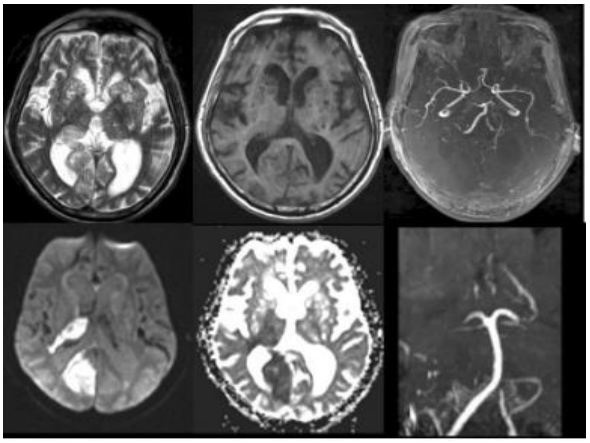

Figure 2:Images from an MRI and MRA scan of a patient who had symptoms suggestive of a posterior circulation strok

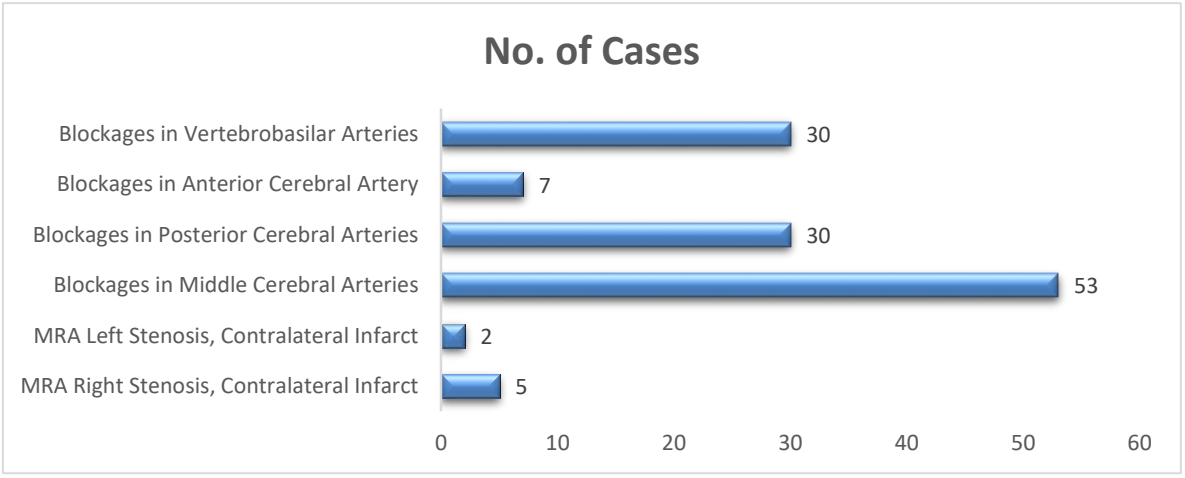

Figure 1: Sites of Infarcts

Discussion

Diffusion-weighted (DW) magnetic resonance imaging greatly aids early stroke diagnosis and treatment. In contrast to CT and traditional MR imaging, DW imaging allows the identification of lesions within the first hour following the development of clinical symptoms (Warach et al., 1995). In addition, DW imaging can distinguish between chronic and acute lesions and better identify extremely minute ischemia lesions because of its high signal intensity-to-noise ratio (Roh et al., 2000). This research partly supports our original idea by demonstrating a strong positive connection between diffusion-weighted images and arterial vasculopathy. Diffusion Weighted Imaging shows a high degree of contact

with arterial vasculopathy (73.1%), which may indicate an arterial vascular foundation in acute ischemic stroke.

35 out of 130 participants with Diffusion limited regions had a normal MRA. This may be due to occlusive disease of the lenticular-striate artery or a missed minor arterial lesion on MRA, such as the M3 branch or more distant branches. Tissue perfusion might have been altered in the presence of patent vessels, or another technique could have been used. Thus, although some overlap, the MRI, MRA, and DWI results did not demonstrate complete agreement. In situations when MRA and DWI were found to be inconsistent, there aren't many avenues to explore.

The likelihood of an artery lesion with a resolution lower than that of MRA cannot be ruled out, even in individuals with diffusion restriction zones and normal MRA. Regular MR angiography findings of smaller, diffusion-restricted lesions support this notion. However, the possibility of a local or alternative cause of tissue ischemia must be considered. In up to 20-30% of patients with strokes, traditional angiography has shown a short-term negative detection rate of cerebral artery occlusive disease (Fieschi et al., 1989). Foulkes MA et al. found that up to 30% of cases in the stroke data bank had no precise mechanism (Foulkes et al., 1988). Conventional angiography or high-resolution MR angiography with improved arterial definition and MRI performed soon after the beginning of stroke has been demonstrated to have a higher detection rate of arterial occlusion in a review of MR imaging in cerebral ischemia by Brant-Zawadzki M et al. (Brant-Zawadzki et al., 1987). One possible limitation of this research is that conventional angiography was not employed to verify the MRA findings. However, Polak JF et al. discovered that MR and traditional angiography had high detection rates for internal carotid artery stenosis (Polak et al., 1992). However, the sensitivity and specificity of MR angiography and arteriography have not been extensively investigated in instances of occlusive disease for intracranial lesions (Stock et al., 1995). Treatment with intravenous recombinant tissue plasminogen activator within three hours after the European Cooperative Acute Stroke Research group recommends ischemia infarction. This medication opens big cerebral arteries blocked by thrombo-embolic material (Hacke et al., 1995). This suggests that artery imaging is the most reliable starting point for treatment. It is unclear what course of therapy is best for people who have a diffusion limitation but a normal MRA. An artery blockage may exist below the MRA's resolution in some instances. Although it is known that these branch occlusions have a high and early incidence of spontaneous recanalization, the current theory is that they may be susceptible to recanalization with tissue plasminogen activator treatment. However, in certain situations, alterations in tissue perfusion and microcirculation may be to blame (del Zoppo and Hallenbeck, 2000). Reperfusion treatments that target the microcirculation may be of particular use to this population of patients (Sherman et al., 2000).

Conclusion

The MRA findings of infarcted tissue and vascular alterations were highly concordant (93.6%). Lesions found by MRA but not by diffusion restriction (6.3%) may have been caused by occlusions in arterial branches that are not visible on MRA or by some other reason. Therefore, in acute ischemic stroke, we evaluated the diagnostic value of combined DWI and MRA acquired within 24 hours of admission. It might help enhance diagnosis, especially in hospitals without diffusion-weighted sequencing access.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department Concerned.

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

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