



## ROLE OF MRI IN EVALUATION OF CEREBROVASCULAR STROKE.

## Radiodiagnosis

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## ABSTRACT

Magnetic resonance imaging (MRI) is increasingly being used in the diagnosis and management of cerebrovascular stroke and is sensitive and relatively specific in detecting changes that occur during and after strokes. Despite the practical issues in using magnetic resonance imaging (MRI) for acute stroke management, multimodal MRI provides useful information for accurate diagnosis of stroke, evaluation of the risks and benefits of thrombolysis, and prediction of outcomes. The high sensitivity and specificity of diffusion weighted image (DWI) can help distinguish acute ischemic stroke from stroke-mimics. Multimodal neuroimaging is assuming an increasingly important role in the initial evaluation and management of acute stroke patients in parallel with the expansion of therapeutic options. Multimodal MRI can identify the type of stroke (ischemia or hemorrhage), severity and location of the lesion, the patency of the intracranial vessels, the degree of cerebral perfusion, and the presence and size of the ischemic penumbra. This information can be used to guide both acute and long-term treatment decisions for stroke patients.

## KEYWORDS

MRI (magnetic resonance imaging), DWI (diffusion weighted image), cerebrovascular stroke.

## Introduction:

Stroke, or a cerebral vascular accident, is the sudden death of brain cells due to inadequate blood flow. Stroke is a clinical syndrome divided into two broad categories, Ischaemic and Haemorrhagic that defines its pathophysiology.

Stroke is one of the leading causes of mortality and morbidity worldwide. Approximately 20 million people each year suffer from stroke and of these 5 million do not survive. Developing countries account for 85% of global deaths from stroke. Stroke is also a leading cause of functional impairments, with 20% of survivor requiring institutional care after 3 months and 15%-30% being permanently disabled.

The cause of the stroke must be ascertained, along with the nature of the vessel pathology, the pattern and extent of the damage. Brain imaging provides an objective basis for the clinical interference that direct individual patient management and accurate diagnosis will determine whether a patient is treated with thrombolytic or other interventions, is admitted to a stroke unit, and or is started on secondary prevention therapies.

An accurate & early diagnosis of ischemic stroke is critical in ensuring patients receive prompt treatment, which, in turn, improves their chances of survival & increases their likelihood of recovery.

Almost 60% of CT Scans obtained within first, few hours of cerebral infarction are normal. Computed tomography is insensitive to small-volume ischemia and therefore is usually normal in minor strokes and transient ischemic attack (TIA). The primary diagnostic advantage of CT in the hyperacute phase (0 to 6 hours) is its ability to rule out the presence of hemorrhage. CT scan is also economical and requires short time as compared to MRI scan.

The interest in MRI as a tool for acute stroke management lies not only in the capability of this technique to detect early ischemic lesions with high sensitivity, but also in the breadth of the cerebrovascular pathology revealed by such imaging. Multimodal MRI can delineate the presence, size, location, extent and effects of acute brain ischemia, identify the hypoperfused tissue that is at risk of infarction, and show additional features of the cerebrovascular pathology. Diffusion-weighted imaging has transformed the diagnosis of ischemic stroke in its earliest stages. T2\* or gradient recall echo magnetic resonance imaging is sensitive to hemorrhage.

MRI has demonstrably higher accuracy, carries fewer safety risks and provides greater range of information.

## Material and method:

This prospective study was done in the Department of Radio diagnosis, Mahatma Gandhi Memorial Medical College & M.Y. Hospital, Indore, Madhya Pradesh, India. A total of 100 patients who were referred to our department with symptoms of cerebro-vascular stroke were taken up for study. Patients having trauma, tumor, infection, white matter diseases and those with general contraindication to MRI such as with pace makers, cochlear implants and other electromagnetic implants in body were excluded from the study.

## Results and Discussion:

Stroke imaging & intervention are advancing at a dramatic & welcome pace. Triage of stroke patients & choice of treatment are increasingly driven by advanced imaging findings. MR imaging especially with the advent of diffusion weighted imaging now forms the backbone of stroke imaging. This study, the role of MRI in evaluation of cerebrovascular stroke makes an attempt to show the importance of MRI in diagnosis and improved management of stroke.

The attempt has been made to study the incidence, age, sex distribution, symptomatology, location, territory /sinus involved appearance of pathology on various MRI sequences with insight into the possible causative factors as evident by investigation to aid in effective management.

In this study, the most common presenting age was 51-60 years. The eldest patient was 85 years old female and youngest patient was 2 days old male. The number of male patients having cerebrovascular stroke were 64% & female patients were 36% in my study.

Patients with arterial infarcts presented with motor weakness (61.5%), aphasia (35.38%) & cranial nerve palsies (33.84%). Patients with venous occlusions presented with giddiness (73.68%), headache (63.15%) & altered sensorium (57.89%).

Hypertension was the most common risk factor for both ischemic (62.6%) & hemorrhagic stroke (78%). The next most common risk factor was hypercholesterolemia (35.8%) followed by diabetes mellitus (33.33%). 18% of our study group (100 patients) were found to be alcoholic. 17% of patients with ischaemic stroke had past history of cerebrovascular insult. 56% of patient with ischaemic stroke & 36% of patients with hemorrhagic stroke were smokers.

89% of my patients had presented with a clinical diagnosis of ischemic stroke & the rest with a diagnosis of hemorrhagic stroke. In my study of 100 patients, 81% of patients were diagnosed as ischemic stroke and 19% as hemorrhagic stroke. In this study 81% patients had ischemic stroke. 2 patients had arterial as well as venous occlusion.

### Arterial Infarction:

There were 65 patients of arterial infarction & it was found more common in males. Arterial infarction was found in all age groups with maximum no. of patients >50 yrs. of age. In this study majority of patients had athero-thrombotic stroke (52.30%) and it was more common in the anterior circulation (55.88%). 21.53% of patients had small vessel infarction. 48 patients had single territorial involvement and 17 patients had acute multiple brain infarcts.

Out of 65 patients with arterial infarcts, haemorrhagic conversion was present in 10.76%. 4 patients had infarcts with haemorrhage. 29.41% of patients with embolic stroke had haemorrhagic conversion or infarct with haemorrhage.

Overall anterior circulation was more commonly involved than posterior circulation. 32 patients had MCA territory infarcts & 19 patients had PCA territory infarct.

### Single territory involvement:

In patients with single territory involvement (73.8%), MCA was the most common territory affected (52.1%) followed by PCA (18.7%) & PICA (12.5%). In our study, there were only 2 patients with isolated ACA territory infarct. Both had unilateral, bland infarctions with no hemorrhagic conversion.

We found that PCA was most commonly involved in posterior circulation followed by PICA & BA. There was 1 patient each with isolated involvement of AICA, SCA & VA. Bilateral infarcts were more common in posterior circulation. PCA involvement is seen most commonly in patients afflicted with infarctions of the posterior circulation. Early recognition of these types of infarct may have implication for emergency therapy option in acute phase of stroke.

### AMBI (Acute multiple brain infarction):

In our study out 65 patients with arterial infarcts 17 patients had AMBI (26.2%). Bi-hemispheric involvement was 58.8% & single hemisphere involvement was 41.2%. Early identification of multiple infarcts with the use of DWI provides early clues to stroke mechanism and guide therapeutic options in the acute phase of stroke.

In our study AMBI were more common in the posterior circulation (47.1%) as compared to anterior circulation (23.5%). 17.6% of patients had involvement of both anterior as well as posterior circulation.

### Hyper-acute & acute arterial infarct:

In our study, there were 12 patients of hyper-acute infarct out of which 7 had CT scan prior to MRI all of which were reported normal. In this study out of 49 patients with acute ischemic infarcts, 25 had CT scan of which 16 CT scans revealed normal brain parenchyma. MRI detected infarcts in all 16 patients.

### Venous occlusion:

There were 7 patients in my study with venous occlusions, out of which 2 were associated with hemorrhage & 4 had hemorrhagic conversion. 4 patients had dural sinus thrombosis and 1 patient had isolated cortical venous thrombosis. Since in my study, there were only 4 patients with dural sinus thrombosis, the exact incidence of involvement of individual sinuses could not be calculated.

### MRI Observations:

Acute thrombus revealed isointensity in 3 cases and hyperintensity in 2 cases on T1W images. Subacute thrombus appeared hyperintense on T1W images. Patients revealed absent flow void on T2W images with 2 cases of subacute thrombus revealing absent flow void on GRE.

In our study there was 1 patient with isolated cortical venous thrombosis. She was 25 years female with history of post-partum puerperal sepsis who presented with altered sensorium. 3 to 7 days after thrombosis, the clot becomes hyperintense on both T1 & T2-W images & is thus easier to identify. Because of the extreme variability of the number & position of the cortical veins, isolated cortical vein thrombosis-that is, non-filling of a cortical vein- may be missed during cerebral catheter angiography.

### Haemorrhagic conversion of infarcts

There were 12 patients with acute haemorrhagic transformation of

infarcts, out of which 6 had embolic stroke, 4 had venous occlusion. Haemorrhagic transformation of a brain infarct is a common event that occurs independently of anticoagulation and can be reliably predicted as early as 5 hours from stroke onset on MRI. T2\*-weighted gradient-echo MRI is known to detect old-microbleeds, considered indicative of microangiopathy. They confirmed that microbleeds might be a potential risk factor for early cerebral bleeding after ischemic stroke.

### Hemodynamic Stroke

There were 7 patients with hemodynamic stroke out of which 4 had hypoxic ischaemic encephalopathy and 3 had watershed infarctions. Recognition of the clinical & imaging feature of hemodynamic stroke allows early identification & management of cardiac & carotid disease and correction of iatrogenic causes of hypotension, which may reduce the risk of further events. Watershed infarctions are typically seen in such cases, while some patients have HIE.

The sensitivity of conventional MRI for ischaemic stroke was found to be 73.2% while added with diffusion weighted image sensitivity was found to be 97.1%. Diffusion weighted MRI is superior to conventional MRI of small new ischemic lesion and discrimination of recent infarct from old ones.

### HAEMORRHAGIC STROKE

There were 19 patients diagnosed to have haemorrhagic stroke in our study. All patients revealed blooming on GRE (T2\*W) images. 63.15% of patients had intraparenchymal haemorrhage with 36.8% having isolated intraparenchymal haemorrhage. These patients presented with haemorrhage in the areas as shown in the table.

| Location        | Present Study |
|-----------------|---------------|
| Basal ganglia   | 41.66%        |
| Lobar           | 25%           |
| Thalamus        | 16.66%        |
| Mid brain /pons | 8.33%         |
| Cerebellum      | 8.33%         |

In Conventional MRI small aneurysms may be missed but it can depict small amounts of parenchymal blood surrounding the aneurysms. While MRA is more sensitive for small aneurysms, as small as 3-4 mm. The sensitivity of GRE was 100% in detecting hemorrhagic infarct, as compared to conventional MRI, the sensitivity of which was only 47%.

### Conclusion:

The sensitivity of conventional MRI for ischaemic stroke was found to be 73.2% while added with diffusion weighted image sensitivity was found to be 97.1%. The sensitivity of GRE was 100% in detecting hemorrhagic infarct, as compared to conventional MRI, the sensitivity of which was only 47%. The study showed that MRI can detect primary intracranial haemorrhage and can accurately differentiate haemorrhagic conversion of infarcts.

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