

A Study to Assess the Role of Magnetic Resonance Imaging in Cerebral Stroke in a Tertiary Care Hospital

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Abstract

Background: Cerebral ischemic stroke remains the leading cause of death and disability in many countries. The objective are: Role of MRI in detection of cerebral ischemic stroke. Age and sex distribution of infarcts in an Indian population. To determine the location and the territory of the involved blood vessels. **Subjects and Methods:** All patients referred to the Department of Radio-Diagnosis with clinically suspected cerebral ischemic stroke in a period 2019 January to 2020 March at Gadag Institute of Medical Sciences. All MRI scans were performed on a 1.5 Tesla 16 channel GE with HDXT software. Sequences used are T2WI axial and coronal, flair axial, gradient echo axial, T1WI axial, DWI axial and ADC maps. MRA (TOF) – circle Willis (neck) and SWI (optional). **Results:** 50 patients who were studied it was observed that infarction was most common in the age group of more than 60 years with a male dominance, the most common risk factor being Hypertension. The most common clinical presentation was weakness (hemiplegia). MCA territory infarcts were more common with a slight increase on the right side. Both acute and subacute infarcts showed restricted diffusion on DWI with low ADC values. In the acute infarcts T2 FLAIR was normal, but DWI reflected the changes. **Conclusion:** MRI is noninvasive and there is no radiation hazard. Excellent grey – white matter resolution and multi planar imaging capability of MRI helps in detection of subtle lesions. Sensitivity of MRI to altered water content allows earlier detection of infarcts.

Keywords: Infarct, MRI, Stroke, Diffusion, Cerebellar, Artery.

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Introduction

Stroke specifically the type due to cerebrovascular disease is defined as a sudden, non-convulsive focal neurological deficit. The terms “apoplexy” originating from the Greek and insult from the Latin “insultus” described stroke phenomenon in ancient times. Stroke is defined as an acute loss of focal at times global cerebral functions, the symptoms lasting more than 24hours or leading to death with apparent cause than that of vascular origin. Cerebral ischemic stroke remains the leading cause of death and disability in many countries.^[1]

Analysis of community surveys from different regions of India shows an annual stroke incidence (per 100,000 persons) of about 124 in rural areas and 145 in urban areas.^[2] The term cerebrovascular disease designates any abnormality of the brain resulting from a pathologic process of the blood vessels. Pathologic process is given an inclusive meaning – namely, occlusion of the lumen by embolus or thrombus, rupture of a vessel, an altered permeability of the vessel wall, or increased

viscosity or other change in quality of blood flowing through the cerebral vessels.

The vascular pathologic process may be considered not only in its grosser aspects – embolism, thrombosis, dissection or rupture of vessel – but also in terms of more basic / primary disorder, i.e., atherosclerosis, hypertensive arteriosclerotic change, arteritis, aneurysmal dilatation and developmental malformation. Secondary parenchymal changes in the brain result from vascular lesion – ischemia with/without infarction and hemorrhage.^[3]

Historically Computed tomography (CT) was in more widespread use for the evaluation of the hyperacute and acute stroke patient. However, there is an emerging body of literature pointing to advanced Magnetic Resonance Imaging (MRI) techniques as having far greater sensitivity for defining the presence of early infarction than conventional CT; beyond that, these MR techniques provide unique information that is likely to be highly important to early stroke management.^[4]

MR imaging in stroke is targeted towards assessment of four P's – Parenchyma (assess early signs of acute stroke, rule out hemorrhage), Pipes (assess extra cranial and intracranial circulation for evidence of IV thrombus), Perfusion (assess Cerebral Blood Volume, Cerebral Blood Flow and Mean Transit Time), and Penumbra (assess tissue at risk of dying if ischemia continues without recanalization of IV thrombus) as described by Rowley.^[5]

This approach enables the detection of intracranial hemorrhage, differentiation of infarcted tissue from salvageable tissue, identification of intravascular thrombi, selection of the appropriate therapy, and prediction of the clinical outcome. Conventional MR sequences demonstrate most infarcts, but diffusion weighted MR imaging is more sensitive for detection of hyperacute ischemia. Diffusion – perfusion mismatch indicates penumbra. Gradient echo MR sequences are good in detecting hemorrhages. MR angiography enables to assess status of neck and intracranial vessels. MR spectroscopy provides information regarding the abundance of metabolites.^[6]

Correlation of the MRI findings with the clinical features is very helpful in arriving the diagnosis and look for involvement of the specific sites. MRI is useful for the comprehensive evaluation of acute stroke. To improve patient selection, it is a fast diagnostic tool that allows reliable diagnosis of hemorrhage and ischemia, vessel status and tissue at risk at an early stage may be useful. Advantages of MRI over CT are, it is sensitive in the detection of edema, provides multi planar views and lacks beam hardening artifacts. Also with MRI there is no ionizing radiation associated, the gadolinium based contrast media has a minimal risk for toxic effects.^[4]

In this study, we explain the significance and feasibility of multi planar MRI for the initial evaluation of stroke and also to rule out the presence of hemorrhage or other stroke mimics. We also briefly compare the utility of Diffusion Weighted Imaging and T2 Weighted Imaging in acute infarcts.

Objective

To establish early diagnosis and staging of evolution of cerebral infarction.

Subjects and Methods

The Present Prospective study was carried out in the Department of Radiology at Gadag Institute of Medical Science from January 2019 to March 2020.

A total of 50 study subjects who met the inclusion criteria were selected for the purpose of the study.

Inclusion criteria:

Patients above 30 years of age of both sexes. -Patients presenting with symptoms of stroke

Exclusion criteria:

Patients contraindicated for MRI. - Hemodynamically unstable patients. - Restless and uncooperative patients.

Study done using 16 channel GE MRI machine 1.5 TESLA with HDXT software. The patient was placed supine on the MR table and head coil was positioned. A circulatory head coil was used for excitation and signal reception. The MR imaging protocol is part of our routine protocol and comprises T2W (axial and coronal), T1W (axial), FLAIR (axial), DWI (axial), GRE (axial), SWI (axial) and MRA (TOF - Circle of Willis and neck). The total imaging time with 1.5 T whole body MR imager was approximately 20 minutes 53 seconds. After localizer images were obtained, the axial images were titled parallel to the corpus callosum. The sagittal images were planned on the axial sections. The coronal images were planned on the sagittal/axial sections.

Detailed clinical history was noted in patients admitted in our hospital as per the proforma. Brief history was taken for referred cases from outside hospitals. Data such age, sex, past history of hypertension, diabetes mellitus, and ischemic heart disease, TIA's or stroke were given importance.

Results

Total of 50 study subjects were selected for the purpose of the study

The study subjects in the present study nearly 50% of them were aged more than 60 years, 42% were aged between 40 to 60 years and 8% were less than 40 years. Majority of them (66%) were Male and 34% of them were female in the Present study.

Weakness in the limbs was found to be most common complaint among the study subjects in 54% of them, followed by loss of consciousness in 40%, Slurring of Speech in 20% and Seizures in 10%.

70% of the study subjects had Hypertension and 60% of them Diabetus Mellitus as a co morbidity.

About 42 patients had MCA territory infarcts with 21 cases having right side affection. 8 patients in our study had PCA territory infarcts with an increase involvement on the left side. ACA territory infarcts were seen in 9 patients with 4 Cases involvement of right and 3 cases involvement on left.

Using simple visual analysis of DW images, we found that areas of cerebral infarction have high signal intensity and these lesions showed corresponding decrease signal on ADC maps, creation of ADC maps negates the T2 shine through effect that can contribute to lesion signal hyper intensity on diffusion weighted imaging. From the above table all 7 acute infarcts were detected by DWI which could not be picked up by the conventional MR sequences. It is evident that number of acute infarcts detected by DWI is significantly higher than conventional MR imaging.

Table 1: Age and Gender Profile of the study subjects

		Frequency	Percentage
Age Group	< 40 Years	4	8
	40-60 Years	21	42
	More than 60 Years	25	50
Gender	Male	33	66
	Female	17	34

Table 2: Distribution of Study Subjects based on the Symptoms and Co Morbidities

		Frequency	Percentage
Symptoms	Weakness	27	54%
	Loss of Consciousness	20	40%
	Slurring of Speech	10	20%
	Seizures	5	10%
Co Morbidity	Hypertension	35	70%
	DM	30	60%
	Others	4	8%

Table 3: Distribution of Study Subjects based on the Location of Infarct

Vessels	Right Side		Left Side		Bilateral	
	Frequency	%	Frequency	%	Frequency	%
Middle Cerebral Artery	21	42%	19	38%	2	4%
Posterior Cerebral Artery	2	4%	5	10%	1	2%
Anterior Cerebral Artery	4	8%	3	6%	2	4%

Table 4: Distribution of MRI Sequences among the study subjects

		Frequency	Percentage
Sequences	Diffusion Weighted Image	50	100%
	Apparent Diffusion Co Efficient	50	100%
	T2W Fluid attenuation inversion recovery	45	90%
	Gradient	6	12%
DWI / T2 FLAIR positive	DWI Possitive /T2flairnegative(Acute)	7	14%
	DWI & T2 flair positive (SUBACUTE)	43	86%

Discussion

The age group of the study subjects seen in our study was found to be similar to the study findings of the study done by Shuaib et al and Hideo Tohgi et al.^[7,8] All these studies found that the

cases of infarct is more among the subjects with increased age group.

In the present study the gender predominance of the cases were seen more among male subjects when compared to female

subjects. These findings were found to be similar to the study findings of Hideo Tohgi et al and Shuaib A et al.^[7,8]

The various stroke sub types have unique risk factors during to their individual pathophysiological characteristics. In our study, the common risk factor associated was hypertension, followed by diabetes mellitus which was also seen in the study done by Andrew Kertesz et al and Hideo Tohgi et al.^[8,9] It is also well established by the study done by Kuller L H et al,^[10] that incidence of stroke in 2.5 to 4 times more common among people with diabetics.

The Most commonly involved Vascular territory in our study it was Middle Cerebral Artery involving right side of the brain followed by PCA Artery and Anterior Cerebral artery.

The total number of acute infarcts in our study is 7. Both conventional T2W and DWI sequences were positive in 43. Acute infarcts seen only on diffusion and not visualized in conventional imaging T2W were 7.

Mullins ME, et al, in his study on 691 patients observed 97% sensitivity and 100% specificity with DWI; 58% sensitivity and 100% specificity with conventional MRI and 40% sensitivity and 92% specificity with CT.⁸³ Lansberg et al in his study to determine yield of adding DWI to conventional MRI protocol for acute stroke observed 50.60% sensitivity and 46.59% specificity using conventional MRI as compared with DWI.⁸⁴ These results are consistent with our results and substantiate the superiority of DWI over conventional MR imaging.^[11]

Conclusion

Our study observed that diffusion weighted imaging add sensitivity and specificity to the standard MR evaluation. DWI makes an important contribution to stroke management. DW imaging with restricted diffusion helped in the evaluation of acute infarcts in the setting of multifocal infarcts, lacunar infarcts and white matter ischemic changes responsible for the patients symptomatology and in distinguishing acute from subacute and chronic infarcts. Though CT is considered as the imaging modality widely available at affordable cost, multimodal MRI has carved a niche as the feasible, cost effective and time saving initially, state of the art“ imaging modality in cerebral ischemic stroke and has a definite role in the diagnosis and management of the same.

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