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A STUDY ON ROLE OF MAGNETIC RESONENCE IMAGING IN DETECTION OF CEREBRAL STROKE

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ABSTRACT:

Background and Objectives: Cerebral ischemic stroke remains the leading cause of death and disability in many countries. The objective is 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.

Materials and Methods: All patients referred to the Department of Radio-Diagnosis with clinically suspected cerebral ischemic stroke in a period of 2 years from 2020 May to May 2021. The main source ofdata for the study are patients from Kamineni Academy of Medical Sciences, LB Nagar, Hyderabad. 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: 182 patients who were studied it was observed that infarction was most commonin the age group of 51-69 years with a male dominance, the most common risk factor being diabetesmellitus. 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 valves. In the acute infarcts T2 FLAIRwas 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. Our study observedthat diffusion weighted imaging add sensitivity and specificity to the standard MR evaluation. DWI makes an important contribution to stroke management. DW imaging with restricteddiffusion 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.

Keywords: MRI, Cerebral Ischemic stroke, subacute and chronic infarcts, DWI

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INTRODUCTION:

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 and145 in urban areas.[2] One of the most common diseases worldwide and a leading cause of morbidity and mortality risk factors attributable to stroke are mainly the ones that are also common in other non-communicable diseases, such as diabetes, blood pressure, being obesity, smoking, and alcohol consumption; although, the prevalence of them may vary between different countries. Alteplase (recombinant tissue plasminogen activator, rtPA) is the only approved drug for patients with acute ischemic stroke. It is recommended as an initial treatment within 4.5hours after stroke onset and also showstherapeutic effects in a longer time window, if this is based on differentiated stroke imaging.[1,2] Its safe routine use is documented by data analyses from large thrombolysis registers.[3] In addition, since 2015, several studies have shown the efficacy of mechanical thrombectomy (MT) in strokes caused by occlusions of large vessels.[4,5]. Compared with CT scans, the advantages of MRI include higher sensitivity for smaller lacunar or embolic lesions and ischemia in the posterior cranial fossa, easier assessment of the age of the infarction, and the reduction of SMs and SCs. These advantages add to the absence of radiation exposure. To date, less than 20% of stroke units reportedly use MRI for acute diagnosis, although the number of available MRI scanners is constantly increasing worldwide.[6-12]

Historically Computed tomography (CT) was in more widespread use for the evaluation ofthe hyperacute and acute stroke patient. However, there is an emerging body of literature pointingto 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.[-13-18].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 comprehensiveevaluation of acute stroke. To improve patient selection, it is a fast diagnostic tool that allowsreliable diagnosis of hemorrhage and ischemia, vessel status and tissue at risk at an early stage may be useful.[19-25]

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.[26,27]

Therefore, an intelligent choice of imaging technique could result in an early, lifesaving diagnosis of acute stroke. This article aims to review the role of different imaging methods in the diagnosis of acute ischemic stroke and 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[28-30]. We also briefly compare the utility of Diffusion Weighted Imaging and T2Weighted Imaging in acute infarcts.

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OBJECTIVES:

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

1. To determining stroke age in patients with an unknown onset time, potentially increasingthe number of patients who are eligible for thrombolysis.

2. To distinguish between reversible and irreversible brain tissue damage.

METHODOLOGY:

Source of data: The main source of data for the study is patients from May 2020 to May 2021 admitted in Kamineni Academy of Medical Sciences, LB Nagar, Hyderabad.

Method of collection data: All patients referred to the Department of Radio-Diagnosis for MRI evaluation of brain with clinically suspected cerebral ischemic stroke in a period of 2 years from 2020 May to 2021 May. Study done using **16 CHANNEL GE MRI MACHINE 1.5 TESLA with HDXT SOFTWARE.**

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.
- Rule out the stroke mimics Tumors are stroke-mimics that should be ruled out. Migraines and seizures are other diseases that could present with stroke-like symptoms and require imaging for ruling out the stroke[31].

RESULTS:

A total of 182 patients who were admitted to Kamineni Academy of Medical Sciences with aclinical diagnosis of stroke were included in our study.

Table 1: Age distribution in males and females of patients studied

Age in years	**Gender & percentage**				**Total no**	**Total %**
	Female	**Percentage %**	**Male**	**Percentage %**		
<30	0	0%	0	0%	0	0%
30-40	2	3.33%	8	6.55%	10	5.49%
41-50	20	33.33%	25	20.49%	45	24.72%
51-60	23	38.33%	52	42.62%	75	41.20%
61-70	9	15%	31	25.40%	40	21.97%
71-80	5	8.33%	4	3.27%	9	4.94%
>80	1	1.66%	2	1.63%	3	1.64%
Total	**60(32.96%)**	**100%**	**122 (67.03%)**	**100%**	**182**	**100%**

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Out of 182 majority **67.03%** were males and 32.96% (60) were females and most of the individuals are under age group of 51-60 yrs in both males (42.62**%**) and females (38.33**%**) respectively

Table 2: Symptoms distribution of patients studied

Symptoms	**Gender & percentage**				**Total (n=182)**	**Total %**
	Female (n=60)	%	**Male (n=122)**	**%**		
Weakness	26	43.33%	22	18.03%	48	26.37%
Loss of consciousness	17	28.33%	56	45.90%	73	40.10%
Slurring ofspeech	9	15%	42	34.42%	51	28.02%
Seizures	8	13.33%	2	1.63%	10	5.49%

In the present study most common symptom was weakness (43.33%) in females followed by loss of consciousness (28.33%) and the commonest in males was (45.90%) loss of consciousness followed by slurring of speech (34.42%)

Table 3: Co-morbidities distribution of patients studied

Co-morbidities	**Gender & percentage**				**Total (n=182)**	**Total %**
	Female (n=60)	**%**	**Male (n=122)**	%		
Hypertension	39	65**%**	54	44.26**%**	93	51.09**%**
Diabetes Mellitus	18	30**%**	58	47.54**%**	76	41.75**%**
Cardio vascular diseases	3	5**%**	10	8.19**%**	13	7.14**%**

In our study hypertension was the most common (65**%)** comorbidity in females followed by diabetes (30**%**) where as in males both hypertension (44.26**%**) and diabetes (47.54**%**) were almost equal and the overall incidence of hypertension was the most predominant risk factor (51.09**%**) followed by diabetes (41.75**%**

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Table 4: Gender and Location Wise Distribution of Various Cerebral Lessions

Infracts type	Laterality	Gender				Total (n=182)	Total %
		Female (n=60)	%	Male (n=122)	%		
Middle cerebral artery	Right	39	65%	54	44.26%	93	51.09%
	Left	18	30%	58	47.54%	76	41.75%
	Bilateral	3	5%	10	8.19%	13	7.14%
Total		60	100%	122	100%	182	100%
Posterior cerebral artery	Right	39	65%	54	44.26%	93	51.09%
	Left	18	30%	58	47.54%	76	41.75%
	Bilateral	3	5%	10	8.19%	13	7.14%
Total		60	100%	122	100%	182	100%
Anterior cerebral artery	Right	39	65%	54	44.26%	93	51.09%
	Left	18	30%	58	47.54%	76	41.75%
	Bilateral	3	5%	10	8.19%	13	7.14%
Total		60	100%	122	100%	182	100%
Infarcts in other locations	Watershed infarct	0	0%	8	6.55%	8	4.39%
	Vertibro basilar artery	8	13.33%	12	9.83%	20	10.98%
	Lacunar infarct	6	10%	19	15.57%	25	13.73%
	Multiple	11	18.33%	34	27.86%	45	24.72%
	White matter ischemic changes	6	10%	11	9.01%	17	9.34%
	Diffusion weighted image	29	48.33%	38	31.14%	67	36.81%
Total		60	100%	122	100%	182	100%
Sequence	Apparent diffusion co-efficient	29	48.33%	66	54.09%	95	52.19%
	T2W Fluid attenuation inversion recovery	22	36.66%	46	37.70%	68	37.36%

	Gradient	9	15%	10	8.19%	19	10.43%
Total		60	100%	122	100%	182	100%
Hemorrhagic	Yes	19	31.66%	31	25.40%	50	27.47%
transformation	No	41	68.33%	91	74.59%	132	72.52%
Total		60	100%	122	100%	182	100%

In all the three types of cerebral lessions right lateralness was identified most common followed by left and bilateralrespectively. diffusion weighted image was the common infarcts in other locations in both males (31.14%) and females(48.33%). apparent diffusion co-efficient was the most common in sequence in both males (54.09%) and females (48.33%)

Table 5: DWI / T2 FLAIR positive (Acute /Subacute Infarct)

DWI / T2 FLAIR	**No. of patients**	**%**
DWI /T2FLAIR NEGATIVE(ACUTE)	69	37.91%
DWI & T2FLAIR POSITIVE (SUBACUTE)	113	62.08%
Total	182	100%

37.91% were DWI /T2FLAIR was shown negative in acute cases where as 62.08% subacute cases wereDWI & T2FLAIR positive.

Table 6: Gender & Age wise distribution of patients studied in relation to the distribution of acuteand sub-acute cases

Age in years					**Total no**	**Total %**
	Female		**Male**			
	Acute	**Subacute**	**Acute**	**Subacute**		
<30	0(0%)	0(0%)	0(0%)	0(0%)	0	0%
30-40	2(3.33%)	1(1066%)	3(2.45%)	4(3.27%)	10	5.49%
41-50	9(15%)	11(18.33%)	8(6.55%)	17(13.93%)	45	24.72%
51-60	4(6.66%)	19(31.66%)	12(9.83%)	40(32.78%)	75	41.20%
61-70	1(1.66%)	9(15%)	6(4.91%)	24(19.67%)	40	21.97%
71-80	0(0%)	3(5%)	2(1.63%)	4(3.27%)	9	4.94%
>80	0 (0%)	1 (%)	0(%)	2(1.63%)	3	1.64%
Total	**16**(26.66%)	**44**(73.33%)	**31**(25.40%)	**91**(74.59%)	**182**	**100**%

P=0.539, Significant, Fisher Exact test, P=0.499, Significant, Chi-Square test

Most of the males (44, 74.59%)) and females (91, 73.33%) were with subacute infractions than acute infractions. Most of the acuteinfractions in females (9, 15%) fall under the age group of 41-50 yrs whereas (19, 31.66%) were under 51-60 yrs age. In males both acute (12, 9.83%) and subacute infractions (40, 32.78%) are under the age group of 51-60 yrs.

Table 7: Symptoms in relation to the distribution acute and sub-acute cases

Symptoms	**Acute/Sub Acute**		**Total (n=182)**	**P value**
	Acute(n=47)	**Subacute (n=135)**		
Weakness	8(17.02%)	40 (29.62%)	48(26.37%)	1.000
Loss of consciousness	28(59.57%)	45(33.33%)	73(40.10%)	0.958
Slurring of speech	7(14.89%)	44(32.59%)	51(28.02%)	0.568
Seizures	4(8.51%)	6(4.44%)	10(5.49%)	1.000

Chi-Square –test/Fisher Exact test

Loss of consciousness was the commonest symptom in acute (28, 59.57%) and subacute infractions (45, 33.33%).

Table 8: Comorbidities in relation to the distribution acute and sub-acute cases

Comorbidities	**Acute/Sub Acute**		**Total (n=182)**	**P value**
	Acute(n=47)	**Subacute(n=135)**		
Hypertension	31 (65.95%)	62 (45.92%)	93 (51.09%)	0.754
Diabetes Mellitus	13 (27.65%)	63 (46.66%)	76(41.75%)	0.934
Cardio vascular diseases	3(6.38%)	6(4.44%)	13(7.14%)	1.000

Chi-Square –test/Fisher Exact test

Diabetes (63,46.66%) and hypertension (62,45.92%) were the most common morbidities in subacute infractions than inacute cases. And hypertension was found to be the most prevalent (93,51.09%) risk factor in both subacute and acute cases

Table 9: Location Wise Distribution of Various Acute and Subacute Cerebral Lessions

Infarcts type	**Laterality**	**Acute(n=47)**	**Subacute (n=135)**	**Total (n=182)**	**P value**
Middle cerebralartery	Right	30(63.82%)	65 (48.14%)	95 (52.19%)	1.000
	Left	14 (29.78%)	60 (44.44%)	74 (40.65%)	0.781
	Bilateral	3(6.38%)	10 (7.40%)	13(7.14%)	1.000
Total		47	135	182	
Posterior	Right	29 (61.70%)	62 (45.92%)	91 (50%)	1.000

cerebralartery	Left	13(27.65%)	63 (46.66%)	76 (41.75%)	1.000
	Bilateral	5(10.63%)	10 (7.40%)	15 (8.24%)	1.000
Total		47	135	182	
Anterior cerebralartery	Right	31(65.95%)	59 (45.92%)	90 (49.45%)	1.000
	Left	13 (27.65%)	65 (46.66%)	78(42.85%)	0.079+
	Bilateral	3(6.38%)	11(4.44%)	14(7.69%)	1.000
Total		47	135	182	
Infarcts in otherlocations	Watershed infarct	0(0%)	8 (5.92%)	8	1.000
	Vertibro basilarartery	0(0%)	20 (14.81%)	20	0.594
	Lacunar infarct	25(53.19%)	0 (0%)	25	0.733
	Multiple	13(27.65%)	32(23.70%)	45	0.210
	White matter ischemic changes	9(19.14%)	8 (5.92%)	17	1.000
	Diffusion weighted image	0(0%)	67 (49.62%)	67	1.000
		47	135	182	
Sequence	Apparent diffusion co-efficient	31(65.95%)	62 (45.92%)	93 (51.09%)	0.204
	T2W Fluid attenuation inversion Recovery	13 (27.65%)	63 (46.66%)	76(41.75%)	1.000
	Gradient	3(6.38%)	10 (7.40%)	13(7.14%)	1.000
Total		47	135	182	

Chi-Square –test/Fisher Exact test

Right sided cerebral artery lessions were commonest in all three types of cerebral artery lessions in both acute and subacute infractions. Diffusion weighted image was common in subacute infractions whereas Lacunar infarct was the commonest in acute infractions. T2W Fluid attenuation inversion Recovery of sequence was major in subacute (63,46.66%) and

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Apparent diffusion co-efficient type of sequence was (31,65.95%) common in acute infractions

DISCUSSION:

This study was directed to evaluate the role of MRI in patients presenting with cerebral ischemic stroke, to age the infarct based on MR sequences, to study the common vascular territoryinvolvement in ischemic stroke and to note the common age group and sex in ischemic stroke.

A total of 47 patients were presented in the acute stage of infarction and rest 135 were presented in the subacute stage. DWI along with ADC mapping proved to be more sensitive than the conventional MR sequences to identify acute infarction.

AGE AND SEX:

The age structure of the study population in this series varies from the 3rd to 9th decade. The youngest patient was 25 years old and the oldest was 86 years old. Maximum number of caseswas noted in the 51-69 years of the total 182 cases of infarcts, the mean age at imaging was 54.53±12.90 years. This correlated with study of A. Shuaib et al[24], who had reported a similar meanage of onset of 66 years and with the study of Hideo Tohgi et al[25] who reported a mean age of 65.6years. Regarding cerebral hemorrhage, the maximum incidence was found to be between 51-60 years in our series. This is similar to the study by Harrison et al[26], where maximum cases were between 50-59 years (33.33%).

In a review of stroke epidemiology by Feigin; they concluded that the average age of patients affected by stroke is 60 years in men and 75 years in women. Our statistics shows a similar age reflection. Among our 182 cases, 60 (32.96%) were females and 122 (67.03%) were males.

A distinct male preponderance was noted in our study. This correlated with the study of Hideo Tohgi et al and A. Shuaib et al. But the noteworthy point is that amongst the female population evaluated, our study shows women in older age group to suffer more from ischemicstroke which is similar to statistics by Reid JM et al[27].

Gender specific risk factors of women shows increased preponderance of stroke in diabetes mellitus[28].

RISK FACTORS:

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 93 (51.09%) followed by diabetes mellitus 76 (41.75%). Cardiovascular disease and atrial fibrillation contributed for about 13 (7.14%).

This observation correlated closely with Andrew Kertesz et al, and Hideo Tohgi et al. Butthe incidence of diabetes mellitus was found to be higher in our study group.

Kuller LH et al[29], study showed stroke was 2.5 – 4 times more common in diabetics.

In our study both diabetes mellitus (51.09%) and hypertension (41.75%) were found predominant in both genders which suggests a multi factorial risk etiology.

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ISCHEMIC STROKE:

The percentage of infarcts reported in NEMESIS series was 72.5%; stroke data bank 80.9%and oxford shire community stroke project is 81%. Our study results are comparable with the various above mentioned studies.

The most common vascular territory involved in our study was the MCA. There was greaterinvolvement of the right MCA.

H. Naess et al[30-32]., conducted that the left MCA territory was more involved compared to right MCA territory mainly among male subjects. PCA territory involvement was next common with left sided involvement.

Lacunar infarcts were noted in 25 (53.19%) patients, which is also comparable with VSA – stroke register (R.L. Sacco et al) 15.30% and North East China stroke (X Long et al) 15.2%.

COMPARISON OF DWI AND CONVENTIONAL MR IMAGING IN ACUTE INFARCTS:

The total number of acute infarcts in our study is 47. Both conventional T2W and DWI sequences were positive in 113. Acute infarcts seen only on diffusion and not visualized in conventional imaging T2W were 69.

Out of the 182 lesions also seen on conventional imaging, the extent of the lesions were better detected with MRI. 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 and40% sensitivity and 92% specificity with CT.

These results are consistent with our results and substantiate the superiority of MRI over conventional techniques.

CONCLUSION:

Acute ischemic stroke is a heterogeneous disease, with major stroke caused by proximal artery occlusions representing the stroke subtype with the most devastating outcomes. Because there are effective treatments for majorstrokes, the primary role of imaging is to identify these patients rapidly and accurately. MRI is particularly powerfulin depicting the most important relevant physiology in acute ischemic stroke: the occlusion site and the size of the infarct core.The present study is a prospective study and included patients with suspected cerebral ischemic stroke. This study is an analysis of the epidemiological trends (age, sex); risk factors (hypertension, diabetes mellitus, smoking and cardiac disease); vascular distribution of infarcts.The results obtained from our study are wellcomparable with other stroke surveys. Differences in pattern of stroke may be related to genetic, environmental or sociocultural factors and to differences in the control of risk factors. 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. 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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