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Original Research Article

A Study on Role of MRI in Detection of Cerebral Ischemic Stroke in Kalaburagi Region

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Abstract

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. Incidence of negative cases (stroke mimics).

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 November 2014 to September 2016.The main source of data for the study are patients from Basaveshwara teaching and general hospital attached to M R Medical College Kalaburagi. All MRI scans were performed on a 1.5 T Philips Achieva.

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: 150 patients who were clinically suspected of cerebral ischemic stroke were subjected to MRI study of the brain. Among these 150 patients, 77.33% had infarcts, 10.33% had intracerebral hemorrhage, 5.31% patients had cerebrovenous thrombosis, 4% patients had subarachnoid hemorrhage and 3.03% patients had tumours. However 5 patients had normal scans and was excluded from our series.

Predominant risk factors were hypertension and diabetes mellitus. Men were commonly affected. Youngest age group was 17 years and oldest was 84 years.

MCA territory (L>R) was the commonest territory involved in patients with cerebral infarction.

Conclusion: The present study is a prospective study. The results obtained from our study are well comparable 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 non invasive and there is no radiation hazard. Excellent grey – white matter resolution and multiplanar imaging capability of MRI helps in detection of subtle lesions. Our study observed that diffusion weighted imaging add sensitivity and specificity to the standard MR evaluation.

Keywords: Cerebral ischemic stroke, Haemorrhage, Stroke mimics, MRI.

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Introduction

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 a annual stroke incidence(per 100,000 persons) of about 124 in rural areas and 145 in urban areas. [2]

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.

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 it 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 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 MR 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 extracranial and intracranial circulation for evidence of IV thrombus), *Perfusion* (assess CBV, CBF and MTT), 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. [6]

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 and in detecting hemorrhages. MR angiography enables to assess status of neck and intracranial vessels. MR spectroscopy provides information regarding the abundance of metabolites. [6]

Advantages of MRI over CT are, it is sensitive in the detection of edema, provides multiplanar 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]Correlation of the MRI findings with the clinical features is very helpful in arriving the diagnosis and look for involvement of the specific sites. [6] 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 a early stage may be useful. In this study,we explain the significance and feasibility of multiplanar MRI for the initial evaluation of stroke and also to rule out the presence of hemorrhage or other stroke mimics. We also brief;y compare the utility of DWI and T2WI in acute infarcts .

Methodology

The main source of data for the study are patients from the Basaveshwara teaching and general hospital attached to M.R. Medical college kalaburagi.

Method of collection data :

All patients referred to the Department of Radio-Diagnosis with clinically suspected cerebral ischemic stroke in a period of 2 years from November 2014 to September 2016. Initially a minimum of 50 cases were intended to be taken-up, however the number of cases were extended upto 150 as there was good availability within the study period. All MRI scans were performed on a 1.5T Philips Achieva.

Inclusion Criteria:

- All patients clinically suspected of cerebral ischemic stroke
- Cases of all age groups irrespective of sex.

Exclusion Criteria:

- Patients with history of metallic implant, foreign body, pacemaker, aneurysm clip, recently implanted prosthetic valve.
- Patients too unstable undergo MRI scan who are on ventilator support.
- Patients with history of claustrophobia.

Results

150 cases admitted in the Basaveshwara teaching and general hospital attached to M.R. Medical college kalaburagi with clinical diagnosis of cerebral ischemic stroke were taken up for the study. Out of 150 patients clinically suspected of cerebral ischemic stroke submitted for MRI scan study of brain, 116 patients had infarction 15 patients had hemorrhage 19 patients had stroke mimics.

Table 1: Case distribution

	No. of cases	Percentage
Infarcts	116	77.33
Hemorrhage	15	10.33
Stroke mimics	18	12.34

Table 2: Infarcts in vascular territory (n=116)

Vascular territory factors	No. of cases	Percentage
MCA	56	39.66
PCA	14	12.07
ACA	6	5.17
Watershed infarcts	1	0.86
Lacunar infarcts	18	15.52
Multiple infarcts	7	6.03
Basilar except PCA	9	7.76
WMIC	15	12.93

From the above table, it reveals that the most commonly involved vascular territory is of the middle cerebral artery.

Table 3: Total number of MCA territory infarcts (n=46)

	Site of involvement	No. of cases	Percentage
Right		15	33.0
Left		29	63.0
Bilateral		2	4.0

Table 4: Total number of PCA territory infarcts

	Site of involvement	No. of cases	Percentage
Right		8	57.0
Left		5	36.0
Bilateral		1	7.0

Table 5: Total number of ACA territory infarcts

	Site of involvement	No. of cases	Percentage
Right		3	50.0
Left		2	33.0
Bilateral		1	17.0

Table 6: Categories of infarct related stroke (n=116)

Categories	No. of cases	Percentage
Large vessel disease	42	36.21
Cardioembolic disease	26	22.41
Small vessel	34	29.31
Vasculitis	3	2.59
Others	11	9.48

Table 7: Type of infarcts (n=116)

Types	No. of cases	Percentage
Acute infarcts	74	63.79
Chronic infarcts	25	21.55
Acute and chronic	17	14.66

Table 8: Comparison between DWI and conventional T2 WI in acute infarcts (n=74)

	No. of cases	Percentage
Conventional and diffusion positive cases	42	56.75
Conventional negative and diffusion positive cases	32	43.25

Using simple visual analysis of DW images, we found that areas of cerebral infarction have high signal intensity and these lesions showed corresponding decreased signal on ADC maps, creation of ADC maps negates the T2 'shine through' effect that can contribute to lesion signal hyperintensity on diffusion weighted imaging.

Table 9:

	No. of cases	Percentage
Detected by DWI	74	100
Detected by T2 WI and DWI	39	52.8

From the above table, all (74) acute infarcts were detected by DWI. This is over and above the 39 infarcts detected using conventional MRI. It is evident that the number of acute infarcts detected by DWI is significantly higher than conventional MR imaging.

Table 10: Incidence of hemorrhage in different parts of the brain (n=15)

Area	No. of cases	Percentage
Basal ganglia	6	40.0
Thalamus	1	6.67
Cerebellum	2	13.33
Lobar	3	20.0
Brainstem	3	20.0

It can be assumed that there is greater involvement of the basal ganglia in case of intraparenchymal hemorrhage.

Table 11: Stroke mimics (n=19)

Stroke mimics	No. of cases	Percentage
SAH	6	31.58
CVT	8	42.11
Tumours	5	26.31

Commonest stroke mimics was CVT out of which 7 were females and 1 male.

Discussion

This study was directed to evaluate the role of MRI in patients presenting with cerebral ischemic stroke and also to differentiate from hemorrhage and other stroke mimics and also to study the common vascular territory involvement in ischemic stroke and to note the common age group and sex in ischemic stroke, haemorrhage and other stroke mimics.

A 50 patients clinically suspected of stroke were submitted for MRI scan of brain, among these, 116 (77.33%) had cerebral infarction and 15 (10.33%) had intracerebral hemorrhage.

According to Mumbai stroke registry, 80.2% (366 out of 407) had ischemic stroke and 17.7% (81 out of 401) had hemorrhagic stroke which is similar to our study. [7] Lausanne stroke registry also showed 82.2% infarcts. [8] Our study showed 77.33% of infarction; 10.33% of intracerebral hemorrhage; 5.31% of cortical venous thrombosis; 4% of subarachnoid hemorrhage; 3.03% of tumours. Framingham study showed 85% cases of ischemic stroke secondary to cerebral atherothrombosis and cardioembolism; 7.3% of subarachnoid hemorrhage; 6.7% of parenchymal hemorrhage; 1.70% of other types of hemorrhage. [9] Out of 150 cases, we observed 116 (77.33%) cases with infarction. The percentage of infarcts reported in NEMESIS series was 72.5% [10]; stroke data bank 80.9% [11] 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, accounting for 39.66% (46 cases) of all infarcts. There was greater involvement of the left MCA. H. Naess et al., also conducted that the left MCA territory was more involved compared to right MCA territory mainly among male subjects. This could be associated with more frequent atherosclerosis in the left carotid artery, lateralization of cortical functions or both. [12] PCA territory involvement was noted in 14 patients (12.07%) with 8 cases showing right sided involvement. 6 patients were noted to have ACA territory involvement, out of which 3 patients had right sided involvement. Involvement of basilar artery territory except posterior cerebral artery was noted in 9 patients (7.76%). Lacunar infarcts were noted in 18 patients (15.52%), which is also comparable with VSA – stroke register (R.L. Sacco et al) 15.30% [13] and North East China stroke (X Long et al) 15.2%. [14]

Solely white matter ischemic changes were noted in 15 (12.93%) cases. Most of these were clinically diagnosed as transient ischemic attacks. Few cases were also attributed to carotid stenosis. Out of these 15 cases, 11 cases showed periventricular hyperintensities – 5 cases were classified as grade – I [small caps (5mm or less in diameter) / thin lining (5mm or less) with regular margins]; 4 cases as grade – 2 [large caps (6-10 mm in diameter) / smooth halo (6-10 mm broad) with irregular margins]; and 2 cases as grade – 3 [extending cap (10 mm in diameter) / irregular halo (10mm in diameter) with irregular margins]. 4 cases showed white matter hyperintensities in deep and subcortical white matter. Also 6 cases showed foci of acute infarction within these white matter hyperintensities on diffusion weighted imaging.

Multifocal infarcts were seen in 7 (6.03%) cases. Multifocal infarcts included those infarcts in different arterial territories excluding the lacunar infarcts and white matter ischemic changes.Only 1 case of watershed infarction were noted, which involved right middle cerebral artery – post cerebral artery territory and were attributed to embolic etiology.

Small artery occlusion includes patients with lacunar infarcts and white matter ischemic changes with no potential cardiac sources for embolism / athero-sclerotic cause. All cases under vasculitis had supportive diagnostic blood tests with correlative imaging findings. Stroke of undetermined etiology include patients with no definite cause of stroke / when this / more potential causes are attributed but unable to make a final diagnosis. Our study shows 36.21% cases of large vessel disease (atherothrombotic); 22.41% cases of cardioembolic origin; 29.31% cases of small vessel disease; 2.59% of vasculitis and 9.48% cases of unknown origin. The TOAST subtype classification system (TRIAL of Org 10172 in

acute stroke treatment) includes five categories : 1) large artery atherosclerosis; 2 cardioemboli; 3) small artery occlusion; 4) stroke of other determined etiology and 5) stroke of undetermined etiology. [15] We classified patients with cortical, cerebellar brainstem, subcortical infarcts >1.5 cms as large artery atherosclerosis with added findings of stenosis / occlusion of a major brain artery / branch cortical artery. The cardio-embolic category of stroke included patients with similar parenchymal changes in whom large artery atherosclerotic causes are ruled out / with evidence of a previous TIA or stroke in more than one vascular territory and with high and medium risk sources of cardioembolism. The total number of acute infarcts in our study is 74. Both conventional T2W and DWI sequences were positive in 42 (56.75%). Acute infarcts see only on diffusion and not visualized in conventional imaging T2W were 32 (43.25%).Out of the 52 lesions also seen on conventional imaging, the extent of the lesions were better detected with diffusion imaging. The 42 infarcts picked up only by diffusion weighted imaging presented within 6 hours (mean of 4.35 hours) of symptom onset to our hospital. 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. [16] 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. [17] These results are consistent with our results and substantiate the superiority of DWI over conventional MR imaging. The percentage of hemorrhagic stroke in our study population was 10.33% (15). This is comparable with following studies : NEMESIS 14.5%; LAUSANNE stroke registry 9.17% and Oxford shire community stroke project 10%. [18] In our study 40.0% (6) cases showed intracerebral hemorrhage in basal ganglia; 20.0% showed lobar involvement; 20.0% showed in brainstem; 13.33% (2) in cerebellum and 6.67% (1) showed thalamic involvement. Lausanne registry also showed 42% of lenticulocapsular involvement; 8% cerebellum; 4% thalamus; 6% in brainstem and 40% lobar involvement. These results were comparable with our study.

Conclusion

MRI is non invasive and there is no radiation hazard. Excellent grey – white matter resolution and multiplanar 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.

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