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Evaluation Of Stroke On Magnetic Resonance Imaging In A Subset Of Pondicherry Population

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Abstract

Background

Globally, stroke is the second principal reason of death and third foremost cause of disability. Central nervous system infarction can be defined as the death of brain tissue, spinal cord, or retinal cell due to ischemia, based on neuropathological, neuroimaging, and/or clinical indication of permanent injury. 1

Aim & Objectives

To assess the role & utility of MRI in stroke Evaluation and to differentiate between ischemic and hemorrhagic stroke.

To analyze the epidemiological trends, risk factors, vascular distribution of infarcts& pattern of hemorrhage.

Material And Methods

This study was conducted using Siemens Magnetom Essenza 1.5 T in the Department of Radiodiagnosis, Shri Lakshmi Narayana Institute of Medical Sciences, Puducherry, from November 2019 to May 2021.

Results

Majority of Patients in our study were in age group 60- 69 years . Male preponderance was observed. Hypertension was the most common risk factor . Hemiplegia was the most common presenting complaint followed by gait disturbance. Infarct was the main etiology and MCA territory was the commonest territory involved followed by PCA.

Conclusion

Stroke continues to be a leading cause of mortality and morbidity globally. Infarction was the most common etiology. Risk factors such as diabetes, atrial fibrillation etc lead to ischemic stroke and are more commonly seen in our population hence ischemic infarct is more common etiology of stroke. 2,3

The absence of ionizing radiation, direct visualization of infarct extent through DWI, estimation of stroke age using DWI, FLAIR, and ADC, and MRI has the ability to detect small but clinically relevant areas of ischemia and hypoperfusion (including lacunes and lesions not well seen by CT).

Keywords: Stroke, MRI, MRA, Ischemic, Hemorrhage

Introduction

Globally, stroke is the second principal reason of death and third foremost cause of disability. Stroke occurs average 15 years earlier among the population in middle and low income countries [1]. Stroke is the leading cause of death and disabililty in India with the incidence rate of 119-145/100,000 and prevalence rate is 84-262/100,000 in rural and 334-424/100,000 in urban area[2].

Central nervous system infarction can be defined as the death of brain tissue, spinal cord, or retinal cell due to ischemia, based on neuropathological, neuroimaging, and/or clinical indication of permanent injury. The revised definition of stroke integrates both clinical as well as tissue criteria and can be incorporated into practice, research, and assessments of the public health[3].

Stroke can be of two types; Ischemic stroke (infarction) accounting for 80% of cases of stroke and Hemorrhagic stroke (including primary spontaneous intracranial hemorrhages, subarachnoid hemorrhages and venous occlusion) accounting for 20% of cases of stroke.

The clinical symptoms indicative of stroke are sudden numbness or weakness on one side of the body either face, arm or leg, confusion, sudden difficulty in speaking, swallowing, vision, walking, dizziness, loss of coordination, excessive headache with unidentifiable cause, hiccups or nausea, palpitations, chest pain or dyspnea.

Stroke continues to be a leading cause of mortality and morbidity globally. The goals of an imaging evaluation for acute stroke are to establish a diagnosis as early as possible and to obtain accurate information about the intracranial vasculature and brain perfusion for guidance in selecting the appropriate therapy to prevent permanent damage

In general opinion, CT is still considered as the gold standard technique prior to thrombolysis, the advanced reperfusion approaches in acute stroke due to ischemic cause however require more extensive use of MRI. Although with CT we can primarily differentiate between ischemic stroke and hemorrhagic stroke, we can't exactly differentiate between acute, subacute and chronic ischemic strokes, which is essential for administering intravenous tPA. With MRI on the other hand by just doing a few sequences- T1WI, T2WI, FLAIR, SWI, DWI which each takes about 5 minutes, thus saving the precious 'door to needle time' we can accurately differentiate between ischemic and hemorrhagic stroke and also differentiate between acute, subacute and chronic ischemic strokes, without increasing the risk of radiation exposure to the patient an in case of CT

MRI helps in differentiating between hemorrhagic, ischemic and any other cause of stroke. MRI is also beneficial in precisely differentiating between various stages of stroke like - early hyperacute (0-6 hours), late hyperacute (6-24 hours), acute (24 hours- 1 week), subacute (1-3 weeks), or chronic (>3 weeks) stroke.

This is essential to make decision regarding employing intravenous thrombolytic therapy in timely manner[6].

MRI is the most sensitive and specific imaging technique for diagnosing cerebral infarction and various MRI features are studied under three heading- Parenchyma, perfusion and vasculature.

Hyperacute stage is divided based on the time in early hyperacute(0-6 hours) and late hyperacute(6-24 hours). Both show high signal on DWI and corresponding low signal intensity on ADC, isointense on T1-weighted images.

During the hyper acute (< 6hrs) and acute (<1 week) stages of cerebral ischemia, loss of normal vascular flow voids represents the earliest possible MRI finding using conventional spin-echo sequences.

Morphological changes in brain parenchyma caused by tissue swelling may be seen as early as 6 hours after onset of ischemia on T1W images, T2W, FLAIR and PD weighted images.

During the sub-acute (1 to 4 weeks) stage of cerebral ischemia, mass effect and edema stabilize during the second week. Hyperintensity on T2 W regress / disappear - 'fogging'.

The chronic stage (> 4 weeks) begins when the integrity of blood brain barrier in restored, edema has resolved and most of resorption of necrotic tissue is complete . This leads to glial scarring, encephalomalacic cysts, shrunken gyri, enlarged sulci and adjacent ventricular dilatation.

Magnetic Resonance Angiography (MRA) enables the noninvasive evaluation of vascular patency. MRA is useful technique for display of major cerebral vascular anatomic details in stroke as well as to provide functional information about dynamics of flow in circle of Willis. MRA is useful for detecting intravascular occlusion due to a thrombus and for evaluating carotid bifurcation in acute stroke patients.

Aim & Objectives

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1. To assess the role of Magnetic Resonance Imaging in stroke Evaluation.
2. To assess utility of MRI to differentiate between ischemic and hemorrhagic stroke.
3. To analyse the epidemiological trends, risk factors, vascular distribution of infarcts.
4. To analyse the pattern involvement of hemorrhage.

Material And Methods

This study "Role of Magnetic Resonance Imaging In Stroke" was conducted in the Department of Radiodiagnosis, Shri Lakshmi Narayana Institute of Medical Sciences, Puducherry, from November 2019 to May 2021.

All patients clinically suspected to have stroke were referred from various departments of our institute and were subjected to MRI examination with stroke protocol including DWI and ADC (axial), T1W, FLAIR, T2W (axial), T2W (coronal) and MRA(TOF) after obtaining a written and informed consent.

Patients with stroke detected on MRI, from all age groups irrespective of their gender were included in our study with documentation of risk factors, time of onset of symptoms and presenting clinical features.

Inclusion Criteria-The criteria for inclusion of the patients in the study included the patients who were clinically referred for MRI of the brain and detected to have acute stroke.

Exclusion Criteria- Patients who are detected to have traumatic brain injury excluded from the study and patients with Claustrophobia.

Results

The present study is a prospective analysis of the epidemiological trends, risk factors, vascular distribution of infarcts, pattern involvement of hemorrhage based on MRI findings in 100 patient who were clinically suspected of stroke were subjected to MRI study of the brain.

The results are of our study are summarized as below:

Majority of patients were in age group 60-69 years (23%) and mean age of patients was 56 years. Male preponderance was observed with a M:F ratio of 7:3.

Risk factors like hypertension, diabetes mellitus, smoking and cardiac disease play major role in the evolution of stroke. About 34% patients had both diabetes mellitus and hypertension.

About 45.3% of patients presented clinically with hemiplegia. Gait disturbance, facial palsy, vertigo, vomiting and headache were among the other common clinical features at presentation.

Infarction was the most common aetiology of stroke seen in 87% most common followed by intracerebral haemorrhage seen in 12% patients and stroke mimics (intracerebral tumor)1% patient.

With DWI and ADC sequence the exact age of infarct could be diagnosed and were categorized into four groups based on the time since onset of stroke. 39.1% cases of hyperacute, 47.13% patients with acute, 9.2% patients had subacute and 4.6% patients had chronic infract were diagnosed.

Infarction was more common in the age group of 50-69 years. Men were affected commonly. The commonest territory involved in patients with cerebral infarction was middle cerebral artery (L > R) and accounted for 51.72% patients, 12.64% patients showed posterior cerebral artery involvement (L = R), 4.6% patients showed anterior cerebral artery involvement (L = R), 8.05% showed watershed infarct, 3.45% showed lacunar infarcts, 6.9% shower basilar artery territory involvement;12.64 % showed multiple infarcts.

34 Patients with hyperacute infract as etiology of stroke showed changes in DWI sequence, whereas 41 patients with acute, subacute and chronic infract as etiology of stroke showed changes in both T2 and DWI sequences.

Hemorrhage was more common in the age group of 60-69 years. Men were affected commonly (75%). Commonest regions affected were basal ganglia affected in 33.33% followed by thalamus in 25% patients.

Discussion

The age structure of the study population in this series varies from the 1st to the 9th decade. The youngest patient was 1year old and the oldest was 85 years old. Maximum number of cases was noted in 60-69 years (23% of patients) of the total 100 cases of stroke, the mean age at imaging was 54 years.

This correlated with study done by Bhattacharya et al, Dalal et al and Sridharan et al in Stroke in India -

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Fact-sheet, with similar mean age of onset of stroke for men in India ranges from 63-65 for men and 57-68 for women and study done by Nagaraja D et al who reported a similar mean age of 54.5 years[4,5,6,7].

High prevalence of stroke risk factors leading onto premature atherosclerosis, unreliability of hospital statistics in estimating the age distribution of stroke occurrences in the community and population structure with smaller proportion of people 60 years have been implicated as reasons for the increased occurrence of stroke in the young in developing countries.[7]

In our study among the 100 cases of stroke 69% were males and 31% females, a distinct male preponderance was noted. Which can be attributed to estradiol has terribly potent effects on endothelia that promote dilation of blood vessels and blood flow, whereas testosterone has opposite effects. This indicates women are protected by endogenous estrogens.

Hypertension (56% patients), diabetes mellitus (52% patients) and hypercholesterolemia (32% patients) were the most common risk factors for stroke seen in our study. Similar observation was made by Puneet K Yadav et al in their study, high cholesterol 36% patients. Hypertension was seen as the most common risk factor for stroke in their study too, though it was higher than in our study in 81% patients [8]Similar findings of hypertension as the ,most common risk factor seen in (60%patients) was seen in study done by P.N. Sylaja[9].

In our study hemiplegia was the most common presenting sign was seen in 45.33% patients Also instability of gait (4.5% patients), vomiting (1.9% patients) and headache (1.1% patients) were common clinical features observed in their study and similar clinical presentations were observed.

Of the total 100 cases in our study 87% strokes were caused due to infarct, 12% due to haemorrhage and 1% case was of stroke mimics.

Infarction was the most common etiology of stroke in their study with cerebral infarcts seen in 68% patients and cerebral hemorrhage in 32% patients [10].Risk factors such as diabetes, atrial fibrillation, previous myocardial infarction, previous stroke, and intermittent arterial claudication lead to ischemic stroke and are more commonly seen in our population hence ischemic infarct is more common etiology of stroke.

Patients with infarct as etiology of stroke were categorized in hyperacute (39.1% patients), acute (47.13% patients), subacute (9.19% patients) and chronic (4.59% patients) based on MRI brain findings on T1,T2,FLAIR, DWI and ADC sequences

In our study distribution of patients on the basis of vascular territory involved in infarct showed MCA territory was the commonest territory involved seen in 51.72% patients. In our study the laterality of involved in the MCA territory infarct was :60% patients had left side, 37.78% patients had right side involved, and 2.22% patient had bilateral MCA territory involved.

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Majority of patients with haemorrhage as the etiology were in the age range of 60-69 years (25% patients). Among the 12% cases of haemorrhage 75% patients were males and 25% females in our study.

In our study 33.33% (4 patients) had haemorrhage in the basal ganglia, 25% (3 patients) in the thalamus,8.33%(1 patient) in the intraventricular region and 33.33%(4 patients) in the lobar region.

Conclusion

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.

The absence of ionizing radiation, direct visualization of infarct extent through DWI, straightforward estimation of stroke age using DWI, FLAIR, and ADC, and MRI has the ability to detect small but clinically relevant areas of ischemia and hypoperfusion (including lacunes and posterior fossa lesions not well seen by CT).

There are several hurdles to widespread use of hyperacute MRI for ischemic stroke, as well as its

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use in the subacute and chronic stroke population. MRI is often not rapidly available to the local emergency department. Although customized sequences can reduce the acquisition time to 15 min, MRI has a longer imaging time than CT. In addition, MRI is contraindicated in patients with certain metallic implants, including pacemakers

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