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ORIGINAL ARTICLE

Examining the Role of Magnetic Resonance Imaging (MRI) in Cerebral Ischemic Stroke: A Cross-Sectional Study

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ABSTRACT

Objective: The aim of this study is to examine the role of Magnetic Resonance Imaging (MRI) when detecting cerebral ischemic stroke.

Study design: A cross-sectional study

Place and Duration: This study was conducted at Sandeman Provincial Hospital/ Bolan medical complex hospital Quetta, Quetta from March 2021 to March 2022

Methodology: Age and gender distribution of infarcts was done to find out the territory and location of the blood vessels involved. Overall, 52 individuals were involved in this research. Every patient was clinically suspected to have a cerebral ischemic stroke during the time span of our research. HDXT software with 1.5 Tesla 16 channel GE was used to perform the MRI scans. FLAIR axial, T1WI axial, T2WI axial and coronal, ADC maps, and gradient echo axial were the sequences used. SWI was optional.

Results: The age group which was above 60 years included more percentage of males than females. It was seen that in the age group above 60 years, infarction was the most common and hypertension was the most common risk factor. Hemiplegia (Weakness) was seen to be the most common clinical presentation. It was seen that middle cerebral artery (MCA) territory infarcts had a slight rise on the right side. On the diffusion-weighted imaging (DWI), restricted diffusion was seen from subacute as well as acute infarcts along with a low apparent diffusion coefficient (ADC)valves. T2 FLAIR was normal in acute infarcts, but changes were reflected by DWI.

Practical implication : Expanding the rationale for acute stroke thrombolysis may be more rationally accomplished by comprehending the clinical implications of numerous valuable MRI findings and thoroughly incorporating those factors into treatment decision-making.

Conclusion: No radiation hazard is seen in MRI and it is non-invasive. The multiplanar imaging ability and grey-white resolution of the MRI perceive the subtle lesions. Infarcts are detected early due to the sensitivity of MRI to altered water content.

Keywords: magnetic resonance imaging, stroke, cerebral infarcts,

INTRODUCTION

Stroke is caused by cerebrovascular illness and is described as a sudden and non-convulsive focal neurological deficit. The phenomenon of stroke is described as 'insults' in Latin terms and 'apoplexy' in Greek terms [1]. It is also described as an acute loss of focal neurologic deficit. The symptoms of stroke last for more than 24 hours. It can even lead to death due to an apparent cause than that of vascular origin. One of the major causes of disability and death in numerous countries is cerebral ischemic stroke [2]

When the analysis of annual stroke incidence was done through surveys of different regions, it was seen that the incidence of stroke was about 144 in urban areas and 125 in rural areas [3]. Any disorder of the brain caused by a pathologic process of blood arteries is called cerebrovascular disease. The meaning of pathologic process includes rupture of a vessel, occlusion of the lumen by embolus or thrombus, increased viscosity, altered permeability of the vessel wall, or any other alteration in the quality of the blood which is flowing through the cerebral vessels [4].

The larger aspects of the vascular pathologic process are dissection, embolism, rupture of vessels, or thrombosis [5]. Pathologic process is also defined in terms of primary or basic disorders which are hypertensive, arteritis, arteriosclerotic change, atherosclerosis, developmental malformation, and aneurysmal dilatation [6]. Secondary parenchymal alterations in the brain are caused by vascular lesions such as ischemia with or without infarction and hemorrhage [7].

Acute and hyper acute stroke patients were evaluated by Computed Tomography (CT) scans earlier and it was used widely. However, Magnetic Resonance Imaging (MRI) is an advanced method which has better sensitivity that describes the existence of early infarction better than CT scans. Moreover, unique and important information related to early stroke management is also provided by the MRI method [8].

According to Rowley, four P's are included in the MRI of stroke that assesses different functions [9]. The first P is Parenchyma which detects ruling out hemorrhage and detects early signs of acute stroke. The second P is Perfusion which examines the blood volume and blood flow or cerebrum as well as the mean transit time. The third P is Pipes which provides the evidence of IV thrombus by examining extra intracranial and cranial circulation. The fourth P is Penumbra which Identifies tissue at risk of death if ischemia persists without recanalization of the IV thrombus.

Due to MRI, intravascular thrombi is recognized, the difference between salvageable tissue and infarcted tissue is defined, intracranial hemorrhage is detected, appropriate therapy is selected, and clinical outcome is predicted. Infarcts are demonstrated by magnetic resonance sequences. However, the MRI is more sensitive to detect hyper acute ischemia. Penumbra is indicated by a diffusion-perfusion mismatch. The condition of the intracranial vessels and neck can be assessed by magnetic resonance angiography. The abundance of metabolites can be determined using magnetic resonance spectroscopy [10].

When clinical features are linked with the MRI results, it helps in detecting the diagnosis as well as finding engagement of the specific sites. To evaluate acute stroke comprehensively, MRI is used. MRI is useful because it improves selection of patients and it is a technique that allows reliable diagnosis of ischemia and hemorrhage and status of vessels at an early stage. If we compare CT scans and MRI, MRI is beneficial because of its sensitivity to detect edema, beam hardening artefacts lacking, and gives a multi-planar view. Furthermore, no ionizing radiation is linked with the MRI [11].

In this research, we describe the importance and feasibility of MRI for early assessment of stroke as well as to exclude the

existence of hemorrhage and other stroke types. Moreover, the comparison of T2WI and DWI in acute infarcts was also done.

METHODOLOGY

Overall, 52 individuals were involved in this study who are according to the inclusion criteria. Participants who possess symptoms of stroke and were above 30 years (both genders) were included in this research. Participants who were uncooperative and restless and hemodynamically unstable were excluded from this study. Patients who were contraindicated for MRI were also excluded from this research.

HDXT software with 1.5 Tesla 16 channel GE was used to perform the MRI scans. The patient was laying with their face upward on the MRI table of MRI and head coil was positioned. For signal reception and excitation, a circulatory head coil was used. FLAIR axial, T1WI axial, T2WI axial and coronal, ADC maps, SWI axial, TOF (Circles of Willis and neck), and gradient echo axial were the sequences used. It took approximately 20 mins and 53 secs to complete the whole-body MRI. Following the acquisition of localizer pictures, the axial images were titled parallel to the corpus callosum. The axial sections were used to plan the sagittal pictures. On the sagittal/axial sections, coronal pictures were anticipated.

The clinical history of patients that were admitted in the hospital was recorded in detail according to the proforma. For referred cases, a brief history was obtained from outside hospitals. The important data include the age, gender, diabetes mellitus history, ischemic heart disease history, hypertension history, and stroke.

RESULTS

Overall, 52 participants were picked for this research. Table No. 1 shows the gender and age of patients that were involved in this research. This table shows that almost half of the total participants were above the age of 60 years (48%), 43% were from 40 years to 60 years, and 9% were less than forty years. It is seen that more than half of the participants were males and the females represented only 34.7%.

Table No. 2 shows the participants distributed according to their comorbidities and symptoms. The most common symptom seen was hypertension, which represents 71%, and weakness in the limb, which represents 55% along with loss of consciousness, which represents 39%. Moreover, slurring of speech was seen in 19% and seizures in 19% of cases. A large number of participants had diabetes mellitus, which represents 62% of cases.

Table No. 3 shows the data of participants according to the location of the infarct. Middle cerebral artery territory infarcts were found in forty-two participants, representing 21 right-side affection cases. Anterior cerebral artery territory infarcts were found in nine participants, representing 4 right-side affection cases. Posterior cerebral artery territory infarcts were found in eight participants, representing 4 right-side affected cases.

Table 1: gender and age of patients

	N	%
Age (years)		
Below 40	5	9
40 to 60	22	43
Above 60	25	48
Gender		
Male	34	65.3
Female	18	34.7

Table No. 4 shows the distribution of participants according to the MRI sequences. The analysis of DWI shows that the areas of cerebral infarction that were observed were having high signal intensity. Correspondingly, there is a decrease in the apparent diffusion coefficient (ADC) maps' signal. Creating ADC maps negates the T2 shine-through effect, which can contribute to lesion signal hyperintensity on DWI. According to table no. 4, DWI detected all 7 acute infarcts that conventional magnetic resonance sequences missed. The number of acute infarcts revealed by DWI is clearly higher than that detected by conventional MRI.

Table 2: participants distributed according to their comorbidities and symptoms

	Frequency	%
Symptoms		
Hypertension	34	71
Weakness	28	55
Seizures	6	11
Loss of consciousness	21	39
Slurring of speech	10	19
Comorbidity		
Diabetes mellitus	31	62
Others	5	9

Table 3: data of participants according to the location of the infarct

Arteries	Left		Right		Bilateral	
	N	%	N	%	N	%
Middle Cerebral	21	42	19	38	2	4
Anterior Cerebral	4	8	3	6	2	4
Posterior Cerebral	2	4	5	10	1	2

Table 4: distribution of participants according to the MRI sequences

	N	%
Sequences		
ADC	52	100
DWI	52	100
Gradient	44	85
T2WI	7	14
DWI/T2 FLAIR		
Acute	8	15
Subacute	44	85

DISCUSSION

The research of Hideo and Shuaib et al. also shows much the same age group of participants as determined in our research [12, 13]. Both of the research conclude on the point that the cases of infarct are higher in the age group above 60 years. In our research, it was seen that males were dominant in the population. The percentage of males is much greater than the percentage of females. This is also similar to the research of Hideo and Shuaib et al.

Due to the different pathophysiological attributes, different subtypes of strokes have unique risk factors. The most common risk factor seen in our research was hypertension along with weakness and diabetes mellitus. These findings are much alike to the findings of the research done by Andrew Kertesz et al [14]. The research of Kuller et al. also determined similar results [15]. Their study also evaluates that people with diabetes are 4 times more likely to have a stroke. In our research, the middle cerebral artery was seen to be the most engaged vascular territory with the right side of the brain involved [16]. The anterior cerebral artery and posterior cerebral artery are also seen to be involved but not as much as the middle cerebral artery. A total of 8 acute infarcts were found in our study. DWI and T2 FLAIR were positive in 44 participants.

There was a study conducted previously by Mullins et al. in which 691 individuals were involved. It was seen that DWI showed ninety-seven percent sensitivity and one hundred percent specificity. Conventional MRI showed fifty-eight percent sensitivity and hundred percent specificity and CT scans showed forty percent sensitivity and ninety-two percent specificity [17-20]. These outcomes are also similar to the outcomes of our research.

CONCLUSION

Our research concludes that specificity and sensitivity are added to the magnetic resonance evaluation by DWI. DWI also contributes to stroke management. DWI with restricted diffusion proved beneficial in evaluating acute infarcts in the context of lacunar infarcts, white matter, and multifocal infarcts. Ischemia changes

are responsible for the patient's symptoms, as well as distinguishing acute from subacute and chronic infarcts. CT scans are considered the most affordable and widely available imaging modality. However, MRI is seen to be cost-effective and feasible along with time-saving. MRI is a state-of-the-art imaging modality in cerebral ischemic stroke and plays an important role in its diagnosis and therapy

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