

Role of MR Cerebral and Four Vessel Neck Angiography in Evaluation of Young Patients with Ischemic Stroke

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Abstract

Original Research Article

Background: Cerebral ischemic stroke is life-threatening and debilitating neurological disease, it is the third leading cause of death in the world. Studies have shown that there is a close relationship between carotid artery stenosis and ischemic cerebral vascular disease. This study is done to assess the role of MR cerebral and four vessel neck vessel angiography in the evaluation of patients with ischemic stroke [1]. Magnetic resonance imaging (MRI) has the advantage of relying on the intrinsic magnetic properties of body tissues and blood in an external magnetic field to produce an image, without the need of ionizing radiation or nephrotoxic contrast agents. **Aim & objectives:** The aim of the study to evaluate the role of MR cerebral angiography in evaluation of patients with ischemic stroke and to evaluate the role of four vessel neck angiography in evaluation of patients with ischemic stroke. **Methods:** This observational study was conducted between APRIL 2024 and JAN 2026 at DR.B.R. AMBEDKAR MEDICAL COLLEGE & HOSPITAL. The study consisted of 40 patients.

Keywords: Cerebral ischemic stroke, Carotid artery stenosis, MR angiography, Ischemic stroke, Magnetic resonance imaging, Four vessel neck angiography.

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INTRODUCTION

Cerebral ischemic stroke is life-threatening and debilitating neurological disease, it is the third leading cause of death in the world. Studies have shown that there is a close relationship between carotid artery stenosis and ischemic cerebral vascular disease. This study is done to assess the vessels with the help of MR angiography and to correlate cerebrovascular accidents.

The primary use of MR angiography in the neck, is for the evaluation of the presence and severity of carotid stenosis. Other conditions such as vertebral artery stenosis, carotid and vertebral artery dissection and fibromuscular dysplasia are much less common but easily detectable with conventional angiography and are becoming increasingly reliably evaluated by non-invasive imaging. Intracranially, the value of MR angiography is less clear cut. It is certainly of use presurgery to look for vessel occlusion and encasement of vessels by tumour. It is also useful in excluding venous thrombosis as a cause of stroke [2].

Clinical applications for Magnetic Resonance Angiography (MRA) are rapidly expanding as technological advances in both hardware and imaging

techniques overcome previous limitations, and the risks from intravenous contrast agents and repeated ionizing radiation exposure become more salient for the clinician and patient.

In the last two decades, the advances in diagnostic tools have helped us to identify the responsible mechanism in patients with ischemic stroke and has crucial implication in relation to targeted treatment and prevention. At the same time, extraordinary imaging technology has been introduced that allows the physician to make physiologic distinctions between normal, ischemic, and infarcted brain tissue so as to institute appropriate therapy.

Magnetic resonance imaging (MRI) has the advantage of relying on the intrinsic magnetic properties of body tissues and blood in an external magnetic field to produce an image, without the need of ionizing radiation or nephrotoxic contrast agents. With the increasing availability and use of optimized pulse sequences, high-quality images with excellent spatial resolution can be obtained in shorter scan times with smaller or no injections of contrast agents [3].

Aims & Objectives

- To evaluate the role of MR cerebral angiography in evaluation of young patients with ischemic stroke.
- To evaluate the role of four vessel neck angiography in evaluation of patients with ischemic stroke.

METHOD AND METHODOLOGY**Study place**

The study was conducted among patients attending department of Radio diagnosis of DR.B.R. Ambedkar medical college & hospital.

Study Design

Prospective observational study.

Study Period

April 2024 to Jan 2026

Ethical approval

Institutional ethical committee approval was obtained prior to the initiation of the study.

Study Population

Patients referred from the OPD/ IPD of Department of Medicine of DR.B.R. Ambedkar medical college.

Inclusion Criteria

1. Patients either suspected or diagnosed with stroke.
2. Patients of age group less than 50 years.

Exclusion Criteria

1. Patients in whom MRI is contraindicated e.g. with pacemakers, metallic implants.
2. Patients of age group more than 50 years.
3. Patients diagnosed with hemorrhagic stroke on any imaging modality.

Sample size:

The sample size(n) calculation is $N = \frac{Z^2 p (100-p)}{d^2 1-\alpha/2}$

where,

$Z_{1-\alpha/2}$ = Is standard normal variate (at 5% type I error ($P < 0.05$) it is 1.96).

p = Expected proportion in population based on previous studies or pilot studies.

d = Absolute error or precision

p = 10.2

q = 100 – p = 89.2 d = 10%

Using the above values at 95% Confidence level a sample size of 35 subjects with cerebrovascular disease will be included in the study.

However, considering 10% non-response a sample size of subjects will be included in the study.

$.35 + 3.5 \approx 39$

Total sample size N = 40

Study Tools

Pre-designed pre-tested questionnaire.

Data collection methodology

All the MR angiography will be performed using 1.5 Tesla MRI machine.

The patient is centralized to the brain coil with the chin pointed upwards using landmarking. For patient comfort and safety, the earplugs are used for hearing protection, immobilization pads and straps are placed around the head to reduce noise and motion, leg support pads are placed.

Data analysis

The data collected was coded, entered into Microsoft excel work sheet and exported to SPSS. Data was analyzed using SPSS version 21. Data is presented as percentage in categories and then presented as tables and diagrams.

Independent t test, and paired t-test were used for test of significance.

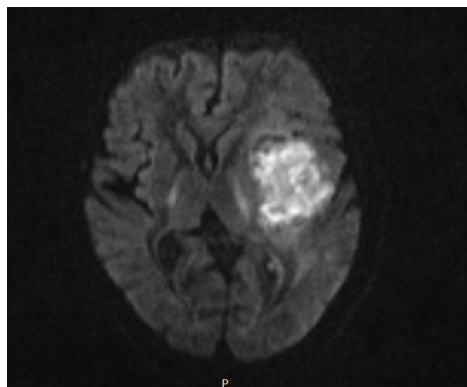
CASE GALLERY

Figure 7: Acute Left MCA Infarct showing Hyperintensity on DWI

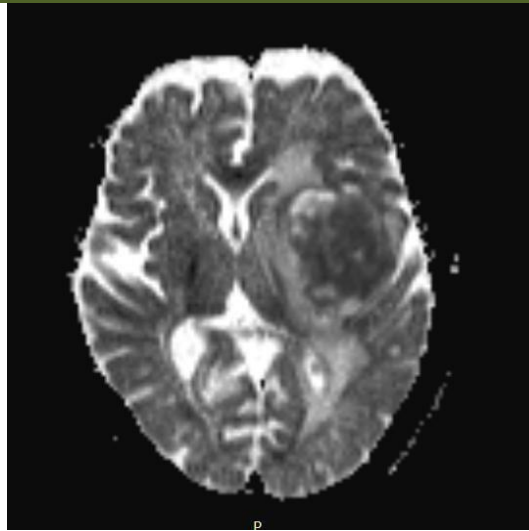


Figure 7a: Corresponding ADC image showing Hypointensity

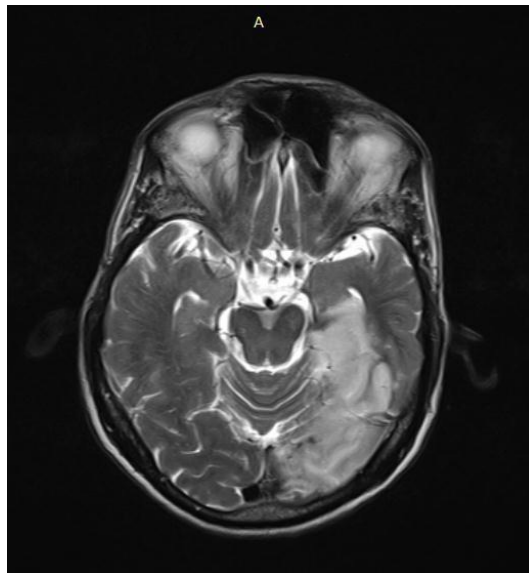


Figure 8: T2WI showing hyperintense signal in PCA Territory

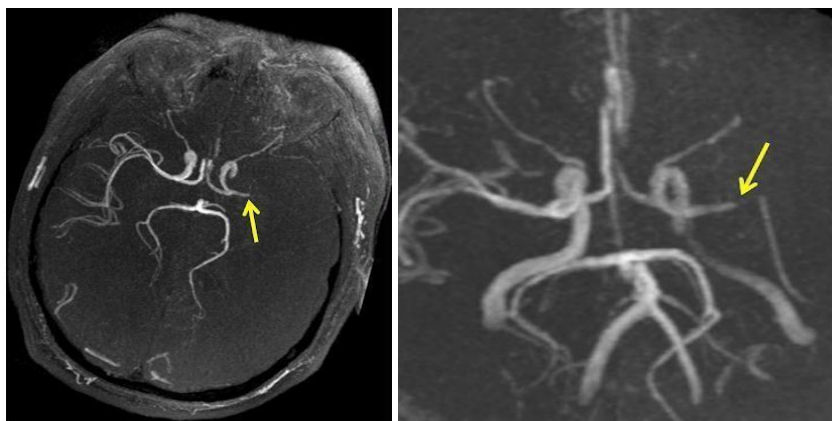


Figure 9: Left MCA Occlusion – 3d TOF

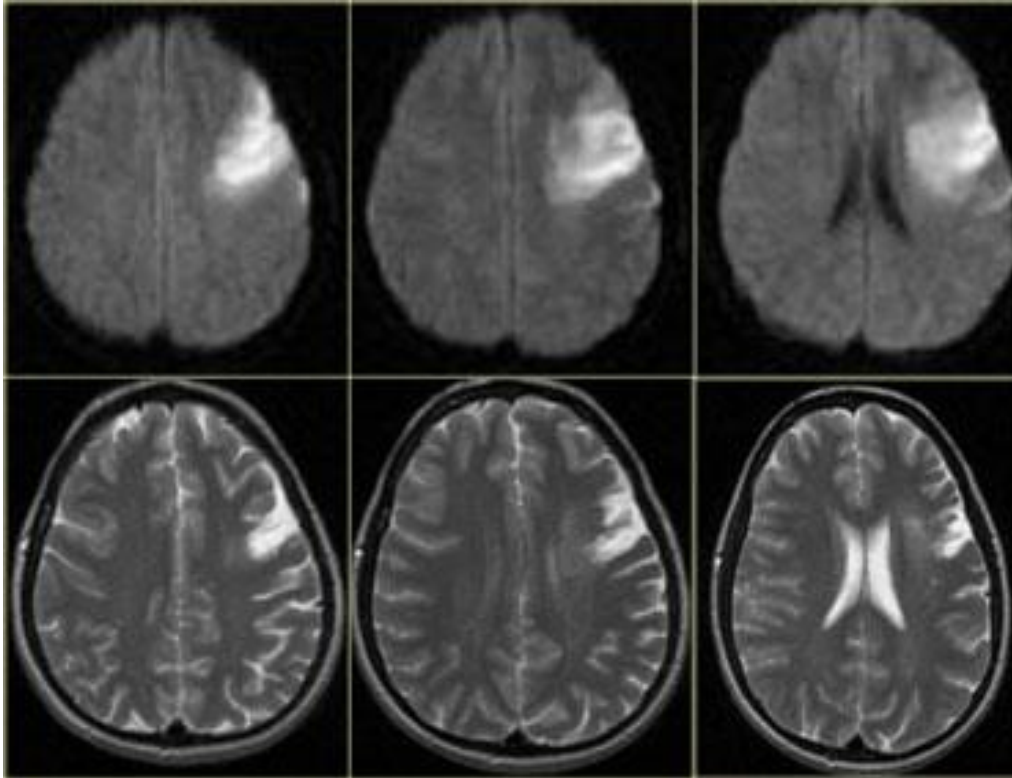


Figure 10: DWI and T2WI demonstrating Acute Infarct in Left MCATerritory

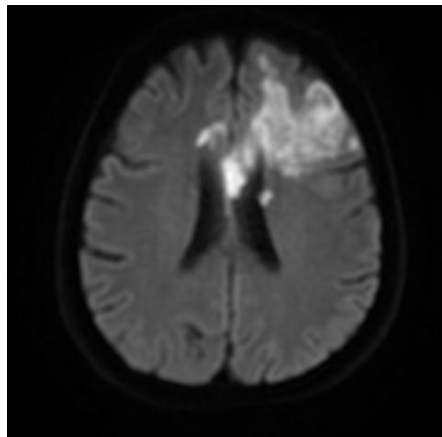


Figure 11: Acute Infarct in Left MCA and Left ACA Territory- Embolic

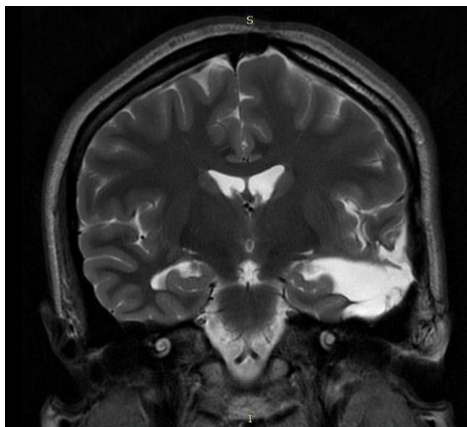


Figure12: Chronic Infarct in Left MCA Territory

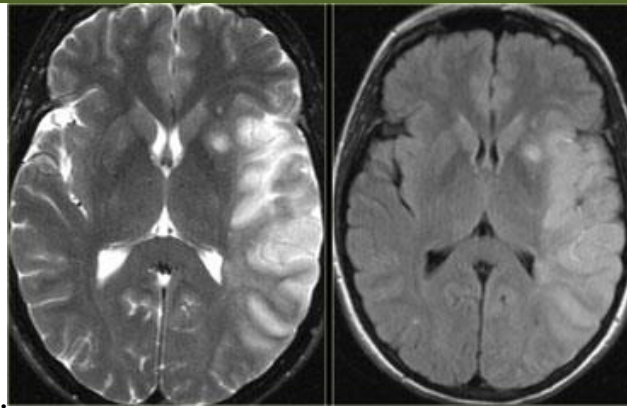


Figure 13: T2WI and FLAIR demonstrating hyperintensity in the territory of the middle cerebral artery. Notice the involvement of the lentiform nucleus and insular cortex

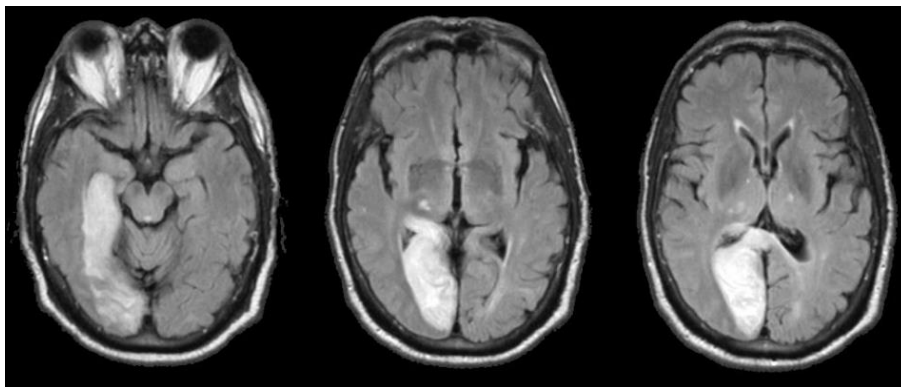


Figure 14: Flair Images Showing Hyperintense Signal in PCA Territory

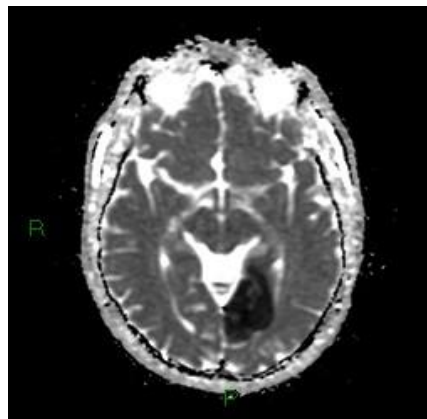


Figure 15: ADC Images Showing Hypointense Signal in PCA Territory

RESULTS

In our study, we studied 40 patients who had ischemic stroke using color doppler and MRA. Basic

characteristics and MRA, carotid and vertebral artery doppler findings are as follows:

Table 2: Age distribution of study participants

Age in years	Percentage
<20	5%
21-30	15%
31-40	22%
41-50	58%
Total	100

Table 3 and figure 16 shows gender distribution in our study. Majority of ischemic stroke patients were males (72.5%) and 27.5% were females.

Table 3: Showing gender distribution

Gender	Frequency	Percentage
Males	29	72.5%
Females	11	27.5%
Total	40	100

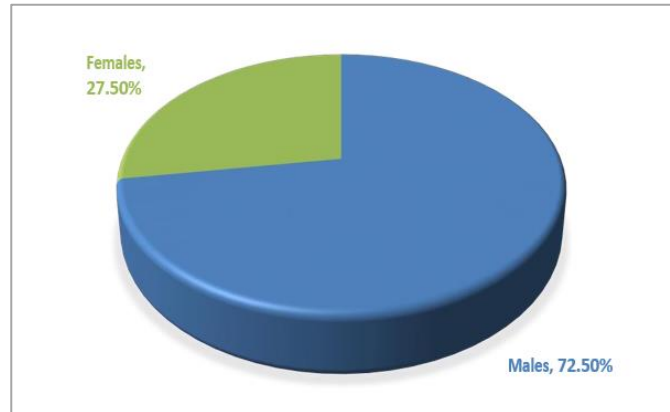


Figure 16: Pie chart showing gender distribution in our study

Among the study participants, dyslipidemia was the most common comorbidity and was observed in 55% of patients. Hypertension was present in 50% of cases, while a history of COVID-19 infection was reported in 47.5%. Stress or depression was noted in 25% of patients, and diabetes mellitus in 22.5%. Sleep apnea and

obesity (BMI >30) were each present in 20% of the study group. Less frequent comorbidities included previous transient ischemic attack (10%), migraine (7.5%), and chronic kidney disease (7.5%). Rheumatic heart disease was observed in 5% of patients, while atrial fibrillation and valvular heart disease were reported in 2.5% each.

Table 4: Distribution of comorbidities:

Comorbidities	Number	%
Dyslipidaemia	22	55
HTN	20	50
H/o COVID-19	19	47.5
Stress/Depression	10	25
DM	9	22.5
Sleep Apnea	8	20
Obesity (BMI>30)	8	20
Previous TIA	4	10
Migraine	3	7.5
Chronic Kidney Disease	3	7.5
Rheumatic Heart Disease	2	5
Atrial Fibrillation	1	2.5
Valvular Disease	1	2.5

Table No 5: Distribution of Lifestyle Related Risk Factors.

Lifestyle Related Risk Factors	Number	%
Substance Abuse	22	55
Smoking	19	47.5
Alcohol	14	35
Tobacco Chewing	10	25
Physical Inactivity	1	2.5

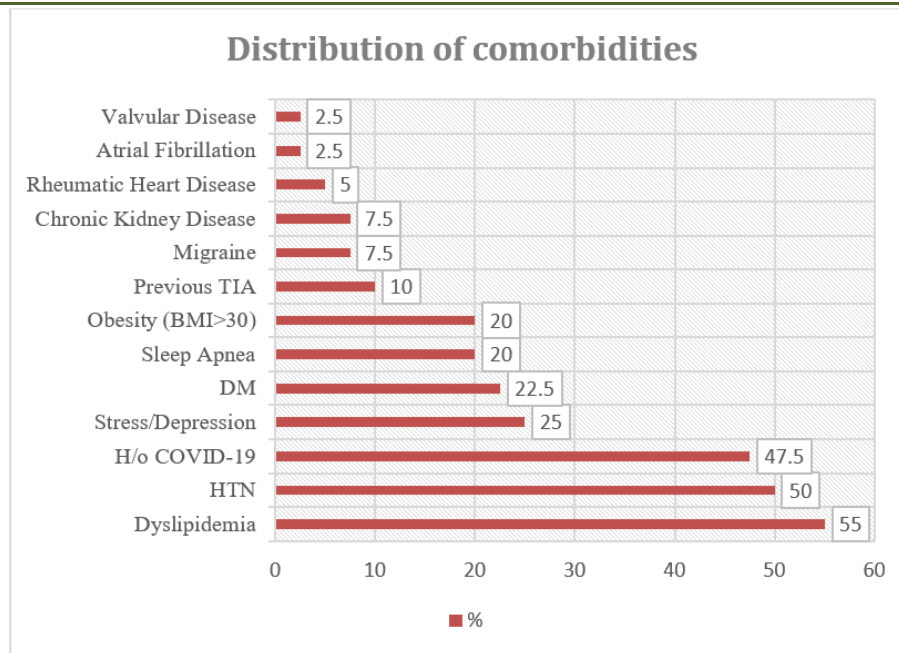


Figure 17: Bar graph showing co-morbidities in our cases

Among lifestyle-related risk factors, substance abuse was the most common and was present in 55% of patients. Smoking was reported in 47.5% of cases, while alcohol consumption was noted in 35%. Tobacco

chewing was observed in 25% of the study population. Physical inactivity was the least frequent risk factor, present in only 2.5% of patients.

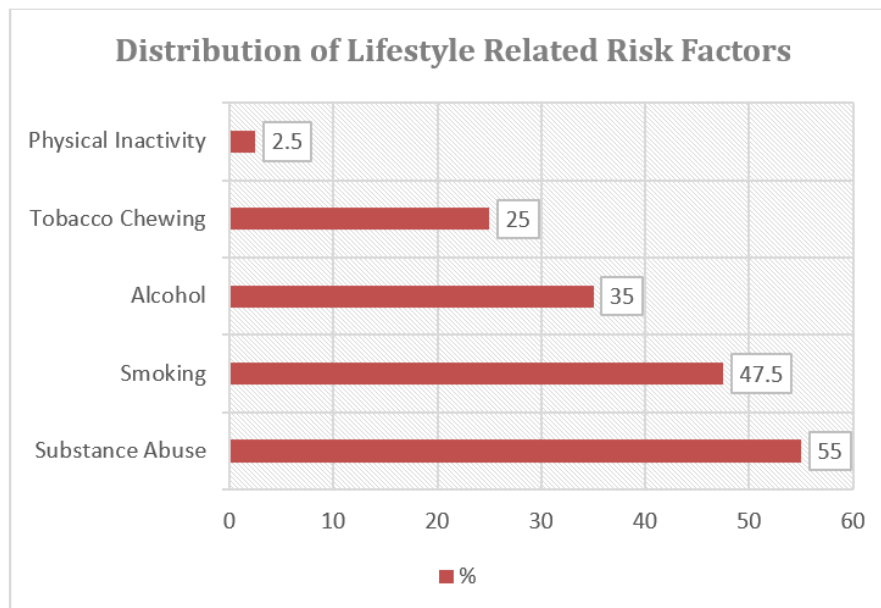


Figure 18: Bar graph showing Lifestyle Related Risk Factors in our cases

Table No 6: Distribution of Family History

Family History	Number	%
Family H/o Stroke	6	15
Family H/o CAD	8	20

In the study population, 15% of patients reported a family history of stroke, while 20% had a family history of coronary artery disease (CAD).

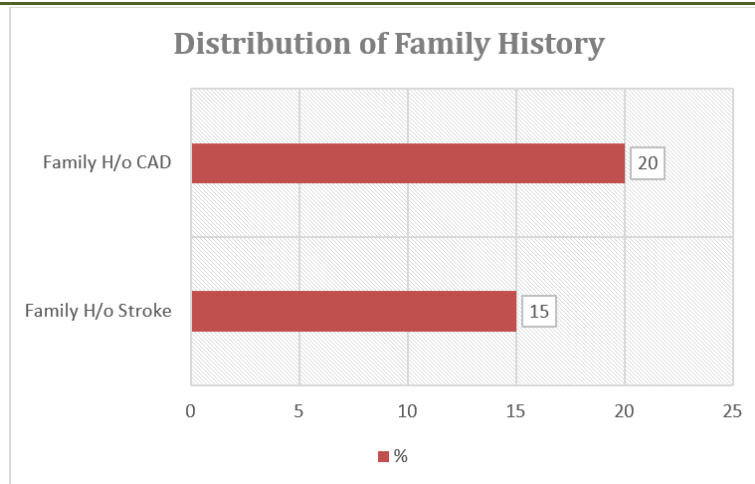


Figure 19: Bar graph showing Family History Factors in our cases

Table 7: Laterality of ischemic stroke

Side affected	Frequency	Percentage
Right	21	42%
Left	18	36%
Both	11	22%
Total	50	100%

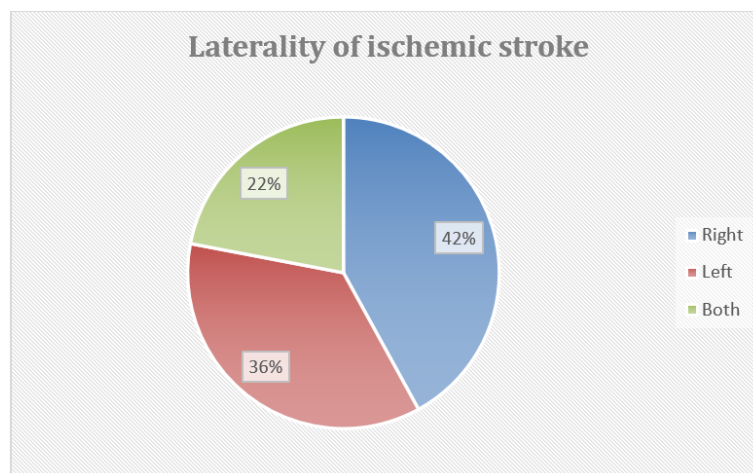


Figure 20: Pie chart showing laterality of ischemic stroke

Table 7 and figure 20 shows the distribution of laterality of ischemic stroke in our study. Majority of our

cases had bilateral ischemic stroke (22%) and 21% had right sided stroke.

Table 8: Number of diseased vascular segments in the intracranial circulation based on magnetic resonance angiography

Area involved	Degree of involvement		
	<50% stenosis	≥50% stenosis	Occlusion
ACA	1	0	0
MCA M1 segment	6	3	1
MCA M2 segment	1	1	1
TICA	1	1	7
PCA	3	4	1
VA	1	1	5
BA	2	0	0
Total	15	10	15

In terms of arterial involvement, less than 50% stenosis was most frequently observed in the middle cerebral artery (MCA) M1 segment (6 cases), followed by the posterior cerebral artery (PCA) with 3 cases. Moderate stenosis ($\geq 50\%$) was most common in the PCA (4 cases) and the MCA M1 segment (3 cases). Occlusion was predominantly seen in the terminal internal carotid artery (TICA) with 7 cases and the vertebral artery (VA) with 5 cases. Overall, 15 patients demonstrated $<50\%$ stenosis, 10 patients had $\geq 50\%$ stenosis, and 15 patients presented with complete occlusion. ACA: Anterior cerebral artery, MCA: Middle cerebral artery, TICA: Terminal internal carotid artery, PCA: Posterior cerebral artery, VA: Vertebral artery, BA: Basilar artery

DISCUSSION

Stroke is the leading cause of mortality and long-term disability in adults. Incidence and prevalence of stroke varies according to the racial and ethnic group studied. Various risk factors dyslipidemia, diabetes mellitus, hypertension is responsible for the development of stroke. Carotid artery atherosclerotic disease has been recognized as a major cause of stroke and is responsible for 20 to 50% of ischemic stroke. Several studies have demonstrated that certain subgroups of the general population, such as blacks, Hispanics, and Asians have significantly higher incidence rates of Carotid artery occlusive disease compared to whites [4, 7].

Among the 40 patients who were included in the study, 72.5% of cases were males and remaining 27.5% were females. This is in line with another study done by Chin Sang Chun *et al*, from South Korea who had also showed 87.3% of male predominance.

On analyzing the risk factors in 40 patients, hypertension has topped the list with 32 patients (81%), Diabetes Mellitus in 28 patients (70%), and finally hyperlipidemia in 11 patients (28%). Many of them had more than one risk factors. Single risk factor was present in only 10 patients. Out of which, 2 had diabetes mellitus, 7 had systemic hypertension and 1 had dyslipidemia.

Intracranial atherosclerosis was found to be the predominant site of cerebrovascular atherosclerosis in our study population. Previous studies have reported intracranial atherosclerosis to be responsible for majority of ischemic stroke in African-American and Asian patients [4, 8, 10]. Limited literature from India has also reported a predominance of intracranial disease. Kaul *et al*, from Hyderabad found a predominance of intracranial atherosclerosis (133/392, 33.9%) in their South Indian population studied [11]. This difference in the atherosclerotic disease spectrum in our population has crucial implications in clinical decision-making and management. Our study results are comparable with other studies. Arenillas, *et al* [12], has reported intracranial internal carotid stenosis has been associated with dyslipidemia especially with increased total

cholesterol and it also revealed that elevated low-density lipoprotein also a risk factor for internal carotid stenosis.

The North Manhattan stroke study demonstrated that higher prevalence of Diabetes Mellitus in 67% and dyslipidemia in 62% of patients with intracranial carotid stenosis when compared with extra cranial carotid stenosis in the study group of 714 patients [13]. (51) Impact of Diabetes Mellitus in the development of intracranial carotid stenosis also established in Wai Hong Chen *et al* who studied in Chinese patients in the study group of 153, which showed 50% association [14].

On the basis of vascular territory involved, 13 patients (26%) had middle cerebral artery infarct, 9 patients (18%) in terminal internal carotid artery infarct, 8 patients (16%) in posterior cerebral artery infarct, 7 patients (14%) in vertebral artery infarct, 2 patients (4%) in basilar artery infarct and the least being anterior cerebral artery infarct that was seen in 1 patient (2%). This pattern of involvement comparable with study by Lee *et al*, lesion patterns and stroke mechanism in atherosclerotic middle cerebral artery disease and early diffusion-weighted imaging study among 63 patients (62%) with middle cerebral artery stenosis, 32 patients showed fragmented infarct in the middle cerebral artery territory [15]. H. Naess *et al*, in their study concurred with our finding that the left MCA territory was more often affected as compared to right MCA territory.

SUMMARY

Our study entitled “ROLE OF MR CEREBRAL AND FOUR VESSEL NECK ANGIOGRAPHY IN EVALUATION OF YOUNG PATIENTS WITH ISCHEMIC STROKE” is a cross-sectional study.

The study was carried out in 40 patients with ischemic stroke were radiologically evaluated with three-dimensional time of flight (TOF) MR cerebral and four vessel neck angiography at Department of Radio-diagnosis and Imaging, at DR. B.R. Ambedkar medical college and hospital, Bengaluru.

The objectives of our study were:

1. To evaluate the role of MR cerebral angiography in evaluation of young patients with ischemic stroke.
2. To evaluate the role of four vessel neck angiography in evaluation of patients with ischemic stroke.

The study population was assessed as described in methodology using three-dimensional time of flight (TOF) MR cerebral and four vessel neck angiography.

Following outcomes were noted from the study.

- Among 40 patients with ischemic stroke, 29 were males and 11 females.

- Hypertension was the most common co-morbidity (81%) followed by diabetes (70%)
- Right sided ischemic stroke was the most common reported in our study (42%)
- 26% cases had middle cerebral artery involvement in MRA.

CONCLUSION

1. The common risk factors for carotid artery disease in our study are systemic hypertension, diabetes mellitus and dyslipidemia in the order of occurrence.
2. Incidence of transient ischemic attack was high in patients with intracranial carotid artery disease indicating the need for intensive management of these patients to prevent morbidity and mortality.
3. The most common radiological presentation is the territorial infarct involving the middle cerebral artery territory.
4. Most of the patients with extracranial internal carotid artery disease also had co-existing intracranial internal carotid artery disease which in turn may further lead to stroke. This emphasizes the need to search for intracranial disease in patients with extra cranial carotid artery disease.

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