Role of MRA as a Diagnostic Tool in Posterior Circulation Stroke- Study Done in a Tertiary Care Hospital in South India

Tariq Harris[1], V. Senthilvel Murugan[2], R. Kishore[3]

[1]2nd Year Resident, Department of Neurology, KAPV Government Medical College, Trichy.

[2]HOD & Professor, Department of Radiology, KAPV Government Medical College, Trichy.

[3]HOD & Professor, Department of Neurology, KAPV Government Medical College, Trichy

Abstract

Background: MRI Brain is an important imaging modality in posterior circulation stroke; there are very few studies on the role of MRA in posterior circulation stroke.

Aims and Objectives: 1. To study the various MRA patterns in posterior circulation stroke 2. To study other radiological patterns in posterior circulation stroke

Materials and Methods: This is a hospital-based observational descriptive study conducted among 100 patients who presented to the medical wards and outpatient departments of Neurology and General Medicine in MGMGH hospital attached to KAPV GMC, Trichy with symptoms and signs of posterior circulation stroke from December 2021 to May 2022.

Results: The most common radiological patterns found in the study were occipital infarcts and cerebellar infarcts found in 31% and 16% of cases respectively. The most common MRA findings were hypoplastic vertebral artery at 14%, fetal PCA at 11% and non-visualisation and attenuation of PCA at 8%.

Conclusion: The majority of the patients with posterior circulation stroke were male. Dizziness and headache were the most common symptoms. The most common radiological patterns found in the study in patients with posterior circulation stroke were occipital infarct and cerebellar infarcts. The most common MRA findings were hypoplastic vertebral artery, fetal PCA, and non-visualisation and attenuation of PCA.

Keywords: MRA patterns in Posterior Circulation stroke.

Introduction

Stroke is defined as the loss of brain function due to a disturbance in the blood supply to the brain due to either ischemia or haemorrhage. [1] Recent studies have elucidated the stroke pattern to a considerable extent in our country with a prevalence rate of 471.58/100000 population. A recent study identified that 7% of medical and 45% of neurological admissions were due to stroke with a fatality rate of 9% at hospital discharge and 20% at 28 days. [2] After coronary heart disease (CHD) and cancer of all types, stroke is the third commonest cause of death worldwide. [3]

Large vessel intracranial atherosclerosis is the commonest cause of ischemic stroke in India. The common risk factors, that is, hypertension, diabetes, smoking, and dyslipidaemia, alcohol consumption, elevated homocysteine levels, obesity, cardiac disease are quite prevalent and inadequately controlled, mainly because of poor public awareness and inadequate infrastructure.

The non-modifiable risk factors are age, gender, race / ethnicity, family history, and genetics. Stroke syndromes are classified into anterior circulation strokes and posterior circulation strokes, based on the blood supply. The internal carotid artery and its branches comprise the anterior circulation and paired vertebral artery, basilar artery and paired posterior cerebral arteries constitute the posterior circulation.

Stroke syndromes of the posterior circulation account for approximately 20% of all strokes. Though there have been many studies of stroke around the world, studies pertaining to the subset of posterior circulation stroke are still scarce. There are specific signs and symptoms found in posterior circulation stroke patients which help to differentiate them from Non-PCA strokes.

These are dizziness, nausea and vomiting, diplopia, dysarthria, dysphagia, and headache whereas the signs are ataxia, nystagmus, visual field defects and cranial nerve palsies.

MR angiogram (MRA) can be done in place of CTA to visualize the cervical and cerebral vasculature. There is a paucity of published data on sensitivity rates in MRA. However, in one series, the sensitivity of CT Angiogram and MR Angiogram for vertebral artery stenosis ≤ 50% was both good to excellent, up to 68% and 89%, respectively. In another series, CT/CTA was subjectively favoured over MR/MRA for vertebral dissection. The other utility of these vascular studies is that they also provide anatomic information with regards to the degree of blockage of the carotid arteries and their branches as well as detecting arterial dissections, which may have implications for further treatment decisions in these patients.

Vessel wall MRI has been widely used for further investigation following luminal imaging and clinically established as one of the imaging modalities for the evaluation of steno-occlusion. MRA is sufficient to depict intracranial posterior circulation, including the vertebrobasilar system and posterior cerebral artery wall. [4]

The SONIA study (n = 407) showed that the positive predictive value and negative predictive value in TOF-MRA were 59% and 91%, respectively, for detecting ≥50% stenosis in the pooled intracranial artery while the vertebral artery showed a positive predictive value of 61% and negative predictive value of 88% and basilar artery showed a positive predictive value of 60% and negative predictive value of 89%. [4]

Another study showed that TOF-MRA had a sensitivity of 78–85%, a specificity of 95%, a positive predictive value of 75–79%, and a negative predictive value of 95–97% for detecting ≥50% stenosis in the pooled intracranial artery using DSA as the reference standard. [5]

In the study, discordant proportions between TOF-MRA and DSA were 8.1% in the internal carotid artery, 7.4% in the middle cerebral artery, and 4.1% in the vertebrobasilar artery, respectively in the exclusion of intracranial arterial steno-occlusion based on the high negative predictive value, it may not be enough to measure intracranial artery stenosis accurately because of the low positive predictive value. TOF-MRA can overestimate stenosis due to the disadvantage of flow-related artifact. [2]

However, the flow-related artifact can provide hemodynamic information, which

is not offered by CE-MRA or CTA. In addition, TOF-MRA is robust to evaluate stenosis due to calcified plaques such as a cavernous internal carotid artery or intracranial vertebral artery, in which CTA can overestimate the stenosis. [2]

Aims and Objectives

- To study the various MRA patterns in posterior circulation stroke.

- To study the other radiological patterns of posterior circulation stroke.

Materials and Methods

The study was observational. All patients who presented to the medical wards and outpatient departments of Neurology and General Medicine in MGMGH hospital attached to KAPV GMC,

Trichy with symptoms and signs of posterior circulation stroke from the period of December 2021 to May 2022 were included in the study which involved 100 patients.

ECG, Routine blood investigations were performed and MRI brain with MRA was done for all patients.

Inclusion Criteria

1. Patients who had signs, symptoms, and radiological features of posterior circulation stroke.

Exclusion Criteria

- Patients with clinical features and neuro–otological features of vestibular disorders and labyrinthine disorders.

- Patients with subarachnoid haemorrhage, extradural or subdural haemorrhage

Methods of Data Collection

All patients were registered in the proforma regarding their names, age, sex, occupation, address, and education, and questioned about the symptoms of posterior circulation stroke like dizziness, vomiting, headache, dysarthria, and limb weakness. The patients were examined for signs of posterior circulation stroke such as altered sensorium, ataxia, dysarthria, nystagmus, visual field defects and cranial nerve palsies. History regarding the risk factor profile in the patients including systemic hypertension, smoking, alcoholism, dyslipidaemia, diabetes mellitus, coronary artery disease, rheumatic heart disease, and previous stroke was documented. A detailed clinical examination of the neurological status of the patients and a comprehensive examination of other systems were recorded in the case sheets. Basic biochemical, and haematological investigations were done for all patients. MRI, MRA Brain was done in patients suspected of having posterior circulation stroke (PCA). MRI sequences used were T1, T2, FLAIR, DIFFUSION, ADC, and MRA TOF (Imaging planes – Sagittal, Coronal, and Axial)

Results

The study group included 100 patients suspected of posterior circulation stroke. 81 patients had MRI findings suggestive of posterior circulation stroke. For 19 patients, MRI was normal. Out of these 81 patients, 73 had infarcts and 8 had haemorrhages. Out of the 100 patients, 64 were males and 36 females.

The clinical examination revealed the following findings, dizziness and headache were the most common symptoms found in patients with posterior circulation stroke and were present in 81% and 80% of them respectively.

Table 1: Symptoms of Posterior Circulation Stroke

Symptoms	No. of patient (%) n=100
Dizziness	81% (81)
Vomiting	16% (16)
Headache	80% (80)
Dysarthria	19% (19)
Limb weakness	67% (67)
Dysphagia	38% (38)

Table 2: Clinical Signs of Posterior Circulation Stroke

SIGNS	No. of patient (%)
Ataxia	47% (47)
Nystagmus	12% (12)
Visual field defect	38% (38)
Cranial nerve palsies	42% (42)
Altered sensorium	14% (14)

The most common radiological patterns found in the study in patients with posterior circulation stroke were occipital infarct and cerebellar infarcts in 31% and 16% of cases respectively whereas the least common radiological patterns found were medullary and pontine bleed.

The most common MRA findings were hypoplastic vertebral artery at 14%, fetal PCA at 11% and non-visualisation and attenuation of PCA at 8%.

Table 3: Radiological patterns in posterior circulation stroke

Radiological Findings	No. of Patients (%)
Cerebellar bleed	04% (4)
Cerebellar Infarct	16% (16)
Medulla infarct	09% (9)
Medulla bleed	
Pons infarct	09% (9)
Pons bleed	01% (1)
Occipital Infarct	31% (31)
Occipital bleed	03% (3)
Combination of the above findings	08% (8)

Table 4: MRA Findings

| MRA Findings	No. of Patients (%)
Hypoplastic Vertebral Artery	14% (14)
Hypoplastic PCA	05% (5)
Non-Visualisation of PCA	08% (8)
Non-Visualisation of Vertebral Artery	07% (7)
Flow Void in ICA	05% (5)
Fetal PCA	11% (11)
Attenuation of PCA	08% (8)
Attenuation of Basilar Artery	02% (2)
Non-Visualisation of ICA	04% (4)
Hypoplastic ACA	03% (3)

Out of a total of 67 patients with MRA findings, only 6 patients were females, among these patients most common were hypoplastic vertebral artery (4) patients.
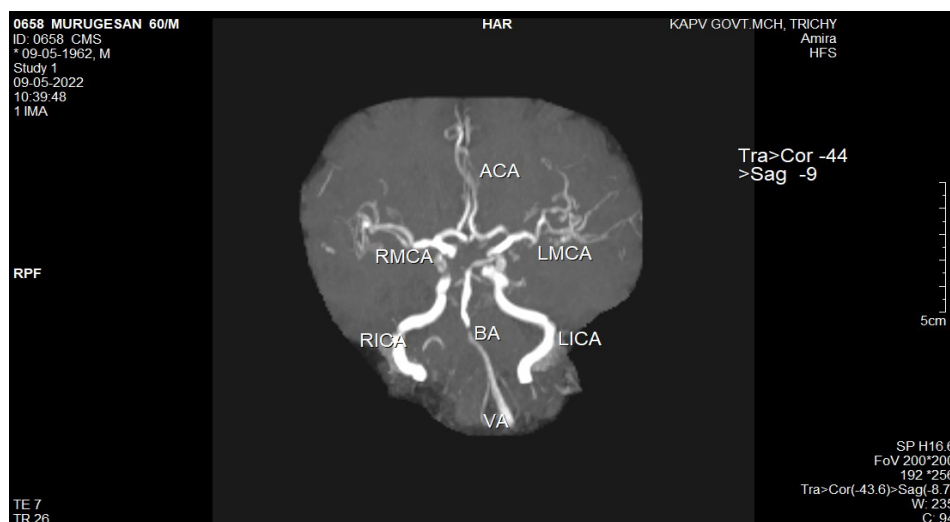
Figure 1: 60 Year old male patient presented with swaying while walking MRA Shows Non visualisation of right vertebral artery and PCA.
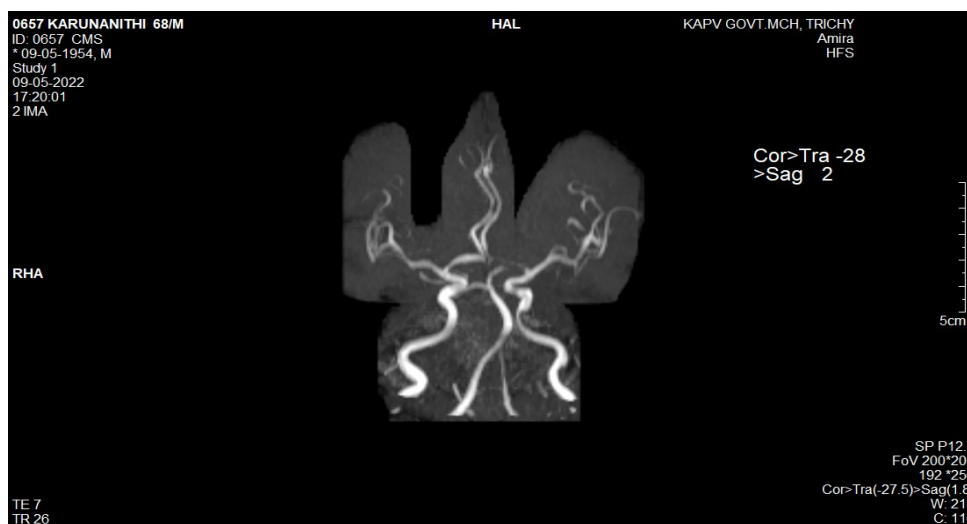
Figure 2: 68 Year old male patient presented with dizziness, dysphagia, MRA shows complete non visualisation of Left PCA distal to the P1 segment
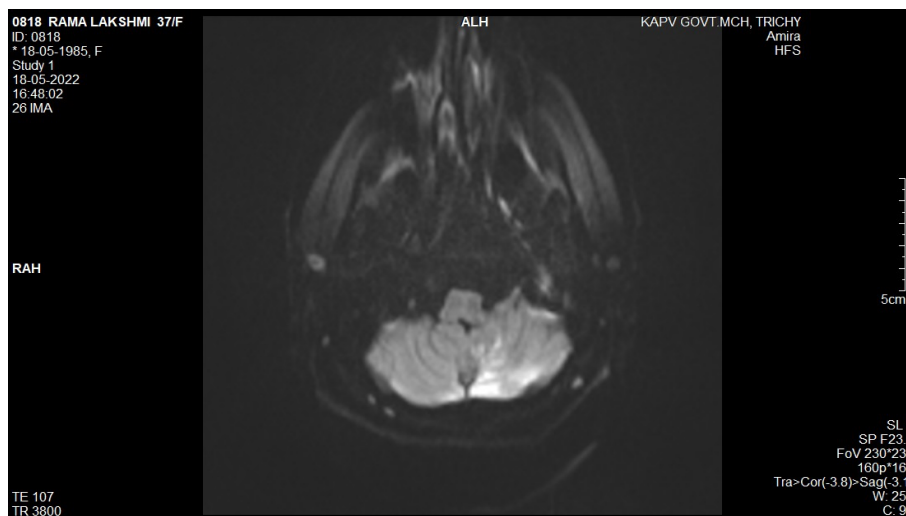
Figure 3: 37 year old female patient MRI DWI shows focal lesion in left cerebellum, lesion shows significant diffusion restriction.

Discussion

Epidemiological studies have revealed that the prevalence of stroke is increasing along with the rising prevalence of risk factors for stroke in India. There is not much-published data on MRA as a diagnostic tool and its different patterns in posterior circulation stroke in India hence it was decided to undertake this study. This study was conducted over 6 months and included patients suspected of posterior circulation stroke. 81% MRI was suggestive of PCS with predominantly infarct of which occipital infarcts were most common, followed by cerebellar and pontine infarcts. The majority of cases had MRA findings of which hypoplastic vertebral artery and non-visualisation of the vertebral arteries were most common.

In our patients, dizziness and headache were commonly seen and as suggested by previous studies. [4,6] These symptoms were more commonly seen, in anterior circulation strokes. [4] Fisher reported that headache in anterior circulation strokes is generally frontal, usually ipsilateral to the lesion, while posterior circulation stroke headache tended to be occipital. [7] A proposed explanation for this difference is that the cerebral vasculature of the meninges in the posterior circulation is more heavily innervated by nociceptive afferents than the anterior circulation. [8] Vomiting may occur due to the involvement of the vestibular nucleus or chemoreceptor trigger zone (CTZ). A study from China by Shi et al that analyzed clinical characteristics in 216 patients with posterior circulation stroke found dizziness in 33.8% and ataxia in 30%, which were less compared to our observations. [9] Posterior circulation stroke can have varied clinical presentations. The clinical manifestations encountered in our study are comparable to those of

Dubey TN et al, Kora S et al, Mehndiratta et al, and Patrick et al. [6,10,11,12] The major clinical symptoms like nystagmus, visual field defect, ataxia, altered sensorium and cranial nerve deficits were attributable to the affection of brain stem, long tracts, cranial nerve nuclei and cerebellar connections. Ataxia in posterior circulation stroke is due to the involvement of the cerebellum or its connections. The varied clinical manifestations are probably due to the difference in infarct size, location, presence of collaterals and vascular territory involvement in different studies. [13]

Table 5: Comparisons of presenting neurological signs / symptoms of stroke in percentages among different studies

Neurological symptoms / signs	Patrick et al	Kora S A et al	Mehndiratta et al	Dubey TN et al	Present study
Ataxia	29	37	48.7	34	47
Nystagmus	29	32	48.7	10	12
Visual field defect	13	47	20	15	38
Cranial nerve palsies	64	53	26.2	6	42
Altered sensorium	17	05		9	14

The most common radiological patterns found in the study in patients with posterior circulation stroke were occipital infarct and cerebellar infarcts found in 31% and 16% of cases respectively whereas the least common radiological patterns found were bleeding in the pons in only 1% of the patients and bleed in the medulla was not found in any patient in the study.

This is in line with the study of Dubey TN et al, in which the most common

radiological patterns found were cerebellar infarct and occipital infarcts in 30% and 18% cases respectively and in 30% the least common radiological patterns found were bleeding in the pons found in only 2% of the patients and bleed in the medulla was absent in patients. [6]

All the patients, in our study, underwent an MRI of the brain. Hypoplastic vertebral artery and fetal PCA lesions were commoners. Whereas in the study of Jena SS, "infra tentorial stroke lesions were more common than supratentorial lesions [158 (56.02%) v/s (92 (32.6%)]. The most common anatomical site of involvement was cerebellum [86(30.5%)]. [13]

Our study suggests that MRA has a significant role in the diagnosis of posterior circulation stroke with 82% of patients having positive MRI findings with MRA changes.

Conclusion

The majority of the patients with posterior circulation stroke were males. Dizziness and headache were the most common symptoms. The most common radiological patterns found in the study in patients with posterior circulation stroke were occipital infarct and cerebellar infarcts. The most common MRA findings were hypoplastic vertebral artery, fetal PCA, and non-visualisation and attenuation of PCA.

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