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Original Research Article

MRI Features, Clinical Profile and Their Relationship with Functional Outcomes in Posterior Circulation Stroke

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Abstract:

Background: Posterior circulation stroke (PCS) accounts for 20–25% of all ischemic strokes and presents diagnostic and therapeutic challenges due to its diverse symptomatology and complex vascular anatomy. Early identification with MRI and MR angiography is critical for management and prognosis.

Aim: To analyze the clinical profile, MRI features, and their correlation with functional outcomes in posterior circulation stroke patients.

Methods: A cross-sectional study was conducted on 93 patients with MRI-confirmed PCS between 2023 and 2025. Clinical features, vascular risk factors, and imaging findings were documented. Functional outcomes were assessed at discharge using the Modified Rankin Scale (mRS). Statistical analysis was performed using SPSS version 23.

Results: Of 93 patients, 64 (68.8%) were males, and the mean age was 61 years. Hypertension (53.8%) and diabetes mellitus (37.6%) were the most prevalent risk factors. The most common presenting symptoms were giddiness, vomiting, headache, and cranial nerve deficits. MRI revealed brainstem (31.2%) and cortical/subcortical (29%) infarcts as the predominant sites. At discharge, 50.5% of patients had minor disability, 26.9% major disability, 17.2% no disability, and 5.4% mortality. Brainstem infarcts were significantly associated with poor outcomes ($p<0.0001$).

Conclusion: PCS shows a male predominance with peak incidence in the 6th decade. Hypertension and diabetes are key risk factors. Brainstem involvement strongly correlates with adverse outcomes, underscoring the importance of early recognition and aggressive risk factor control.

Keywords: Posterior circulation stroke; MRI; Brainstem infarct; Functional outcomes; Hypertension; Diabetes mellitus; Modified Rankin Scale.

Introduction

Posterior circulation stroke (PCS) constitutes approximately 20–25% of all ischemic strokes and poses a diagnostic and therapeutic challenge due to its varied clinical presentation and complex vascular anatomy. The posterior cerebral circulation is primarily supplied by the vertebrobasilar system, including the posterior cerebral artery (PCA), anterior inferior cerebellar artery (AICA), and posterior inferior cerebellar artery (PICA). Clinical features are often non-localizing and include dizziness, ataxia, cranial nerve deficits, altered sensorium, and visual disturbances, which may delay diagnosis and treatment initiation (Caplan, 2000; Kim et al., 2013). Early diagnosis through imaging, particularly magnetic resonance angiography (MRA), plays a crucial role in identifying vascular pathology and guiding clinical decision-making.

Functional outcomes in PCS can vary widely depending on the stroke subtype, collateral circulation, and timing of intervention. Despite advances in imaging and stroke care, posterior circulation strokes are often under-recognized and under-studied compared to anterior circulation strokes, underscoring the need for focused studies evaluating their clinical-radiological spectrum and outcomes. This study aims to explore the clinical profile, MRI features, and their correlation with functional outcomes in patients presenting with posterior circulation stroke, utilizing the Modified Rankin Scale (mRS) as a measure of functional status at discharge.

Review of Literature: Posterior circulation strokes are distinct from anterior circulation strokes in both anatomical distribution and clinical presentation.

The vertebrobasilar arterial system supplies the brainstem, cerebellum, thalamus, and occipital lobes, regions crucial for consciousness, coordination, and visual processing (Bogousslavsky et al., 1996). Atherosclerosis remains the leading etiology, particularly affecting the large arteries at the vertebral-basilar junction, while other causes include cardioembolism, vertebral artery dissection, and small vessel disease (Caplan et al., 2004). Clinical features vary depending on the location and extent of infarction. For example, infarcts in the cerebellum often present with vertigo, imbalance, and ataxia, whereas brainstem involvement can result in cranial nerve deficits and altered consciousness (Kim & Caplan, 2005). Unlike anterior circulation strokes, posterior strokes may lack hemiparesis or aphasia and instead manifest with symptoms like giddiness and nausea, leading to potential misdiagnosis. Several studies have attempted to stratify PCS using imaging modalities. Magnetic resonance angiography (MRA) offers a non-invasive method to visualize vascular abnormalities and stroke mechanisms, and when combined with diffusion-weighted imaging (DWI), it enhances diagnostic sensitivity (Nogueira et al., 2009).

Regarding outcomes, PCS was previously associated with worse prognosis due to the critical brainstem involvement. However, recent evidence suggests that with timely diagnosis and management, many patients have favorable outcomes. Studies have found that stroke subtype, lesion volume, and early rehabilitation are significant predictors of recovery (Schonewille et al., 2009). The Modified Rankin Scale remains a widely accepted tool to assess post-stroke functional status. The findings of the current study are in line with earlier research by Caplan et al. (1996), highlighting the prevalence of large artery atherosclerosis in PCS and the importance of clinical vigilance in atypical presentations. Furthermore, the observed predominance of minor disability outcomes aligns with studies emphasizing the role of early imaging and intervention in improving prognosis (Samaee et al., 2016).

Epidemiology and Risk Factors: Studies indicate that PCS exhibits a male predominance and typically affects older individuals, particularly those over the age of 60. Hypertension and diabetes mellitus remain the most prevalent modifiable risk factors. In a large stroke registry analysis, these vascular comorbidities significantly increased the likelihood of both anterior and posterior circulation strokes. However, in PCS, hypertension often plays a more prominent role, given its association with large artery atherosclerosis in the vertebrobasilar system.

Clinical Features of Posterior Circulation Stroke: The clinical presentation of PCS is variable and often non-specific. The most common symptoms include giddiness, nausea, vomiting, ataxia, and altered sensorium. Cranial nerve involvement, particularly affecting the brainstem, is more common in PCS than in anterior circulation strokes. Cerebellar signs such as dysmetria, limb ataxia, and nystagmus are frequently observed, especially in infarcts involving the PICA or AICA territories. Visual disturbances, including homonymous hemianopia, are associated with

PCA infarctions. Because of the wide variability in presenting features, clinical suspicion remains a cornerstone in early identification of PCS.

Radiological Features and Stroke Subtypes: MRI with MR angiography (MRA) remains the gold standard for imaging posterior circulation strokes. Diffusion-weighted imaging (DWI) can detect acute ischemic changes, while MRA can identify arterial occlusions or stenosis in the vertebrobasilar system.

According to the TOAST (Trial of ORG 10172 in Acute Stroke Treatment) classification, stroke subtypes in PCS include large artery atherosclerosis, small vessel occlusion (lacunar infarcts), and cardioembolism. Studies, including the present one, report large artery atherosclerosis as the predominant etiology, highlighting the importance of evaluating both extracranial and intracranial vertebral arteries.

Functional Outcomes and Prognosis: Functional outcomes in PCS vary depending on the extent of infarction, presence of collateral circulation, and time to treatment. The Modified Rankin Scale (mRS) is commonly used to assess post-stroke disability. Most studies indicate that with early diagnosis and appropriate management, a majority of PCS patients have minor disabilities or good recovery outcomes. However, the risk of mortality and severe disability is notable in cases with basilar artery occlusion or delayed presentation. The current study revealed that minor disability was the most common outcome, consistent with literature emphasizing the benefit of early intervention.

Comparative Studies and Literature Review: Caplan et al. emphasized the diagnostic challenges of PCS due to frequent non-localizing symptoms and the need for high clinical suspicion. Numerous retrospective studies and meta-analyses confirm the predominance of large artery atherosclerosis in PCS and highlight the role of early neuroimaging in improving outcomes. Comparative data also suggest that while cardioembolic strokes are less frequent in PCS than anterior strokes, they carry a significant risk, especially in patients with atrial fibrillation. The clinical- radiological correlation and outcome patterns seen in the present study are

in line with findings from studies conducted in both high-income and resource-limited settings.

Aim: TO throw light in the clinical and radiological features of Posterior circulation stroke and to correlate with their functional outcomes.

Methodology: Cross Sectional Study with samples being patients who attended neurology department with posterior circulation stroke from 2023 to 2025.

Based on previous studies, sample size was computed as 93 based on formula: n= Z2 * p*

(1-p) *1/e2..

Symptomatology, risk factor status and radiological features was observed.

Functional status was implied by Modified Rankin scores at the time of discharge.

Inclusion Criteria and Exclusion Criteria: The patients with symptoms of posterior circulation stroke with age 18-80 confirmed by MRI brain studies are included. Those with recurrent strokes and presence of hemorrhagic foci and age less than 18 years or more than 80 years are excluded.

Proforma

Name	
Age	
Sex	IP Nos
Address	

Detailed Clinical History and Examination with emphasis on the following like giddiness, weakness, slurring of speech, cerebellar signs, sensorium, loss of consciousness, seizure, headache visual disturbances, time interval and risk factors was done.

General Examination

- Pulse
- BP
- Examination of Central Nervous System
- Examination of Other Systems
- Investigations
- CBC
- Diabetic Profile
- Lipid Profile
- CT MRI

Modified Ranking Scale: 0 no symptoms

1. No significant disability able to carry out daily activities

2. Slight disability to carryout daily activities with assistance

3. Moderate disability. Needs help. Able to walk.

4. Moderately severe disability. Needs assistance for ADL and walk.

5. Severe disability. Bed ridden, incontinent, nursing care required.

6. Dead

Statistical Analysis

- Detailed questionnaires were filled regarding clinical features, comorbidities, risk factors and imaging findings.
- Data were analysed using SPSS 23 software.
- Data were presented as mean and SD for continuous variables and as percentages for categorical variables.
- A p-value <0.05 is considered as statistically significant.
- Sample size was estimated as 93

Results

Among 93 patients, 59 were males and 34 were females. Maximum age group-6th decade. 42 had hypertension and 30 had diabetes mellitus. Common symptoms being giddiness and vomiting followed by headache, altered sensorium, cranial nerve deficits. Large artery stroke being the commonest seen in 65, lacunar stroke in 20 and cardioembolic in 8. In functional outcomes, no disability is seen in 18, minor in 62, major in 9 and 4 died.

Table 1: Outcomes in Different Age Group

Age Group in years	No of cases (n)	Percentage (%)
<35 years	1	1.08%
35-44 years	9	9.68%
45-54 years	17	18.28%
55-64 years	28	30.11%
65-74 years	23	24.73%
75-84 years	7	7.53%
>85 years	8	8.60%
Grand Total	**93**	**100.00%**
Mean	61.02150538	
SD	12.37105536	

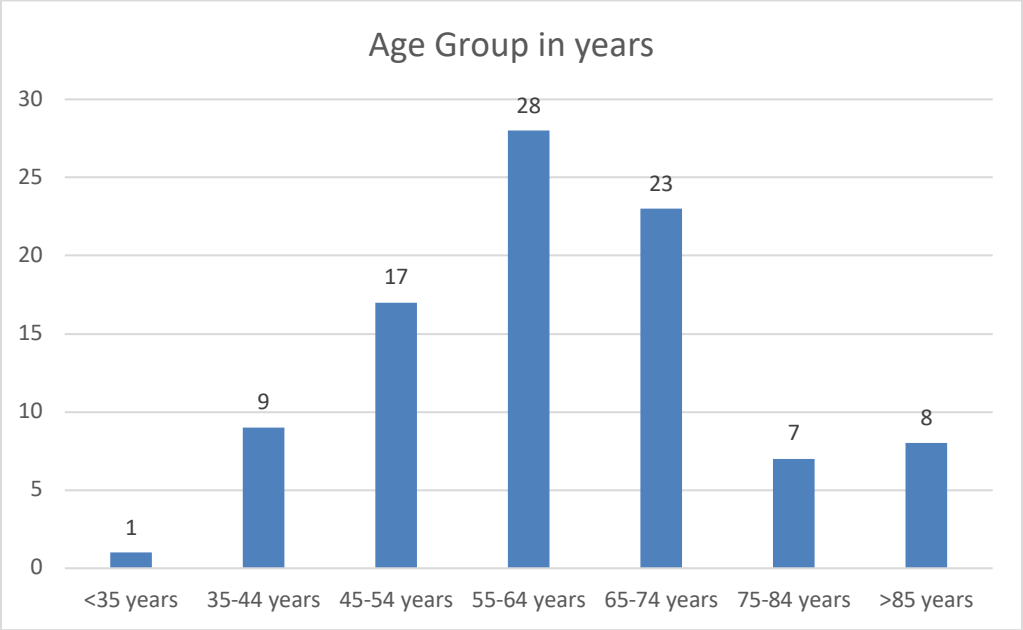

Figure 1: Age gropu in years

Table 2: Gender Distribution

Gender	No of cases (n)	Percentage (%)
Male	64	68.82%
Female	29	31.18%
Grand Total	**93**	**100.00%**

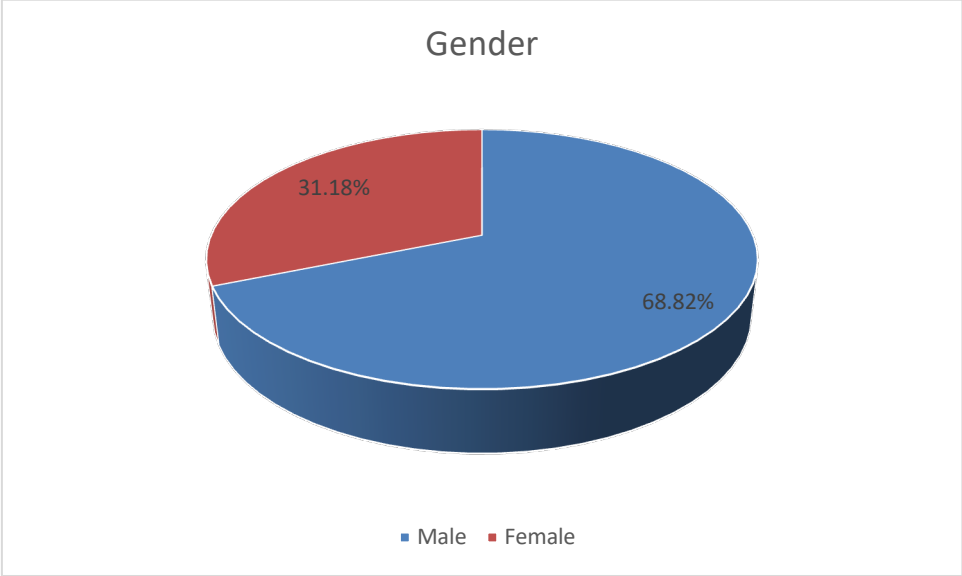

Figure 2: Gender

Table 3: Risk Factors and Outcomes

Risk Factors	**No Of Cases (N)**	**Percentage (%)**
Hypertension	50	53.76%
Diabetes	35	37.63%
Dyslipidemia	22	23.66%
Haematocrit	21	22.58%
Smoking	29	31.18%

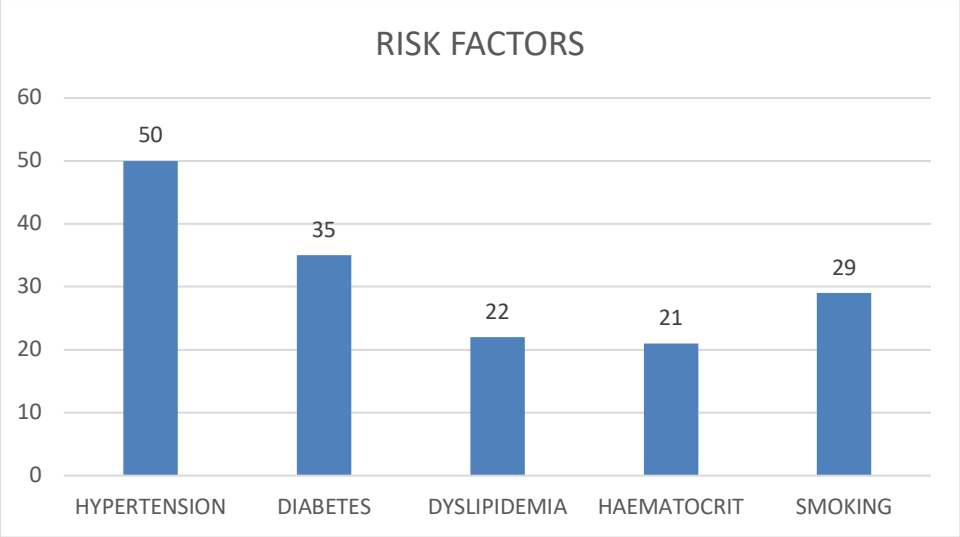

Figure 3: Risk factors

Table 4: Neuroimaging Findings--- CT Brain

CT Brain	No of cases (n)	Percentage (%)
Cerebellum	16	17.20%
Brainstem / Pons / MB	21	22.58%
Cortical / Subcortical	29	31.18%
Thalamus / Deep Structures	2	2.15%
Normal	25	26.88%
Grand Total	**93**	**100.00%**

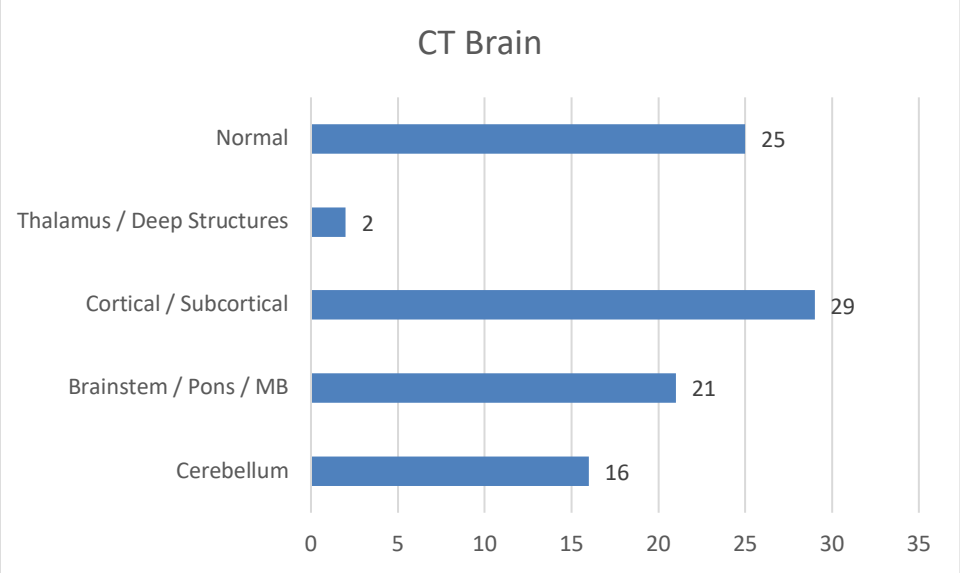

Figure 4: CT Brain

Table 5: MRI Findings

MRI Location Of Infarcts	No of cases (n)	Percentage (%)
Cerebellum	19	20.43%
Multiple Infarcts / Mixed	1	1.08%
Thalamus / Deep Structures	4	4.30%
Brainstem / Pons / MB	29	31.18%
Cortical / Subcortical	27	29.03%
Normal	13	13.98%
Grand Total	**93**	**100.00%**

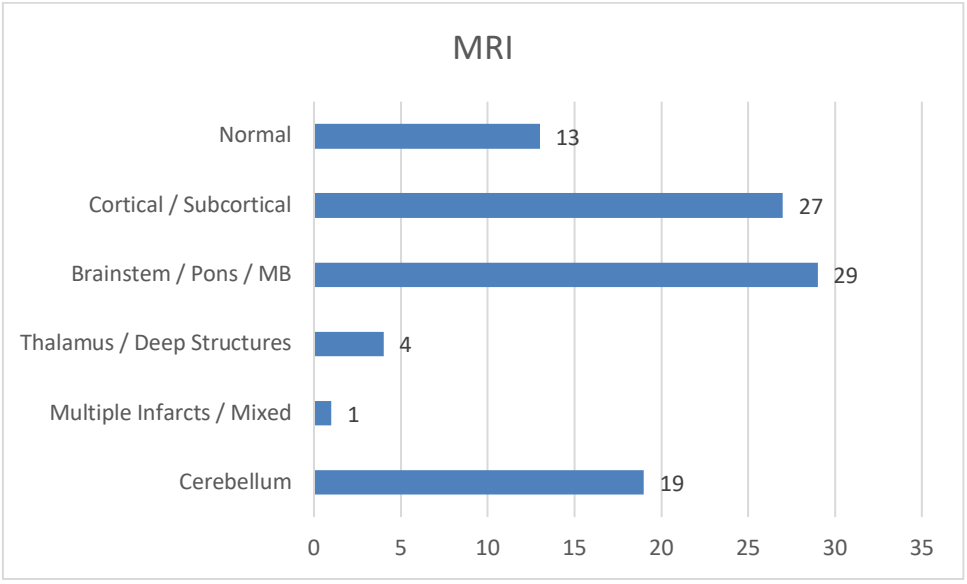

Figure 5: MRI

Table 6: Functional Outcomes

Outcome	No of cases (n)	Percentage (%)
Death	5	5.38%
No Disability	16	17.20%
Minor Disability	47	50.54%
Major Disability	25	26.88%
Grand Total	**93**	**100.00%**

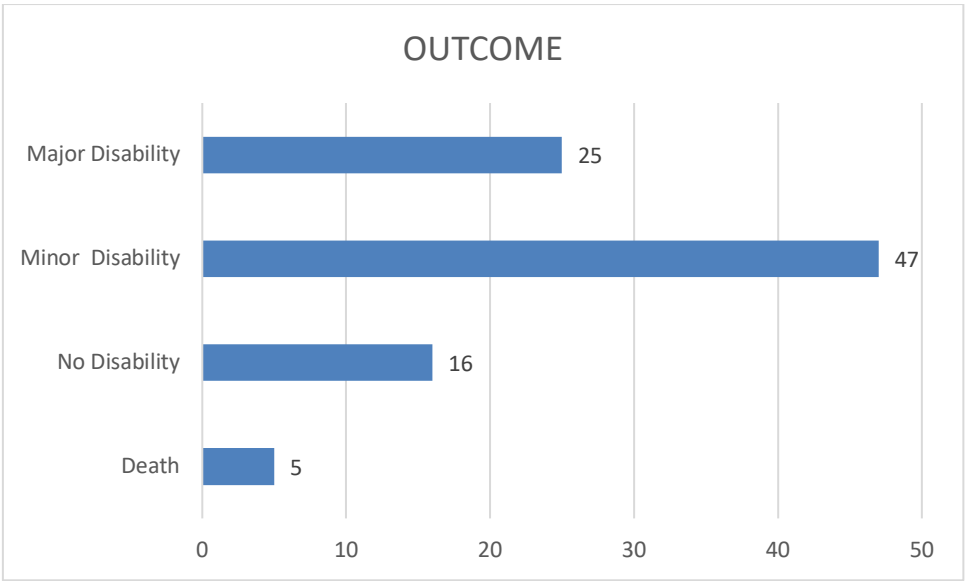

Figure 6: Outcome

Table 7:

Age Group in years	Outcome									
	Death		Major Disability		Minor Disability		No Disability		Grand Total	
	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)
<35 years	0	0.00%	0	0.00%	1	1.08%	0	0.00%	1	1.08%
35-44 years	1	1.08%	2	2.15%	6	6.45%	0	0.00%	9	9.68%
45-54 years	2	2.15%	4	4.30%	10	10.75%	1	1.08%	17	18.28 %
55-64 years	0	0.00%	13	13.98%	7	7.53%	8	8.60%	28	30.11 %
65-74 years	0	0.00%	3	3.23%	14	15.05%	6	6.45%	23	24.73 %
75-84 years	0	0.00%	2	2.15%	5	5.38%	0	0.00%	7	7.53%
>85 years	2	2.15%	1	1.08%	4	4.30%	1	1.08%	8	8.60%
Grand Total	**5**	**5.38%**	**25**	**26.88%**	**47**	**50.54%**	**16**	**17.20%**	**93**	**100.00 %**
Mean	62.000000		60.120000		60.191489		64.562500		61.021505	
SD	19.493589		9.748162		14.167689		7.247701		12.371055	
p=0.03										

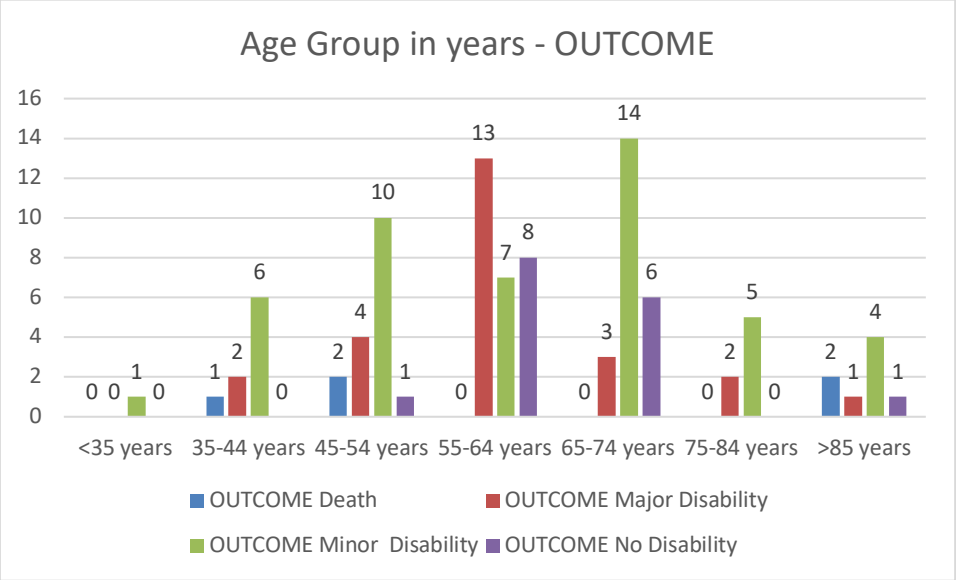

Figure 7: Age group in Years -outcome

Table 8:

MRI	Outcome									
	Death		Major Disability		Minor Disability		No Disability		Grand Total	
	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)	No of cases (n)	Percentage (%)
Cerebellum	0	0.00%	2	2.15%	16	17.20 %	1	1.08%	19	20.43 %
Multiple Infarcts / Mixed	1	1.08%	0	0.00%	0	0.00%	0	0.00%	1	1.08%
Thalamus / Deep Structures	0	0.00%	0	0.00%	4	4.30%	0	0.00%	4	4.30%
Brainstem / Pons / MB	3	3.23%	17	18.28 %	9	9.68%	0	0.00%	29	31.18%
Cortical / Subcortical	1	1.08%	6	6.45%	18	19.35%	2	2.15%	27	29.03%
Normal	0	0.00%	0	0.00%	0	0.00%	13	13.98%	13	13.98%
Grand Total	**5**	**5.38%**	**25**	**26.88 %**	**47**	**50.54 %**	**16**	**17.20 %**	**93**	**100.00 %**
p<0.0001										

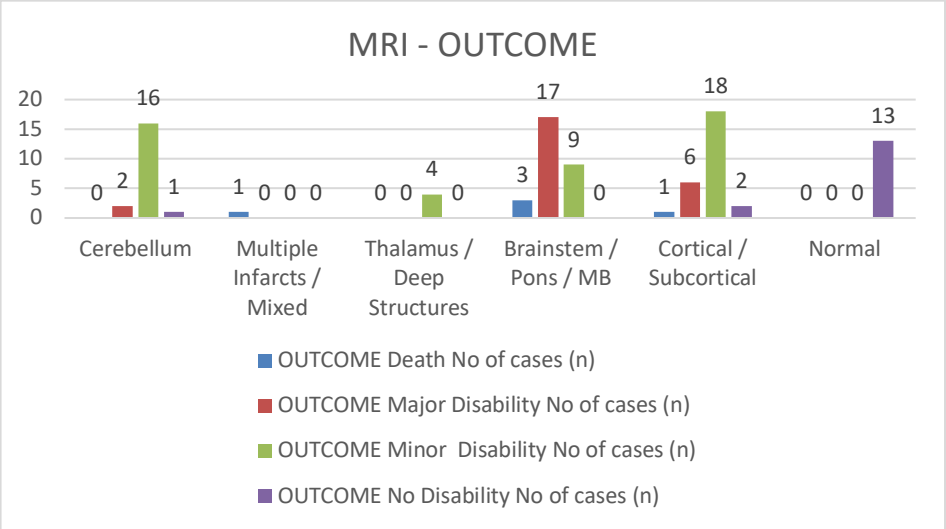

Figure 8: MRI- Outcome

Discussion

Posterior circulation stroke is an important and often under recognised subtype of ischemic stroke accounting for 20 -25 percent of all strokes. This study analysed the clinical profile, radiological features, risk factors and functional outcomes of 93 patients revealing key epidemiological and prognostic patterns.

Demographic Patterns and Risk Factors: In the present study, majority of patients were males suggesting a male preponderance consistent with several previous studies on stroke epidemiology. The most affected age group were more than 60 years which shows that posterior circulation strokes were common in elderly populations.

Among vascular risk factors, hypertension was most prevalent (53.76%) followed by diabetes mellitus (37.63%). Hypertension had a statistically significant association with poor functional outcome (p= 0.01), underscoring its pivotal role in PCS pathogenesis and prognosis. Among the other risk factors smoking was seen in 31.18% population. However it was not statistically significant.

Neuroimaging Findings: Brain imaging revealed a predilection for lesions in the brain stem. 22.58% on the CT and 31.18% on MRI and the cerebellum had lesions in 17.2% on CT and 20.43% on MRI which aligns with the known anatomical territory supplied by the vertebrobasilar system. MRI being sensitive detected more lesions in cortical/

subcortical areas (29.03%) and was superior in localising brainstem infarcts. Significantly the brainstem involvement on both CT and MRI was strongly associated with poor outcomes ($p<0.0001$), particularly major disability and mortality. This is in line with the critical role of brainstem in maintaining consciousness, respiratory and cardiovascular functions, and its dense concentration of motor and sensory pathways.

Normal neuroimaging findings were reported in approximately 13.98% of MRIs and 26.88% in CTs, suggesting either transient ischemia, early imaging before radiological changes or limitations in CT sensitivity for posterior fossa lesions.

Functional Outcomes: At discharge, a substantial proportion (50.54%) had minor disability, while 26.88% had major disability and 5.38% succumbed to the illness. Notably, patients with lesions in the brainstem had the poorest outcomes, while those with cerebellar and cortical infarcts tended to fare better. Mortality was highest among those with brainstem infarcts and multiple infarcts. Age was found to significantly influence outcomes ($p=0.03$), with patients in the 55–64 and >85 age groups showing greater levels of disability and mortality.

However, gender did not significantly impact outcomes ($p=0.86$), suggesting that biological sex alone is not an independent predictor in PCS outcomes.

Clinical features: The most frequent presenting symptoms were weakness followed by cerebellar signs and cranial nerve involvement. Visual field defects were less common but significant.

The high prevalence of cerebellar involvement highlights the need for high index of suspicion in patients with dizziness and unsteadiness.

Though a chisquare test comparing clinical features and functional outcomes did not reveal statistical significance ($p=0.99$), this may be due to overlapping symptomatologies and lack of power from nonstratified data.

Comparison with Existing Literature: Previous studies highlighted the diagnostic challenges in PCS often due to nonlocalising symptoms. Our findings support this studies as mostly they presented with nonspecific symptoms. The findings of cerebellar and cranial nerve involvement were comparable with other studies like caplan et al and existing stroke registries.

While cardioembolic strokes are less common in posterior circulation strokes than anterior circulation, their presence warrants attention especially when associated with atrial fibrillation or valvulopathies.

Conclusion

This study provides the clinical insights into the spectrum of clinical features, radiological findings and outcomes in posterior circulation strokes. The predominance of large artery strokes and high rates of minor disability outcomes suggest the importance of early diagnosis and risk factor management.

Though statistical associations between clinical features and outcomes were not significant in the present study, larger prospective trials are needed for definitive correlations.

The findings emphasize the need for improved clinical awareness and rapid imaging protocols to reduce disability in posterior circulation strokes.

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