Section: Neurology

Original Research Article

ANTERIOR VERSUS POSTERIOR CIRCULATION ISCHEMIC STROKE: A PROSPECTIVE COMPARATIVE ANALYSIS OF VASCULAR RISK FACTORS, ETIOLOGICAL MECHANISMS, CLINICAL SEVERITY, AND OUTCOMES FROM A TERTIARY CARE CENTRE IN NORTHWESTERN INDIA

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Received *: 10/06/2026*
Received in revised form *: 14/07/2026*
Accepted *: 27/07/2026*

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DOI:10.70034/ijmedph.2026.3.767

Source of Support: Nil,
Conflict of Interest: Nonedeclared

Int J Med Pub Health
2026; 16 (3); 4965-4971

ABSTRACT

Background: Anterior circulation ischemic stroke (ACIS) and posterior circulation ischemic stroke (PCIS) differ in clinical presentation, diagnostic challenges, and risk-factor profiles. Comparative data from India, where stroke affects a younger population and non-traditional risk factors are under-recognised, remain sparse. The objective is to compare vascular risk factors, etiological mechanisms (TOAST classification), stroke severity (NIHSS), in-hospital complications, 30-day mortality, and three-month functional outcome (modified Rankin Scale, mRS) between ACIS and PCIS patients at a tertiary care centre in northwestern India.

Materials and Methods: This prospective, hospital-based, comparative observational study enrolled 146 patients with MRI/DWI-confirmed first-ever ischemic stroke (73 ACIS, 73 PCIS) over 18 months. Statistical analysis used Student's t-test, chi-square, and Fisher's exact test; $p<0.05$ was considered significant.

Results: Mean age (54.7±16.5 vs. 57.3±15.0 years) and sex distribution were comparable (both $p>0.05$). No conventional vascular risk factor differed significantly between groups. Migraine was absent in all ACIS patients but present in 30.1% of PCIS ($p<0.001$); OCP use among women was 92.0% in PCIS vs. 50.0% in ACIS ($p=0.001$); prior TIA was more frequent in ACIS (19.2% vs. 5.5%; $p=0.021$). ACIS patients had significantly higher admission NIHSS (9.66±10.14 vs. 4.92±2.03; $p<0.001$); severe deficit (NIHSS>14) was confined to ACIS (23.3% vs. 0%). In-hospital complications (32.9% vs. 31.5%), 30-day mortality (12.3% vs. 15.1%), and three-month good outcome (mRS 0–3: 69.9% vs. 68.5%) were comparable between groups.

Conclusion: ACIS and PCIS share comparable conventional risk factor profiles, TOAST etiological distribution, complication rates, mortality, and functional outcomes. They differ significantly in admission stroke severity and in two clinically actionable non-traditional risk factors — migraine and OCP use — that disproportionately affect the posterior circulation. Systematic neurological screening, including migraine history, before OCP prescription in Indian women of reproductive age is warranted.

Keywords: Brain ischemia; posterior circulation; TOAST classification; migraine; contraceptives, oral; outcome assessment

INTRODUCTION

Stroke is the second leading cause of death worldwide and a major source of disability-adjusted life years (DALYs). The Global Burden of Disease 2019 study estimated approximately 12.2 million new strokes annually, accounting for over 11% of all global deaths.[1] Ischemic stroke constitutes 70–85% of all strokes, and within this category, anatomical classification by vascular territory — anterior circulation ischemic stroke (ACIS) versus posterior circulation ischemic stroke (PCIS) — carries important implications for clinical presentation, diagnostic approach, acute management, and prognosis.[2]

India bears a disproportionate burden of stroke: it accounts for approximately one-fifth of global stroke incidence, with a striking propensity for younger age at onset compared to Western populations.[3] This epidemiological difference has been attributed to early-onset hypertension and diabetes mellitus, a persisting burden of rheumatic heart disease (RHD) as a source of cardioembolism in young adults, and a predominance of intracranial large-artery atherosclerosis over extracranial carotid disease.[4,5] These distinctions mean that findings from Western stroke registries cannot be extrapolated to Indian patients without caution, and Indian-specific prospective data are essential.

PCIS, supplied by the vertebrobasilar system, frequently manifests with non-specific symptoms — vertigo, diplopia, dysarthria, ataxia, and dysphagia — that overlap with benign vestibular and metabolic conditions, predisposing to diagnostic delay.[6,7] CT has well-documented limitations for posterior fossa imaging due to beam-hardening artefacts, making MRI with diffusion-weighted imaging (DWI) the diagnostic benchmark for accurate territory ascertainment.[6] Prior comparative studies of ACIS and PCIS have been limited by variable sample sizes, inconsistent etiological classification, and reliance on CT rather than MRI for territory ascertainment.[7,8] Indian comparative data using standardised MRI-based classification and TOAST etiological criteria are particularly sparse.[9,10]

Non-traditional risk factors, particularly migraine and oral contraceptive pill (OCP) use, are increasingly recognised as disproportionately relevant to posterior circulation ischemia in young women, but their contribution relative to anterior circulation has not been systematically examined in an Indian population.[11–13] Characterising these territory-specific differences has direct implications for primary stroke prevention — especially OCP prescription practices — in young Indian women.

We therefore conducted a prospective, MRI/DWI-based comparative study of ACIS and PCIS at a tertiary care neurology centre in northwestern India, with the primary objective of comparing etiology, risk factor profiles, stroke severity, and functional outcomes between the two territories.

MATERIALS AND METHODS

Study design and setting: This was a prospective, hospital-based, comparative observational study conducted in the Department of Neurology of NIMS&R ,Rajasthan, Jaipur, a tertiary care medical college and research centre in northwestern India. Patient enrolment extended over 18 months (July 2024 to December 2025), with a three-month follow-up period for each participant. Ethics Committee approval was obtained (IEC reference: NIMSUR/IEC/2024/1244), and written informed consent was secured from every participant or their legally acceptable representative before enrolment. The study adhered to the Declaration of Helsinki and to the ICMR National Ethical Guidelines for Biomedical and Health Research Involving Human Participants.

Participants: Consecutive patients presenting with a first-ever clinical stroke syndrome, aged ≥18 years, with acute ischemic infarction confirmed on MRI-DWI and localised exclusively to either the anterior or posterior circulation, who provided informed consent and agreed to three-month follow-up, were enrolled. Patients with haemorrhagic stroke, traumatic brain injury, intracranial space-occupying lesions, CNS infections, demyelinating disorders, acute metabolic encephalopathy, or dual anterior-posterior (watershed) infarction were excluded. Sample size was calculated based on the prevalence of hypertension in PCIS (68%) and ACIS (82%) from published data, with alpha 5% and power 80%, yielding 67 patients per group; adjusting for an 8% dropout, 73 patients per group (n=146 total) were enrolled.[14]

Definitions and classification: Hypertension, diabetes mellitus, and dyslipidaemia were defined per JNC-7, American Diabetes Association, and NCEP-ATP III criteria, respectively.[15–17] ACIS and PCIS territories were classified by MRI-DWI pattern, with anterior circulation events sub-classified using the Oxfordshire Community Stroke Project (OCSP) system and posterior circulation events sub-classified into proximal, middle, and distal territory per the New England Medical Center Posterior Circulation Registry (NEMC-PCR) classification.[18] Stroke mechanism was assigned using the TOAST classification: large artery atherosclerosis (LAA), cardioembolism (CE), small vessel occlusion (SVO), other determined cause, and undetermined cause.[19] Stroke severity was graded using the National Institutes of Health Stroke Scale (NIHSS; mild 1–4, moderate 5–14, severe >14) at admission, discharge, and one and three months.[20] Three-month functional outcome was assessed using the modified Rankin Scale (mRS), dichotomised into good (mRS 0–3) and poor (mRS 4–6).[21] In-hospital complications included a sustained NIHSS rise ≥4 points or the occurrence of aspiration pneumonia, urinary tract infection, deep vein

thrombosis, post-stroke sepsis, dyselectrolytaemia, or clinically significant cardiac events.

Investigations: All patients underwent complete haemogram, fasting and post-meal blood glucose, lipid profile, renal and liver function tests, serum electrolytes, 12-lead ECG, transthoracic echocardiography, and carotid/vertebral Doppler ultrasonography. Non-contrast CT brain was performed at presentation, followed by MRI brain with DWI, ADC mapping, T2/FLAIR, and MR angiography (MRA) for definitive territory ascertainment and vessel characterisation, reviewed in consensus by a neurologist and radiologist. Hypercoagulability workup was performed where clinically indicated.

Follow-up and outcomes: Clinical evaluation (including NIHSS scoring) was performed at admission, discharge, one month, and three months. The primary outcome was three-month mRS (good: 0–3; poor: 4–6). Secondary outcomes were in-hospital complications, 30-day mortality, and NIHSS trajectory. Patients lost to follow-up before three months were excluded from outcome analysis.

Statistical analysis: Data were analysed using IBM SPSS Statistics v.19.0. Continuous variables are expressed as mean ± standard deviation and compared using the independent-samples Student's t-test. Categorical variables are expressed as frequencies and percentages and compared using the chi-square test, with Fisher's exact test substituted where expected cell count was below five. A p-value <0.05 was considered statistically significant throughout. Pre-specified subgroup analyses were performed by age group, TOAST category, and NIHSS severity band.

RESULTS

One hundred and forty-six patients with MRI/DWI-confirmed first-ever ischemic stroke were enrolled — 73 ACIS and 73 PCIS. DWI confirmed acute ischemic infarction in all 146 patients (100%) in both groups.

Demographics and vessel distribution: Mean age was comparable between groups (ACIS: 54.7±16.5 years; PCIS: 57.3±15.0 years; p=0.313), and both groups showed male predominance (ACIS: 60.3%; PCIS: 65.8%; p=0.493). The 61–70 year age band was most prevalent in both groups. In ACIS, the MCA-M1 segment was most commonly involved (39.7%), with total MCA involvement in 63.0% of patients; the ICA terminal segment accounted for a further 17.8%. In PCIS, the PCA territory was most frequently involved (39.7%), followed by PICA (27.4%) and SCA (12.3%), reflecting predominance of distal territory involvement. Basilar artery involvement was uncommon (1.4%), likely reflecting survivor bias [Table 1].

Table 1: Demographic characteristics and vessel distribution — ACIS vs. PCIS (n=73 per group)

Variable	ACIS (n=73)	PCIS (n=73)	p value
Age, mean ± SD (years)	54.7 ± 16.5	57.3 ± 15.0	0.313
Male sex, n (%)	44 (60.3)	48 (65.8)	0.493
Most common vessel/territory	MCA-M1: 29 (39.7%)	PCA: 29 (39.7%)	—
Total MCA / Distal territory involvement	46 (63.0%)	49 (67.1%)*	—
ICA terminal / Basilar artery	13 (17.8%)	1 (1.4%)	—

SD: standard deviation; MCA: middle cerebral artery; PCA: posterior cerebral artery; ICA: internal carotid artery. *PICA (27.4%) + SCA (12.3%) + other territories.

Etiological mechanisms (TOAST): Large artery atherosclerosis was the dominant mechanism in both groups (ACIS: 45.2%; PCIS: 50.7%; p=0.508), followed by cardioembolism (ACIS: 24.7%; PCIS: 26.0%; p=0.849). No TOAST category showed a statistically significant inter-group difference [Table 2]. Age-stratified analysis revealed that in patients aged 18–30 years, cardioembolism was the dominant mechanism (ACIS: 62.5%; PCIS: 50.0%), whereas large artery atherosclerosis dominated progressively with increasing age, particularly in PCIS patients aged 71–80 years (76.9%).

Table 2: TOAST etiological classification — ACIS vs. PCIS

TOAST Category	ACIS n (%)	PCIS n (%)	p value
Large artery atherosclerosis	33 (45.2)	37 (50.7)	0.508
Cardioembolism	18 (24.7)	19 (26.0)	0.849
Small vessel disease	11 (15.1)	6 (8.2)	0.197
Other determined cause	4 (5.5)	5 (6.8)	1.000
Undetermined cause	7 (9.6)	6 (8.2)	0.771

No TOAST category differed significantly between groups (all p>0.05).

Vascular risk factors: No conventional vascular risk factor showed a statistically significant inter-group difference. Hypertension was the most prevalent risk factor in both groups (ACIS: 56.2%; PCIS: 50.7%; p=0.507). Three non-traditional risk factors differed significantly [Table 3] migraine was absent in all 73 ACIS patients (0.0%) but present in 22 PCIS patients (30.1%; p<0.001); OCP use among women was 92.0% (23/25) in PCIS versus 50.0% (14/28) in ACIS (p=0.001); and prior TIA was significantly more frequent in ACIS (19.2% vs. 5.5%; p=0.021).

Table 3: Vascular risk factor distribution — ACIS vs. PCIS

Risk Factor	ACIS n (%)	PCIS n (%)	p value
Hypertension	41 (56.2)	37 (50.7)	0.507
Diabetes mellitus	26 (35.6)	17 (23.3)	0.102
Dyslipidaemia	21 (28.8)	19 (26.0)	0.711
Smoking	30 (41.1)	27 (37.0)	0.611
Atrial fibrillation	16 (21.9)	11 (15.1)	0.286
Rheumatic heart disease	14 (19.2)	12 (16.4)	0.665
Ischaemic heart disease	9 (12.3)	9 (12.3)	1.000
Alcoholism	8 (11.0)	7 (9.6)	0.785
Family history of stroke	11 (15.1)	9 (12.3)	0.630
Prior TIA	14 (19.2)	4 (5.5)	0.021*
OCP use (women only)†	14/28 (50.0)	23/25 (92.0)	0.001*
Migraine	0 (0.0)	22 (30.1)	<0.001*

*Statistically significant. †Analysed among female patients only (ACIS n=28; PCIS n=25). TIA: transient ischaemic attack; OCP: oral contraceptive pill.

Stroke severity (NIHSS): ACIS patients had significantly higher neurological deficit at admission (mean NIHSS 9.66±10.14 vs. 4.92±2.03; p<0.001). Severe deficit (NIHSS>14) occurred in 23.3% of ACIS patients but in none of the PCIS patients (p<0.001); moderate deficit (NIHSS 5–14) was more frequent in PCIS (43.8% vs. 26.0%; p=0.024). Critically, PCIS NIHSS never exceeded 9 regardless of etiological mechanism, confirming the well-recognised NIHSS ceiling effect in posterior fossa strokes. NIHSS scores declined progressively in both groups through three months. Cardioembolism was associated with the highest mean admission NIHSS in both ACIS (11.61±9.35) and PCIS (6.26±1.97); undetermined aetiology in PCIS was associated exclusively with mild deficit (mean NIHSS 3.33±0.82) [Table 4].

Table 4: NIHSS severity at admission — ACIS vs. PCIS

NIHSS Category / Time Point	ACIS	PCIS	p value
Mild (NIHSS 1–4), n (%)	37 (50.7)	41 (56.2)	0.507
Moderate (NIHSS 5–14), n (%)	19 (26.0)	32 (43.8)	0.024*
Severe (NIHSS >14), n (%)	17 (23.3)	0 (0.0)	<0.001*
Mean NIHSS ± SD — Admission	9.66 ± 10.14	4.92 ± 2.03	<0.001*
Mean NIHSS — Discharge	5.25	3.68	NS
Mean NIHSS — 1 Month	3.42	2.81	NS
Mean NIHSS — 3 Months	2.59	2.23	NS

*Statistically significant. NS: not significant. SD: standard deviation. Severe NIHSS (>14) present in 23.3% of ACIS but absent in all PCIS patients. PCIS NIHSS never exceeded 9 regardless of mechanism.

Complications, mortality, and three-month outcome: In-hospital complications occurred in 32.9% of ACIS and 31.5% of PCIS patients (p=0.859). Chest infection was the commonest complication (12.3% in each group). Thirty-day mortality was 12.3% (ACIS) and 15.1% (PCIS; p=0.630). All 20 deaths across both groups occurred exclusively among patients who had developed in-hospital complications. Good three-month outcome (mRS 0–3) was achieved by 69.9% of ACIS and 68.5% of PCIS patients (p=0.858). Among patients with in-hospital complications, poor outcome was significantly more common than in uncomplicated patients (ACIS: 33.3% vs. 10.2%; PCIS: 34.8% vs. 10.0%; both p<0.01). MRA vessel occlusion (89.0% vs. 54.8%; p<0.001) and early CT ischaemic signs (63.0% vs. 31.5%; p<0.001) were significantly more frequent in ACIS [Table 5].

Table 5: In-hospital complications, 30-day mortality, three-month functional outcome, and radiological findings

Variable	ACIS n (%)	PCIS n (%)	p value
In-hospital complications (total)	24 (32.9)	23 (31.5)	0.859
— Chest infections	9 (12.3)	9 (12.3)	—
— Dyselectrolytaemia	8 (11.0)	6 (8.2)	—
— Post-stroke sepsis	7 (9.6)	4 (5.5)	—
— Urosepsis	5 (6.8)	4 (5.5)	—
30-day mortality	9 (12.3)	11 (15.1)	0.630
Three-month good outcome (mRS 0–3)	51 (69.9)	50 (68.5)	0.858
Three-month poor outcome (mRS 4–6)	13 (17.8)	13 (17.8)	NS
DWI acute infarction	73 (100)	73 (100)	1.000
MRA vessel occlusion	65 (89.0)	40 (54.8)	<0.001*
Early CT ischaemic signs	46 (63.0)	23 (31.5)	<0.001*

*Statistically significant. mRS: modified Rankin Scale; DWI: diffusion-weighted imaging; MRA: MR angiography. Remaining patients (deaths) had no three-month mRS recorded. All 20 deaths occurred exclusively among patients with in-hospital complications.

Predictors of complications, mortality, and outcome: Across both territories, cardioembolism was associated with the highest complication rate (ACIS: 50.0%; PCIS: 52.6%), the highest 30-day

mortality (ACIS: 27.8%; PCIS: 36.8%), and the highest rate of poor three-month outcome. Undetermined aetiology carried zero mortality and the best three-month outcomes in both groups (ACIS: 85.7% good; PCIS: 100% good). Admission NIHSS was the single strongest predictor of in-hospital complications and 30-day mortality in both groups [Table 6].

Table 6: Admission NIHSS as a predictor of in-hospital complications and 30-day mortality, and mechanism-wise mortality

Variable	ACIS Adverse	ACIS Non-adverse	PCIS Adverse	PCIS Non-adverse	p value
Complications: mean NIHSS ± SD	17.25 ± 12.18	5.94 ± 6.33	6.39 ± 1.95	4.24 ± 1.68	<0.001*
Mortality: mean NIHSS ± SD	23.78 ± 11.27	7.67 ± 8.29	7.91 ± 1.04	4.39 ± 1.66	<0.001*
Cardioembolism 30-day mortality	5/18 (27.8%)		7/19 (36.8%)		—
Undetermined aetiology mortality	0/7 (0.0%)		0/6 (0.0%)		—

*Statistically significant (p<0.001). Admission NIHSS was the single strongest predictor of both in-hospital complications and 30-day mortality in both groups. Cardioembolism: highest mortality in both territories; undetermined aetiology: zero mortality in both.

DISCUSSION

This prospective study enrolled 73 MRI/DWI-confirmed patients each of ACIS and PCIS, making it one of the few Indian comparative studies to use DWI as the diagnostic benchmark for both territory ascertainment and outcome analysis. Four statistically significant inter-group differences were identified: admission NIHSS, migraine prevalence, OCP use among women, and prior TIA. All conventional vascular risk factors, TOAST etiological categories, in-hospital complication rates, 30-day mortality, and three-month functional outcomes were comparable between groups.

Demographics and comparable risk factor profiles: The comparable demographic profiles — mean age in the mid-50s, male predominance — are consistent with prior Indian comparative series reporting a younger mean age at stroke onset compared to Western registries, attributable in part to a higher burden of conventional vascular risk factors at younger ages in the Indian population. [9,10] The lack of any significant difference in conventional risk factor prevalence between ACIS and PCIS, including hypertension, diabetes, dyslipidaemia, smoking, and atrial fibrillation, is consistent with findings from the Lausanne Stroke Registry and Mousavi et al., supporting the concept that these factors confer broadly equivalent risk across both circulations.[22,23] This finding argues against territory-specific screening strategies based on conventional risk factors alone.

Non-traditional risk factors — migraine, OCP, and prior TIA: The three significant non-traditional risk factor differences represent the principal original findings of this study. Migraine was completely absent in all 73 ACIS patients but present in 30.1% of PCIS patients, corroborating the established disproportionate vulnerability of the posterior circulation to migraine-associated ischemia, attributed to cortical spreading depression and vertebrobasilar vasospasm.[11,12] OCP use was significantly more prevalent in PCIS women (92.0% vs. 50.0%; p=0.001), consistent with prior evidence that OCP-associated stroke disproportionately involves the vertebrobasilar territory, plausibly via oestrogen-mediated vasospasm.[13] The co-occurrence of migraine and OCP use in several PCIS patients in our cohort is of particular concern, since this combination constitutes an absolute contraindication (WHO Medical Eligibility Criteria Category 4).[24] These findings collectively argue for systematic neurological screening — including a detailed migraine history — before OCP prescription in women of reproductive age in India, where combined oral contraceptive use is prevalent but pre-prescription neurological screening remains inconsistent.

Prior TIA was significantly more frequent in ACIS (19.2% vs. 5.5%; p=0.021), consistent with the established role of anterior circulation TIA as a vascular warning event. The lower rate in PCIS may partly reflect underrecognition of posterior circulation TIA, whose non-specific symptoms — vertigo, diplopia, ataxia — are frequently misattributed to benign labyrinthine or metabolic causes, a phenomenon systematically documented in the Oxford Vascular Study.[25].

Stroke severity and the NIHSS ceiling effect: ACIS patients presented with significantly higher neurological deficit, with severe NIHSS (>14) confined entirely to the anterior circulation group. The complete absence of severe NIHSS in any PCIS patient — regardless of stroke mechanism — reproduces the NIHSS ceiling effect in posterior fossa ischemia demonstrated by Tao et al. in a large comparative series.[7] Clinically, this ceiling effect has two important consequences: it leads to underestimation of true posterior circulation deficit severity using NIHSS alone, and it may mask the severity of posterior fossa strokes in triage and prognosis scoring systems that rely heavily on NIHSS. The observation that moderate NIHSS in PCIS was associated with a substantially worse three-month outcome than the same NIHSS band in ACIS (37.5% vs. 63.2% good outcome; p<0.001),

and that all 11 PCIS deaths occurred within the moderate NIHSS group, underscores this point and supports the use of PCIS-specific severity tools in clinical practice.

Etiological mechanisms and outcomes: The comparable TOAST distributions across groups indicate that etiological mechanisms operate across both vascular territories with similar frequency in this Indian population. Age-stratified analysis revealed that cardioembolism dominated the youngest age band in both groups, likely reflecting the burden of RHD in young Indian patients — an important epidemiological distinction from Western cohorts, where young-onset cardioembolism is more frequently attributed to patent foramen ovale and non-rheumatic valvular disease. Across both territories, cardioembolism consistently carried the highest complication rate, the highest 30-day mortality, and the worst three-month functional outcomes, while undetermined aetiology consistently carried the best prognosis. These findings highlight that etiological characterisation — rather than vascular territory per se — is the principal prognostic determinant in ischemic stroke.

Admission NIHSS was the single strongest predictor of both in-hospital complications and 30-day mortality in both groups, a finding consistent with the broader stroke literature and reinforcing NIHSS as a frontline triage tool. All 20 deaths across both groups occurred exclusively among patients who had developed in-hospital complications, confirming that complication prevention is the most modifiable determinant of acute stroke survival, irrespective of vascular territory.

Radiological findings: MRA vessel occlusion and early CT ischaemic signs were both significantly less frequent in PCIS than ACIS. The lower MRA occlusion detection rate in PCIS likely reflects the smaller calibre and greater tortuosity of vertebrobasilar vessels, as well as pial branch strokes that are below the resolution threshold of time-of-flight MRA. The markedly lower rate of early CT ischaemic signs in PCIS (31.5% vs. 63.0%) is a direct consequence of posterior fossa beam-hardening artefact — a well-established limitation of CT in evaluating the brainstem and cerebellum — and reinforces the diagnostic imperative for MRI-DWI in any patient with suspected posterior circulation ischemia.

Limitations: This was a single-centre study with a three-month follow-up only. Prolonged cardiac rhythm monitoring was not performed, which may have led to under-classification of paroxysmal atrial fibrillation as undetermined aetiology. The NIHSS ceiling effect in PCIS may have led to underestimation of true posterior circulation deficit severity. Outcome assessment was not blinded to stroke territory.

CONCLUSION

In this prospective Indian cohort, ACIS and PCIS shared comparable conventional vascular risk factor profiles, TOAST etiological distributions, in-hospital complication rates, 30-day mortality, and three-month functional outcomes. They differed significantly in admission stroke severity — with severe deficit confined entirely to ACIS — and in two clinically actionable non-traditional risk factors: migraine and OCP use, both disproportionately prevalent in PCIS women. The co-occurrence of these two risk factors in PCIS patients carries direct implications for primary stroke prevention in India. Systematic neurological screening, including detailed migraine history, before OCP prescription in women of reproductive age is recommended. Admission NIHSS remained the single strongest modifiable predictor of complications and mortality across both territories, with cardioembolism consistently carrying the worst prognosis irrespective of vascular territory.

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