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Original Research Article

Clinical, Demographic and Radiological Profile of Stroke Patients Presenting to the Emergency Department: A Prospective Observational Study from Central India

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Abstract

Background: Stroke is a time-sensitive neurological emergency and a leading cause of death and disability, with a disproportionate and increasingly younger burden in low- and middle-income countries. Emergency department (ED)-based data characterising stroke presentation in central India remain limited. We aimed to describe the clinical, demographic and radiological profile of stroke patients and to compare ischemic and hemorrhagic subtypes.

Methods: This single-centre, prospective observational study enrolled 75 consecutive adults (≥18 years) with clinically and radiologically confirmed stroke presenting to the ED of a tertiary care hospital over 18 months. Demographics, vital signs, Glasgow Coma Scale (GCS), random blood sugar, electrocardiography and non-contrast computed tomography (NCCT) head findings were recorded. Continuous variables were tested for normality (Shapiro–Wilk) and compared between subtypes using the Student t-test or Mann–Whitney U test; categorical variables using the chi-square or Fisher exact test. $P<0.05$ was significant.

Results: Mean age was 54.4±13.1 years with male predominance (66.7%; male:female 2:1). Ischemic stroke predominated (70.7%). Hypertension was the commonest co-morbidity (64%) and hemiparesis the leading symptom (68%). Only 24% arrived within 4.5 hours. Axillary temperature was the sole variable differing significantly between ischemic and hemorrhagic stroke (98.8±0.8 vs 98.4±0.7 °F; p=0.034); all other admission parameters were comparable.

Conclusion: Stroke predominantly affected middle-aged hypertensive men, with delayed presentation limiting reperfusion eligibility. Admission clinical parameters largely overlapped between subtypes, reinforcing the indispensability of early neuroimaging.

Keywords: Cerebrovascular Accident; Emergency Department; Glasgow Coma Scale; Hypertension; Ischemic Stroke; Neuroimaging.

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Introduction

Stroke remains the second leading cause of death and the third leading cause of combined death and disability worldwide, accounting for almost 12 million new events and more than 7 million deaths each year.[1] The World Health Organization defines it as a rapidly developing clinical syndrome of focal or global cerebral dysfunction of vascular origin lasting more than 24 hours or leading to death.[2,3] More than four-fifths of the global burden is now borne by low- and middle-income countries (LMICs), among which India occupies a prominent position owing to epidemiological transition, an ageing population and inadequately controlled vascular risk factors.[4][5] Community- and registry-based estimates place the incidence of stroke in India between roughly 100 and 170 per 100,000 person-years, and Indian patients are typically affected one to two decades earlier than Western populations.[6,7,8] This younger age of onset magnifies the socioeconomic consequences of stroke, as it strikes individuals during their most productive years. Modern stroke care is governed by the principle that “time is brain”; an estimated 1.9 million neurons are lost every minute of

untreated large-vessel ischaemia, and timely reperfusion sharply improves outcomes.[9] The emergency department (ED) is the first point of medical contact for most patients, where rapid recognition, differentiation of ischemic from hemorrhagic stroke, stabilisation and early non-contrast computed tomography (NCCT) determine eligibility for thrombolysis and downstream management.[10][11] Presentation is clinically heterogeneous and depends on stroke type, vascular territory and lesion size, while demographic factors and co-morbidities further shape subtype, severity and prognosis.[12][13]

Despite this escalating burden, granular ED-based data describing the real-world spectrum of stroke from secondary and tertiary centres in central India remain sparse, yet are essential to inform triage protocols, resource allocation and locally relevant prevention. The present study was therefore undertaken to characterise the clinical, demographic and radiological profile of stroke patients presenting to the ED of a tertiary care hospital and, extending the original descriptive analysis, to compare ischemic and hemorrhagic subtypes across admission parameters using a distribution-appropriate statistical framework.

Materials and Methods

Study Design and Setting: This single-centre, hospital-based, prospective observational study was conducted in the Department of Emergency Medicine of L.N. Medical College and J.K. Hospital, Bhopal, a tertiary care teaching hospital in central India, over 18 months (2024–2026). The study conformed to the Declaration of Helsinki and was approved by the Institutional Ethics Committee; written informed bilingual consent was obtained from every participant or their legally authorised representative.

Participants: Consecutive adults aged ≥18 years of either sex presenting with clinical features of stroke and radiological confirmation on NCCT head were enrolled. Patients with head injury and pregnant women were excluded. Using a finite-population correction, $n = N/(1 + Ne^2)$, for an estimated eligible population of 92 at a 5% margin of error, the required sample size was 75; 75 patients were recruited by consecutive sampling.

Data Collection: A structured proforma captured demographic details, co-morbidities and presenting complaints. Axillary temperature, pulse, respiratory rate, systolic and diastolic blood pressure and peripheral oxygen saturation (SpO_2) were recorded at presentation, together with a complete central nervous system examination and Glasgow Coma Scale (GCS) score categorised as mild (13–15), moderate (9–12) or severe (3–8). All patients underwent random blood sugar (RBS) estimation, 12-lead electrocardiography (ECG) and NCCT head, interpreted by qualified radiologists to determine stroke type, vascular territory or haemorrhage location and additional findings. The interval from symptom onset to ED arrival was documented.

Statistical Analysis: Data were entered in Microsoft Excel and analysed in R (v4.5.2). Categorical variables are summarised as frequencies and percentages. The distribution of each continuous variable was assessed using the Shapiro–Wilk test, preferred over the Kolmogorov–Smirnov test for its greater power at this sample size, with normality accepted at $p > 0.05$. Normally distributed variables are presented as mean ± standard deviation (SD) and non-normally distributed variables as median (interquartile range, IQR). For the subtype comparison, subarachnoid haemorrhage (n = 4) was combined with intracerebral haemorrhage (n = 18) to form a single hemorrhagic group (n = 22), compared against the ischemic group (n = 53). Normally distributed variables were compared using the independent-samples Student t-test and non-normal variables using the Mann–Whitney U test; categorical variables were compared using the chi-square test, with Fisher exact test where any expected cell count was < 5. A two-tailed $p < 0.05$ was considered statistically significant.

Results

A total of 75 patients were analysed [Table 1]. The mean age was 54.4 ± 13.1 years (range 30–86), with most patients in the 41–60-year band. Fifty patients (66.7%) were male (male:female 2:1) and 43 (57.3%) resided in rural areas. Ischemic stroke was the predominant subtype (53; 70.7%), followed by intracerebral haemorrhage (18; 24.0%) and subarachnoid haemorrhage (4; 5.3%) [Figure 1].

Clinical Profile: Hemiparesis or hemiplegia was the commonest presenting complaint (68.0%), followed by speech disturbance (53.3%), headache (37.3%), facial deviation (37.3%) and altered sensorium (36.0%). On examination, a plantar extensor response (70.7%) and right hemiparesis (52.0%) predominated. Nearly half of the patients presented with mild neurological impairment (GCS 13–15; 48.0%), while 37.3% and 14.7% had moderate and severe impairment, respectively.

Hypertension was the leading co-morbidity (64.0%), followed by diabetes mellitus (30.7%), smoking or tobacco use (29.3%) and dyslipidaemia (24.0%) [Figure 2]. Elevated systolic blood pressure (>140 mmHg) was recorded in 65.3% of patients (mean 160.2 ± 27.7 mmHg) and SpO_2 <94% in 20.0%. Hyperglycaemia (RBS ≥140 mg/dL) was present in 53.3%, of whom 30.7% were in the diabetic range (≥200 mg/dL). Normal

sinus rhythm was the commonest ECG finding (54.7%), with left ventricular hypertrophy in 14.7% and atrial fibrillation (including AF with LVH) in 10.7%.

Radiological Profile: On NCCT, an acute ischemic infarct was the most frequent finding (66.7%), followed by intracerebral haemorrhage (24.0%) and subarachnoid haemorrhage (5.3%); the scan was normal in 4.0%, consistent with early ischaemia. The middle cerebral artery territory was involved in 58.5% of ischemic strokes, whereas the basal ganglia (44.4%) was the commonest site of haemorrhage. Cerebral oedema (22.7%) and intraventricular extension (10.7%) were the principal additional findings. Only 24.0% of patients reached the ED within the 4.5-hour thrombolysis window, whereas 26.7% arrived beyond 24 hours (median 10.1 hours) [Figure 3].

Normality and Subtype Comparison: On Shapiro–Wilk testing, temperature, pulse, respiratory rate and diastolic blood pressure were normally distributed, whereas age, systolic blood pressure, SpO_2, GCS score, RBS and time to ED arrival deviated significantly from normality [Table 2]. Parametric and non-parametric tests were therefore applied selectively. In the comparison of ischemic versus hemorrhagic stroke, axillary temperature was the only continuous variable that differed significantly, being marginally higher in ischemic stroke (98.8 ± 0.8 vs 98.4 ± 0.7 °F; $p = 0.034$) [Table 3]. Age, pulse, respiratory rate, systolic and diastolic blood pressure, SpO_2, GCS score, RBS and time to ED arrival did not differ significantly between groups (all $p > 0.05$). None of the categorical variables—sex, residence, GCS category or ECG findings—showed a significant association with stroke subtype [Table 4].

Co-morbidity and Severity Associations: Among co-morbidities, ischemic heart disease showed a near-significant excess in hemorrhagic stroke (27.3% vs 7.5%; $p = 0.056$), whereas hypertension (67.9% vs 54.5%), diabetes, smoking and dyslipidaemia did not differ significantly by subtype. Smoking was significantly more frequent in men than women (40.0% vs 8.0%; $p = 0.009$). On Spearman correlation, the admission GCS score was not significantly associated with age, systolic blood pressure, random blood sugar, time to ED arrival or the number of co-morbidities (all $p > 0.05$), although weak negative trends were noted for age ($r = -0.17$) and systolic blood pressure ($r = -0.14$).

Table 1: Baseline demographic, clinical and radiological characteristics of the study cohort (N = 75).

Characteristic	n	% / summary
Age (years)		
Mean ± SD	—	54.4 ± 13.1
Median (IQR); range	—	52 (44–65); 30–86
Sex		
Male	50	66.7
Female	25	33.3
Residence		
Rural	43	57.3
Urban	32	42.7
Stroke subtype		
Ischemic	53	70.7
Intracerebral haemorrhage	18	24.0
Subarachnoid haemorrhage	4	5.3
Glasgow Coma Scale category		
Mild (13–15)	36	48.0
Moderate (9–12)	28	37.3
Severe (3–8)	11	14.7
Common presenting complaints*		
Hemiparesis / hemiplegia	51	68.0
Speech disturbance	40	53.3
Headache	28	37.3
Facial deviation	28	37.3
Altered sensorium	27	36.0
Co-morbidities*		
Hypertension	48	64.0
Diabetes mellitus	23	30.7
Smoking / tobacco use	22	29.3
Dyslipidaemia	18	24.0
Vital signs at presentation (mean ± SD)		

Systolic BP (mmHg)	—	160.2 ± 27.7
Diastolic BP (mmHg)	—	91.3 ± 13.8
Temperature (°F)	—	98.7 ± 0.8
Pulse (bpm)	—	87.0 ± 15.1
Respiratory rate (/min)	—	19.6 ± 3.9
SpO_2 (%)	—	95.9 ± 2.8
Random blood sugar		
Mean ± SD (mg/dL)	—	184.8 ± 96.2
Hyperglycaemia (≥140 mg/dL)	40	53.3
NCCT head findings		
Acute ischemic infarct	50	66.7
Intracerebral haemorrhage	18	24.0
Subarachnoid haemorrhage	4	5.3
Normal (early ischemic)	3	4.0
MCA territory (of ischemic, n=53)	31	58.5
Basal ganglia (of ICH, n=18)	8	44.4
Time from onset to ED arrival		
≤4.5 h	18	24.0
>24 h	20	26.7
Median (h)	—	10.1

BP, blood pressure; ED, emergency department; ICH, intracerebral haemorrhage; IQR, interquartile range; MCA, middle cerebral artery; NCCT, non-contrast computed tomography; SD, standard deviation; SpO_2, peripheral oxygen saturation. *Multiple responses per patient; percentages do not total 100%.

Table 2: Test of normality (Shapiro–Wilk) for continuous variables, whole cohort (N = 75).

Variable	W	p-value	Distribution	Test applied
Age (yrs)	0.965	0.0367	**Non-normal**	Mann–Whitney U
Temperature (°F)	0.974	0.1179	Normal	t-test
Pulse (bpm)	0.975	0.1505	Normal	t-test
Resp. Rate (/min)	0.975	0.1458	Normal	t-test
Systolic BP (mmHg)	0.958	0.0136	**Non-normal**	Mann–Whitney U
Diastolic BP (mmHg)	0.980	0.2686	Normal	t-test
SpO2 (%)	0.952	0.0065	**Non-normal**	Mann–Whitney U
GCS Score	0.902	<0.001	**Non-normal**	Mann–Whitney U
RBS (mg/dL)	0.857	<0.001	**Non-normal**	Mann–Whitney U
Time to ED (hrs)	0.848	<0.001	**Non-normal**	Mann–Whitney U

Distribution taken as normal if p > 0.05. Normally distributed variables were compared with the Student t-test and non-normal variables with the Mann–Whitney U test.

Table 3: Comparison of continuous variables between ischemic (n = 53) and hemorrhagic (n = 22) stroke.

Variable	Ischemic	Hemorrhagic	Test	p
Age (yrs)	55.6 ± 13.3	51.4 ± 12.1	t-test	0.207
Temperature (°F)	98.8 ± 0.8	98.4 ± 0.7	t-test	**0.034 ***
Pulse (bpm)	88.7 ± 13.7	83.0 ± 17.6	t-test	0.134
Resp. Rate (/min)	20.0 (18.0–22.0)	18.0 (16.2–22.0)	M–W U	0.304
Systolic BP (mmHg)	163.0 (134.0–183.0)	154.5 (136.0–175.2)	M–W U	0.549
Diastolic BP (mmHg)	92.4 ± 13.3	88.8 ± 14.9	t-test	0.310
SpO2 (%)	95.7 ± 2.9	96.5 ± 2.5	t-test	0.288
GCS Score	12.0 (10.0–14.0)	13.0 (10.0–14.0)	M–W U	0.930
RBS (mg/dL)	144.0 (114.0–275.0)	138.5 (119.5–216.2)	M–W U	0.767
Time to ED (hrs)	9.8 (4.4–38.8)	12.4 (5.8–21.9)	M–W U	0.893

Normally distributed variables: mean ± SD (Student t-test). Non-normal variables: median (IQR) (Mann–Whitney U test). * p < 0.05 (statistically significant). M–W U, Mann–Whitney U.

Table 4: Comparison of categorical variables between ischemic (n = 53) and hemorrhagic (n = 22) stroke.

Variable	Category	Ischemic	Hemorrhagic	p
Sex Chi-square (χ^2)	Female	21 (39.6%)	4 (18.2%)	0.127
	Male	32 (60.4%)	18 (81.8%)	
Residence Chi-square (χ^2)	Rural	29 (54.7%)	14 (63.6%)	0.649
	Urban	24 (45.3%)	8 (36.4%)	
GCS Category Chi-square (χ^2)†	Mild	24 (45.3%)	12 (54.5%)	0.500
	Moderate	22 (41.5%)	6 (27.3%)	
	Severe	7 (13.2%)	4 (18.2%)	
ECG Finding Chi-square (χ^2)†	Atrial Fibrillation	5 (9.4%)	2 (9.1%)	0.373
	Atrial Fibrillation with LVH	1 (1.9%)	0 (0%)	
	LBBB	1 (1.9%)	0 (0%)	
	LVH	5 (9.4%)	6 (27.3%)	
	Normal Sinus Rhythm	31 (58.5%)	10 (45.5%)	
	RBBB	0 (0%)	1 (4.5%)	
	ST-T changes	5 (9.4%)	2 (9.1%)	
	Sinus Tachycardia	5 (9.4%)	1 (4.5%)	

Values are n (% within group). † χ^2 reported although one or more expected counts < 5; interpret with caution. LVH, left ventricular hypertrophy; LBBB/RBBB, left/right bundle branch block.

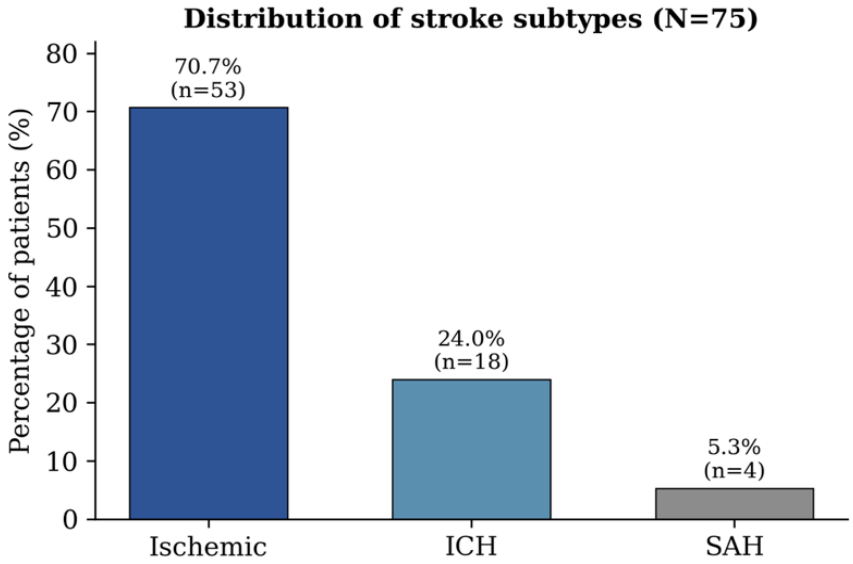

Figure 1: Distribution of stroke subtypes among the 75 patients.

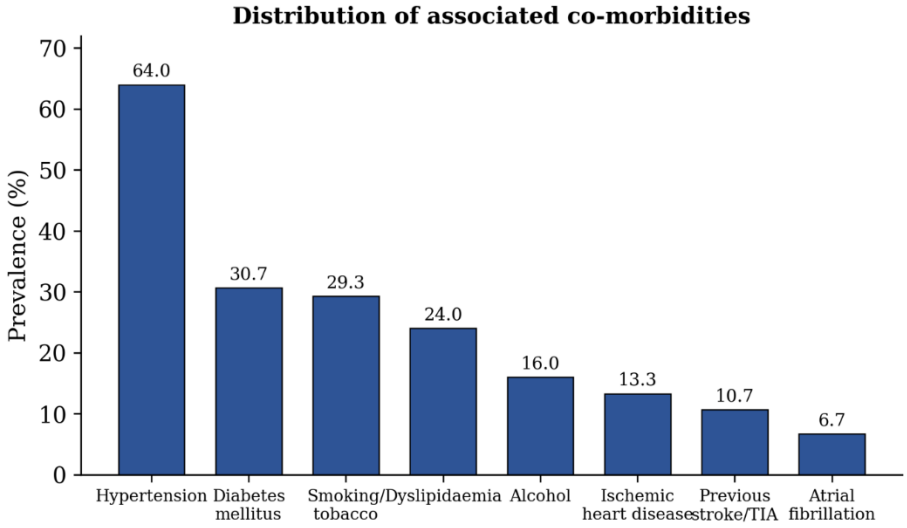

Figure 2: Distribution of associated co-morbidities in the study cohort.

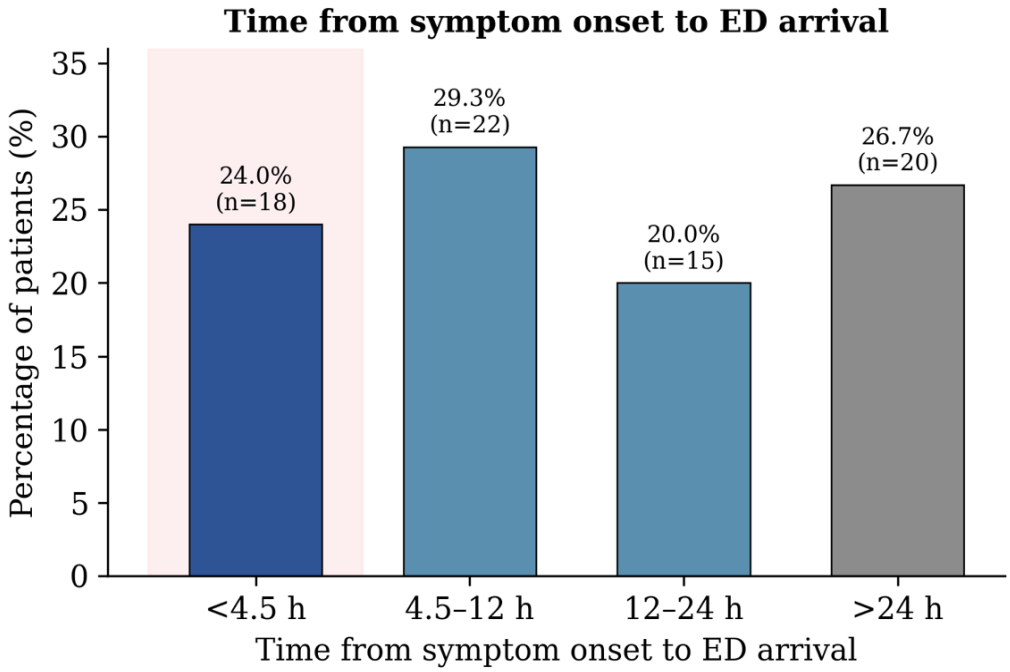

Figure 3: Time from symptom onset to emergency department (ED) arrival.

Only 24.0% of patients reached the ED within the 4.5-hour thrombolysis window (shaded), whereas 26.7% arrived beyond 24 hours (median 10.1 hours). Bars show the percentage of patients; absolute numbers are given above each bar.

Discussion

This prospective ED-based study profiles stroke in a central Indian tertiary care setting and, through a distribution-appropriate comparison of subtypes, offers a nuanced view of how ischemic and hemorrhagic stroke present at first contact.

The mean age of 54.4 years and clear male predominance (2:1) mirror Indian epidemiological data, which consistently show stroke occurring a decade or more earlier than in high-income countries owing to a heavy and poorly controlled burden of modifiable risk factors.[6][8] The male excess is largely attributable to greater exposure to smoking, alcohol and occupational stress, although biological sex and gender also modify risk, presentation and outcome, and stroke in women may be under-ascertained because of sociocultural barriers to care.[14][15][16] The rural preponderance (57.3%) reflects the hospital's referral catchment and echoes wider concerns about awareness, access and socioeconomic disadvantage as determinants of stroke care.[17]

Clinically, focal deficits dominated, with hemiparesis and speech disturbance most frequent—a pattern typical of anterior circulation, particularly middle cerebral artery, involvement, which was the commonest territory on imaging.[11] Although nearly half presented with mild impairment, a substantial proportion had moderate-to-severe deficits, underscoring the value of rapid triage and GCS assessment.[18] The most sobering observation was the delay in presentation: only one-quarter arrived within the 4.5-hour thrombolysis window and more than a quarter after 24 hours. This narrow therapeutic reach—driven by low symptom awareness, inefficient pre-hospital transport and initial presentation to peripheral facilities—represents the single most actionable gap in this population and is consistent with the challenges described for hyper-acute stroke systems in resource-limited settings.[9][12]

Hypertension was the dominant co-morbidity (64%), followed by diabetes, smoking and dyslipidaemia—a hierarchy concordant with the INTERSTROKE study and Indian registry data that identify hypertension as the pre-eminent modifiable risk factor.[13] Its central pathogenic role, mediated through accelerated atherosclerosis and vascular remodelling, together with the acute hypertensive response that frequently accompanies stroke, explains the high admission blood pressures observed,[19][20][21] while the predominance of basal ganglia and thalamic haemorrhages reflects hypertensive small-vessel disease.[22]

The significantly higher prevalence of smoking among men (40% vs 8%) identifies a clear target for sex-specific behavioural intervention,[24] and hyperglycaemia in over half the cohort—whether pre-existing or stress-induced—is a recognised adverse prognostic marker in acute stroke.[23] Atrial fibrillation, detected in about one-tenth, remains an important and potentially under-recognised cardioembolic contributor.[25] The distribution of subtypes (71% ischemic, 29%

haemorrhagic) accords with national data, and NCCT reliably separated the two while identifying oedema and intraventricular extension as markers of severity.[26] The small proportion of normal early scans is an expected limitation of NCCT sensitivity in hyperacute ischaemia and supports selective use of advanced imaging.[27]

The principal analytical finding is that, across a broad panel of admission variables, ischemic and hemorrhagic strokes were statistically indistinguishable except for a marginally higher temperature in ischemic stroke ($p = 0.034$). Given the small absolute difference (0.4 °F) and the multiplicity of comparisons, this isolated result should be interpreted cautiously, is unlikely to be clinically discriminating, and may reflect early infection, stress or an inflammatory response rather than a true subtype signature. The broader message is that admission demographics, haemodynamics, conscious level and biochemistry overlap substantially between subtypes, so no combination of bedside parameters can safely replace neuroimaging for subtype determination[28]—a conclusion of direct operational relevance where clinical stroke scores are sometimes relied upon in the absence of immediate CT.

Consistent with this, admission GCS did not correlate significantly with age, blood pressure, glycaemia or time to presentation, and the near-significant excess of ischemic heart disease in haemorrhagic stroke did not reach significance. These null results are most plausibly explained by the modest sample size and the multifactorial determinants of stroke severity—lesion location, volume and collateral circulation—rather than by a true absence of association, and the observed trends remain biologically coherent with larger cohorts.

Limitations

This study has limitations. It was conducted at a single tertiary centre using consecutive ED sampling, which limits generalisability and may over-represent more severe or symptomatic cases. The modest sample size ($n = 75$), particularly the small hemorrhagic and subarachnoid subgroups, reduced statistical power and rendered comparisons involving sparse categories (for example, individual ECG findings) unstable; these should be regarded as exploratory. The cross-sectional design precludes causal inference, and reliance on NCCT without MRI or angiography may have misclassified early or posterior-circulation ischaemia. Biochemical and risk-factor data were single time-point measurements at presentation and may not reflect chronic control. Finally, treatment received, outcomes and functional recovery were not captured. Multicentric studies with larger samples, advanced imaging and longitudinal follow-up are warranted.

Conclusion

In this central Indian ED cohort, stroke predominantly affected middle-aged men with a high burden of modifiable risk factors, chiefly hypertension, and ischemic stroke of the middle cerebral artery territory was most common. Delayed presentation left only a minority eligible for time-dependent reperfusion, identifying public awareness and pre-hospital systems as urgent priorities. Importantly, admission clinical, haemodynamic and biochemical parameters overlapped almost completely between ischemic and hemorrhagic subtypes, with only a marginal and clinically unimportant temperature difference, reaffirming that early neuroimaging remains indispensable for subtype diagnosis. Strengthening primary prevention through blood pressure and glycaemic control, improving community recognition of stroke symptoms, and building efficient emergency stroke pathways are essential to reduce the regional burden of stroke-related morbidity and mortality.

Declarations

Ethics Approval: Approved by the Institutional Ethics Committee, L.N. Medical College and J.K. Hospital, Bhopal; conducted per the Declaration of Helsinki. Written informed consent was obtained from all participants.

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