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Original Research Article

Clinical Spectrum and Outcomes of Pontine Strokes: An Observational Cross Sectional Study from a Tertiary Care Centre in the North-Eastern Region of India

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Abstract

Background: Pontine strokes represent a critical subset of posterior circulation strokes due to the compact arrangement of vital neural pathways within the pons, often resulting in severe neurological deficits and high mortality. Data on their clinical profile and outcomes from North-Eastern India remain limited.

Objectives: To study the prevalence, clinical spectrum, radiological characteristics, severity, and in-hospital outcomes of patients with pontine stroke admitted to a tertiary care center.

Methods: This hospital-based observational cross-sectional study was conducted in the Department of Medicine, Agartala Government Medical College and G.B. Pant Hospital, Tripura, from January 2025 to December 2025. All consecutive adult patients admitted with acute stroke were screened. Patients with radiologically confirmed pontine involvement on NCCT and/or MRI brain were included. Demographic data, vascular risk factors, clinical presentation, neurological findings, imaging characteristics, hospital course, complications, duration of stay, and in-hospital outcomes were recorded using a standardised proforma. Stroke severity and outcomes were analyzed, and associations were assessed using appropriate statistical tests, with $p < 0.05$ considered significant.

Results: Out of 138 acute stroke admissions, 24 patients (17.39%) had pontine stroke, accounting for 66.7% of posterior circulation strokes. The mean age was 63.33 years, with male predominance. Hypertension was the most common risk factor (50%). Pontine hemorrhage was the predominant subtype (91.6%), while pontine infarction accounted for 8.4% cases. Hemiparesis was the most frequent presenting symptom, followed by crossed neurological deficits and altered sensorium. Clinical severity and outcome strongly correlated with hematoma volume. Patients with massive pontine hemorrhage had uniformly poor outcomes, whereas those with small hemorrhages or infarcts showed favorable recovery. Aspiration pneumonitis was the most common in-hospital complication. Overall in-hospital mortality was 33.3%, occurring exclusively in patients with moderate to massive pontine hemorrhage ($p < 0.001$).

Conclusion: Pontine strokes contribute significantly to posterior circulation stroke burden and are associated with high in-hospital mortality, particularly in hemorrhagic cases with larger hematoma volumes. Early recognition, prompt neuroimaging, and aggressive supportive care are essential to improve short-term outcomes.

Keywords: Pontine Stroke, Tertiary Care Hospital, Clinical Spectrum, Outcome, North-Eastern Region of India.

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Introduction

Stroke continues to pose a significant global health burden and remains a leading cause of mortality and long-term neurological disability. It contributes to approximately 11–12% of deaths worldwide and is a

major determinant of adult disability. In India, stroke is the second most common cause of death, with an estimated incidence of 105–152 per 100,000 population, reflecting the growing impact of cerebrovascular disease on the healthcare system.[1]

Posterior circulation strokes constitute a considerable proportion of ischemic strokes, with pontine involvement accounting for nearly 10% of all stroke cases. Pontine strokes are among the most frequently encountered brainstem strokes due to the vascular supply of the pons from perforating branches of the basilar artery. Given the compact arrangement of vital motor, sensory, and autonomic pathways within the pons, vascular insults in this region often result in severe neurological deficits and are associated with high morbidity and mortality.[2]

The clinical manifestations of pontine stroke are heterogeneous and depend on the extent and location of the lesion. Presentations may range from classical crossed hemiplegia and cranial nerve palsies to pure motor or pure sensory syndromes. The clinical outcome varies widely, from recovery with residual neurological deficits to rapid neurological deterioration and death, particularly in cases of extensive pontine hemorrhage.[3] Previous studies have also demonstrated an increased risk of recurrent stroke among patients with pontine infarction, underscoring the need for early recognition and appropriate management. Despite the clinical significance of pontine strokes, data on their prevalence, severity, and short-term outcomes, especially in comparison with other posterior circulation strokes, remain limited. Furthermore, there is a paucity of region-specific data from North-Eastern India, where demographic factors, vascular risk profiles, and access to specialized stroke care may influence clinical outcomes. Therefore, the present observational cross-sectional study was conducted to describe the clinical spectrum, radiological patterns, severity, prevalence, and in-hospital outcomes of patients with pontine stroke admitted to a tertiary care hospital in Tripura over a one-year period from January 2025 to December 2025. By systematically analyzing clinical presentation and short-term outcomes, this study aims to enhance understanding of pontine strokes and provide evidence that may assist in improving early diagnosis, risk stratification, and management strategies in patients with brainstem strokes.

Materials and Methods

Study Design: This was a hospital-based observational cross-sectional study conducted in the Department of Medicine, Agartala Government Medical College and G.B. Pant Hospital, Tripura, over a one-year period from January 2025 to December 2025.

Study Population: All consecutive patients admitted with a clinical diagnosis of acute stroke during the study period were screened for inclusion. Patients with radiologically confirmed pontine involvement on neuroimaging were enrolled in the study.

Inclusion Criteria

- Patients aged ≥18 years
- Clinical features suggestive of acute pontine stroke.
- Pontine stroke confirmed on NCCT brain and/or MRI brain.
- Patients or legally authorized representatives providing written informed consent.

Exclusion Criteria

- Patients with transient ischemic attack (TIA) without imaging evidence of infarction.
- Stroke involving brain regions other than the pons without pontine involvement.
- Patients with traumatic brainstem lesions.
- Patients who declined consent.

Data Collection: After obtaining written informed consent, data were collected using a predesigned and pretested proforma. The following parameters were recorded:

Demographic details: age, sex, co morbidities.

Clinical presentation: presenting symptoms, time of onset, neurological deficits.

Risk factors and comorbidities: hypertension, diabetes mellitus, dyslipidemia, smoking, alcohol use, atrial fibrillation, and other relevant medical conditions.

Neurological examination: detailed central nervous system assessment including motor, sensory, cranial nerve, and cerebellar functions.

Neuroimaging findings: stroke subtype (ischemic or hemorrhagic), extent and location of pontine involvement on NCCT brain and/or MRI brain.

Outcome Measures

The primary outcome measures included:

Clinical Spectrum and Severity of pontine stroke, assessed clinically based on neurological deficits.

Duration of hospital stay: In-hospital outcome, categorized as recovery, recovery with neurological sequelae, or death.

Secondary outcomes included the occurrence of in-hospital complications, such as aspiration pneumonia, need for ventilatory support, and secondary infections.

Statistical Analysis: Associations between stroke severity, duration of hospital stay, and in-hospital

outcome were analyzed using suitable statistical tests. A p-value <0.05 was considered statistically significant.

Case Description: In this observational cross-sectional study, 24 cases of pontine stroke were analyzed. All patients were admitted to the Department of Medicine, Agartala Government Medical College and G.B. Pant Hospital, Tripura, during a one-year study period from January 2025to December 2025. Written informed consent was obtained from patients or their legally authorized representatives prior to inclusion in the study.

Data were collected using a predesigned and standardized proforma, which included demographic details, clinical presentation, associated comorbid conditions, and findings from a detailed central nervous system examination. Neuroimaging evaluation was performed in all cases using non-contrast computed tomography (NCCT) of the brain and/or magnetic resonance imaging (MRI) of the brain to confirm pontine involvement and determine stroke subtype. Information regarding duration of hospital stay, occurrence of in-hospital complications, and clinical outcome at discharge was documented.

All cases were reviewed by the Departments of Neurology and Neurosurgery available at the institution, and patients were managed conservatively with standard medical therapy as per institutional protocols.

Results

Study Population and Stroke Distribution: During the study period, a total of 138 patients were admitted with acute stroke. Among these, 36 patients (26.08%) were diagnosed with posterior circulation stroke based on clinical features and neuroimaging findings. Pontine involvement was identified in 24 patients, accounting for 17.39% of all stroke admissions and 66.7% of posterior circulation strokes. These 24 patients constituted the study population for further analysis.

Demographic Characteristics and Risk Factors: Among patients with pontine stroke, a male preponderance was observed. The mean age was 63.33 years (range: 32–83 years), indicating a predominance of elderly patients.

Hypertension was the most common vascular risk factor, present in 50% of patients, either as a known comorbidity or newly detected at presentation. Several patients had a history of poor compliance or irregular antihypertensive therapy. Diabetes mellitus and dyslipidemia were present in a smaller proportion of patients. One patient had no identifiable vascular risk factors, while a positive family history of stroke was noted in one elderly patient.

Stroke Subtypes and Radiological Characteristics: Among the 24 pontine strokes, pontine hemorrhage was the predominant subtype, accounting for 22 cases (91.6%), while pontine infarction was identified in 2 patients (8.4%).

Pontine hemorrhages were categorized based on hematoma volume:

Small hemorrhage: <5 ml

Moderate hemorrhage: 5–10 ml

Massive hemorrhage: >10 ml

Massive hemorrhages commonly involved extensive pontine regions and were associated with severe neurological impairment, whereas small hemorrhages were often localized to the tegmental or basal pons.

Clinical Presentation: The clinical manifestations of pontine stroke were highly heterogeneous, correlating with lesion size and anatomical location.

Altered sensorium or coma at presentation was observed in 16.6% of patients, all of whom had moderate to massive pontine hemorrhage.

Quadriparesis was present in 25% of cases, predominantly in patients with large pontine hemorrhages, frequently associated with pin-point pupils and bilateral extensor plantar responses. Crossed hemiparesis was observed in 25% of patients, commonly associated with unilateral tegmental or basal pontine hemorrhage, often accompanied by ipsilateral lower motor neuron facial palsy.

Pure motor hemiparesis was seen in 8.33% of cases, including patients with pontine infarction.

Notably, 25% of patients were neurologically intact at presentation, despite radiological evidence of pontine hemorrhage, particularly in cases with small hematoma volume.

Brainstem Syndromes and Special Clinical Features: Distinct pontine syndromes were identified in selected patients:

One-and-a-half syndrome was documented in one patient with paramedian pontine hemorrhage, presenting with horizontal gaze palsy. Neurogenic bladder dysfunction was observed in a patient with pontine infarction, manifesting as persistent urinary incontinence. Urodynamic studies confirmed detrusor hyperactivity, despite normal ultrasonographic findings.

Hospital Course and Complications: The average duration of hospital stay ranged from 6 to 10 days, with longer stays observed in patients with moderate to massive pontine hemorrhage. Patients with small pontine hemorrhages generally had an uncomplicated course, whereas those with severe

neurological impairment required ICU admission, airway protection, and intensive monitoring. Aspiration pneumonitis was the most frequent and clinically significant in-hospital complication, particularly among patients with impaired consciousness, and was a major contributor to mortality.

In-hospital Outcome and Mortality: A strong association was observed between hematoma volume, neurological severity, and clinical outcome.

Patients with massive pontine hemorrhage experienced uniformly poor outcomes, characterized by rapid neurological deterioration and early death despite aggressive supportive care.

Moderate pontine hemorrhage was associated with variable outcomes, often complicated by aspiration pneumonitis and prolonged hospitalization, with a high mortality rate.

Patients with small pontine hemorrhage demonstrated favorable outcomes, with survival and minimal or no residual neurological deficits at discharge. The overall in-hospital mortality rate among patients with pontine stroke was 33.3% (8 of 24 patients), with deaths occurring exclusively in patients with moderate to massive pontine hemorrhage.

Table 1:

Stroke subtype	Death	Survived	Total
Massive hemorrhage	6	0	6
Moderate hemorrhage	2	3	5
Small hemorrhage	0	11	11
Pontine infarction	0	2	2
Total	8	16	24

By Fisher–Freeman–Halton exact test calculated $p < 0.001$

There was a strong and statistically significant association between stroke subtype (based on hemorrhage volume and infarction) and in-hospital outcome. Mortality increased progressively with increasing hematoma volume, while patients with small pontine hemorrhage and pontine infarction demonstrated favorable outcomes.

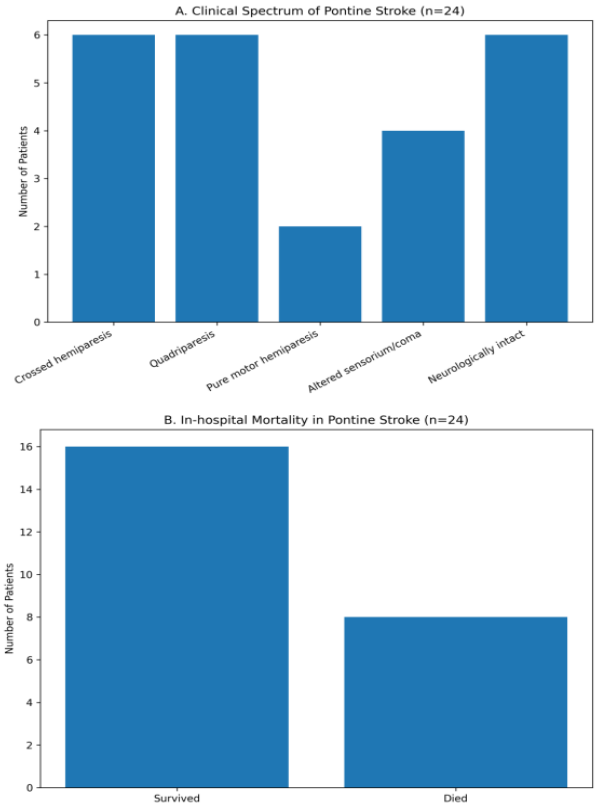

Figure 1: Clinical spectrum and in-hospital outcome of pontine stroke (n = 24)

The bar chart demonstrates the distribution of major clinical presentations along with survival and mortality outcomes among patients with pontine stroke admitted to a tertiary care center in north east India.

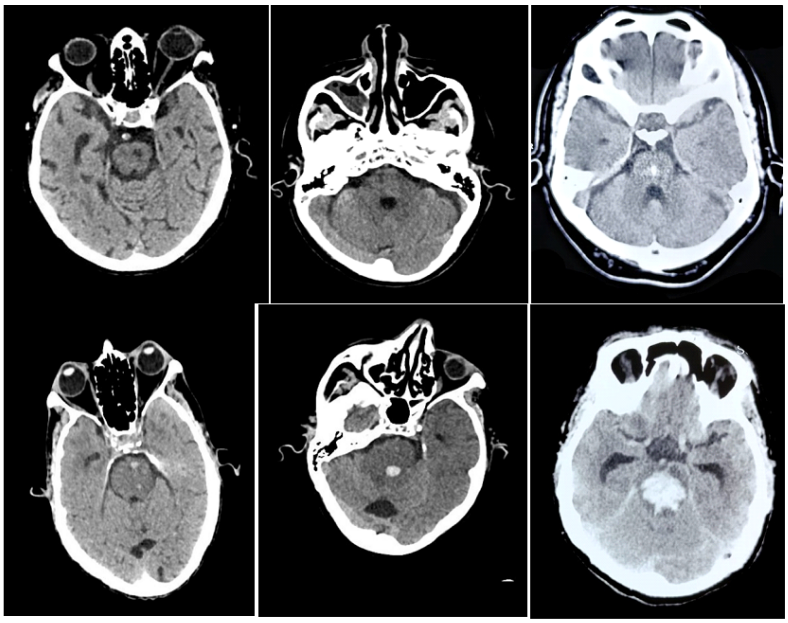

Figure 2: Axial Non Contrast CT brain images showing pontine infarcts as well as hemorrhages of varying size and anatomical distribution. Small hemorrhages were associated with mild or no neurological deficits, while moderate to massive hemorrhages involved extensive pontine regions and correlated with severe clinical presentations and higher mortality

Discussion

This observational cross-sectional study was conducted in the Department of Medicine, Agartala Government Medical College and GBP Hospital over one year period and aimed to evaluate the clinical spectrum, risk factors, radiological characteristics, and short-term outcomes of patients with pontine stroke. Pontine strokes accounted for a substantial proportion of posterior circulation strokes in our cohort, highlighting their clinical relevance in routine stroke practice.

In the present study, pontine involvement was identified in 24 patients, constituting 17.39% of all stroke admissions and nearly two-thirds of posterior circulation strokes. This relatively high proportion underscores the vulnerability of the pontine region in posterior circulation cerebrovascular disease, particularly in elderly patients with multiple vascular risk factors.

A clear male predominance was observed, with males constituting 58.3% of cases. Although the exact biological basis for sex differences in stroke remains incompletely understood, gender-related variations in exposure to modifiable vascular risk factors such as smoking, hypertension, and metabolic disorders may partly explain this observation. The majority of patients (75%) were older than 60 years, with a mean age of 63.33 years, indicating that pontine strokes predominantly affect the elderly population. This age distribution is comparable to other Indian studies on posterior circulation stroke, including the study by Bhat et al., which reported a similar mean age at presentation. The higher occurrence in older individuals likely reflects cumulative vascular injury, endothelial dysfunction, and degenerative changes in cerebral vessels.[4]

Hypertension emerged as the most common associated risk factor, present in 50% of patients, often with a history of long-standing or poorly controlled disease. This finding reinforces the association between chronic hypertension and pontine strokes, particularly hemorrhagic subtypes. Sustained elevated blood pressure contributes to lipohyalinosis and microaneurysm formation in the small perforating arteries supplying the pons, predisposing them to rupture. Diabetes mellitus and dyslipidemia were also observed, further supporting the role of metabolic risk factors in posterior circulation atherosclerotic disease. Although causal inference is not possible in a cross-sectional study, the clustering of these risk factors suggests a strong association with pontine cerebrovascular events.[5] Radiologically, pontine hemorrhage was the predominant stroke subtype, accounting for 91.6% of cases, while pontine infarction constituted a minority. This predominance of hemorrhagic strokes may reflect the high prevalence of uncontrolled hypertension in the study population. Stratification of pontine hemorrhages based on hematoma volume revealed clinically meaningful differences in presentation and outcome. Massive hemorrhages were associated with extensive pontine involvement and severe neurological deficits, whereas small hemorrhages were often localized and occasionally clinically silent. The clinical spectrum of pontine stroke in this study was notably heterogeneous.

Severe presentations such as quadriparesis and altered sensorium were predominantly seen in patients with moderate to massive pontine hemorrhage, reflecting involvement of corticospinal tracts and reticular activating systems. Crossed hemiparesis, often accompanied by ipsilateral lower motor neuron facial palsy, was commonly observed in unilateral pontine lesions, consistent with the anatomical organization of motor and cranial nerve pathways within the pons. Pure motor hemiparesis was observed in a small subset of patients, including those with pontine infarction, underscoring that focal pontine lesions can sometimes mimic supratentorial strokes.[6]

Despite the traditionally grave prognosis associated with pontine strokes, this study also identified a subset of patients with favorable clinical profiles. Notably, 25% of patients were neurologically intact at presentation despite radiological evidence of pontine hemorrhage, particularly when hematoma volume was small. This highlights that pontine strokes are not uniformly catastrophic and that lesion size and precise anatomical location play crucial roles in determining clinical severity.[7]

Distinct brainstem syndromes further illustrated the anatomical specificity of pontine involvement. One patient with paramedian pontine hemorrhage developed one-and-a-half syndrome, attributable to involvement of the medial longitudinal fasciculus and the paramedian pontine reticular formation or abducens nucleus.

Another patient with pontine infarction developed neurogenic bladder dysfunction due to detrusor hyperactivity, reflecting disruption of the pontine micturition center. Similar observations have been documented in Indian neurological literature, supporting the consistency of these findings.[8,9] In-hospital outcomes demonstrated a strong association between hematoma volume, neurological severity, and mortality.

Patients with massive pontine hemorrhage had uniformly poor outcomes, often with rapid neurological deterioration despite aggressive supportive care. Moderate hemorrhages showed variable outcomes, frequently complicated by aspiration pneumonitis, which emerged as the most common and clinically significant in-hospital complication. In contrast, patients with small pontine hemorrhages had favorable outcomes, minimal neurological deficits, and shorter hospital stays.[10] The overall in-hospital mortality rate in this study was 33.3%, with deaths occurring exclusively among patients with moderate to massive pontine hemorrhage. This mortality rate is lower than that reported in several earlier studies on pontine hemorrhage, possibly reflecting advances in neurocritical care, early airway protection, and improved supportive management.[11]

Limitations

The study was conducted over a short duration with a limited sample size, which restricts generalizability. Long-term functional outcomes and rehabilitation status could not be assessed. Additionally, data regarding neurosurgical interventions, and prognostic biomarkers were limited, precluding further outcome stratification.

Conclusion

This cross-sectional study demonstrates that pontine strokes, particularly hemorrhagic subtypes, constitute a significant proportion of posterior circulation strokes. While massive pontine hemorrhage is associated with high mortality, smaller hemorrhages and focal infarctions may have favorable short-term outcomes. These findings emphasize the importance of early neuroimaging, meticulous clinical assessment, and aggressive supportive care in improving in-hospital outcomes of pontine stroke patients.

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