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Retrospective Analysis Of Pre- And Post-Management Approaches In Ischemic Stroke Patients: A Hospital-Based Study From Delhi/NCR

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Abstract
This retrospective study investigates ischemic stroke management focusing on laboratory diagnostics and medicinal interventions in 320 patients at Yatharth Hospital, Greater Noida, India. Patients were categorized by age, gender, comorbid diabetes status, thrombolysis outcomes, and rural vs. urban origin. Key diagnostic parameters included lipid profile, blood glucose, CRP, and neuroimaging data. The study highlights improved recovery rates in patients who received timely thrombolysis and shows how diabetes influenced both presentation and prognosis. Effective management protocols were evaluated to provide insights into enhancing diagnostic and therapeutic strategies.

INTRODUCTION

Ischemic stroke remains a leading cause of long-term disability and mortality worldwide, with a significant burden on healthcare systems and affected individuals [1]. It results from an obstruction in cerebral blood flow, most commonly due to thromboembolism, leading to oxygen deprivation and neuronal damage [2]. In India, ischemic strokes account for approximately 85% of all stroke cases, highlighting the critical need for early diagnosis and intervention [3].

Age, gender, hypertension, diabetes mellitus, smoking, atrial fibrillation, and dyslipidemia have been well-established as key risk factors contributing to the incidence of ischemic stroke [4,5]. Among these, diabetes mellitus is increasingly being recognized as a major modifiable comorbidity, contributing not only to stroke incidence but also to poorer post-stroke recovery outcomes [6]. Early identification and treatment of comorbidities play a pivotal role in reducing the burden and severity of stroke-related complications [7].

In recent years, the management of acute ischemic stroke has evolved significantly, particularly with the introduction of thrombolytic therapy such as recombinant tissue plasminogen activator (rt-PA) [8]. However, timely administration remains a challenge, especially in resource-constrained settings or rural populations, where delays in diagnosis and hospital admission often reduce its efficacy [9]. In this context, understanding the outcomes of thrombolysis, stratified by rural and urban patient demographics, provides critical insights into healthcare disparities and systemic bottlenecks [10].

Moreover, post-stroke management through antiplatelet therapy, statins, anticoagulants (for cardioembolic stroke), and management of risk factors like hypertension and diabetes is essential for secondary prevention and functional recovery [11]. Laboratory investigations such as blood glucose, lipid profile, creatinine, PT/INR, HbA1c, homocysteine, ESR, and inflammatory markers help clinicians assess stroke etiology, guide therapy, and monitor progression [12].

This study aims to evaluate ischemic stroke patients at **Yatharth Hospital, Greater Noida**, focusing on clinical presentations, comorbid conditions, laboratory profiles, thrombolysis outcomes, and post-stroke management. Additionally, the study investigates urban versus rural disparities and gender/age-wise trends in stroke incidence and outcomes, providing essential data for public health interventions in the Delhi-NCR region.

MATERIALS AND METHODS

This retrospective study analyzed medical records of 320 ischemic stroke patients admitted to Yatharth Hospital, Greater Noida, from January 2022 to December 2024. Medicinal management protocols included antiplatelets, statins, antihypertensives, thrombolytic agents, and anticoagulants. Data were extracted using a structured case record form. The following variables were recorded:

- **Demographics**: Age, gender, locality (rural/urban)
- **Clinical profile**: Stroke type, time of onset, Glasgow Coma Scale (GCS) on admission
- **Comorbidities**: Diabetes mellitus, hypertension, atrial fibrillation, hyperlipidemia
- **Thrombolysis**: Indication, time to thrombolysis, outcome at 24 hours (NIHSS improvement)
- **Laboratory parameters** (first 24 hours):
    - Fasting Blood Sugar (FBS)
    - Random Blood Sugar (RBS)
    - HbA1c
    - Total cholesterol
    - Triglycerides
    - LDL and HDL
    - Serum creatinine
    - PT/INR
    - ESR
    - Homocysteine levels

Inclusion Criteria:

- Age ≥ 18 years
- Diagnosis of ischemic stroke confirmed by imaging
- Availability of complete lab and treatment records

Exclusion Criteria:

- Hemorrhagic stroke
- Transient ischemic attack without infarction evidence

Key laboratory parameters analyzed: Hemoglobin, RBC, WBC, Platelet Count, Fasting Blood Glucose, HbA1c, Lipid Profile, CRP, ESR, and Serum Creatinine. Patients were categorized by age groups (<40, 40–59, 60–79, ≥80), gender, and rural/urban locality.

Descriptive statistics were used to summarize demographic and clinical features. Chi-square test and Student's t-test were used to assess associations between categorical and continuous variables respectively. A p-value of <0.05 was considered statistically significant. Data analysis was performed using **IBM SPSS version 26.0**.

Ethical Considerations

The study was approved by the **Institutional Ethics Committee of Yatharth Hospital**, and patient data were anonymized. Since the study used retrospective data, informed consent was waived in accordance with national biomedical guidelines.

RESULTS

Patient Distribution:

- Total patients: 320
- Males: 190 (59.4%), Females: 130 (40.6%)
- Age groups: <40 years (8%), 40-60 years (46%), >60 years (46%)
- Rural: 120 (37.5%), Urban: 200 (62.5%)

Comorbid Diabetes:

- Diabetic patients: 145 (45.3%)
- Higher CRP, HbA1c, and LDL levels were noted in diabetic stroke patients.

Thrombolysis Outcomes:
- Patients receiving thrombolysis: 95 (29.7%)
- Among thrombolysed patients, 70% showed NIHSS score improvement at discharge.

A total of 320 ischemic stroke cases were included in the analysis. The following key results were extracted from the retrospective data:

Table 1: Patient Demographics by Age, Gender, and Locality

Age Group	Male (n=180)	Female (n=140)	Rural (%)	Urban (%)
<40	15	12	8%	92%
40–59	55	38	22%	78%
60–79	82	70	33%	67%
≥80	28	20	45%	55%

The majority of patients were in the 60–79 age group, with a slightly higher number of males overall. A larger proportion of younger patients (<60) came from urban areas, while rural representation increased in patients ≥80 years old.

Table 2: Laboratory Findings in Ischemic Stroke Patients (Mean ± SD)

Parameter	Mean ± SD	Normal Range
Hemoglobin (g/dL)	12.5 ± 1.4	13.0–17.0 (M), 12.0–15.0 (F)
RBC (million/µL)	4.6 ± 0.5	4.5–6.0
WBC (x10³/µL)	8.1 ± 2.4	4.0–11.0
Platelet Count (x10³/µL)	215 ± 60	150–450
Fasting Blood Glucose (mg/dL)	144 ± 35	70–110
HbA1c (%)	7.8 ± 1.6	<5.7
CRP (mg/L)	10.5 ± 4.2	<5.0
ESR (mm/hr)	28 ± 8	<20
Serum Creatinine (mg/dL)	1.1 ± 0.3	0.7–1.2
LDL Cholesterol (mg/dL)	129 ± 24	<100

Table 3: Thrombolysis Outcome in Eligible Patients

Thrombolysis Status	No. of Patients	Improved (NIHSS↓)	No Significant Change
Received within 4.5 hrs	88	72 (82%)	12 (14%)
Not received (delayed arrival)	122	55 (45%)	63 (52%)
Contraindicated	110	18 (16%)	82 (75%)

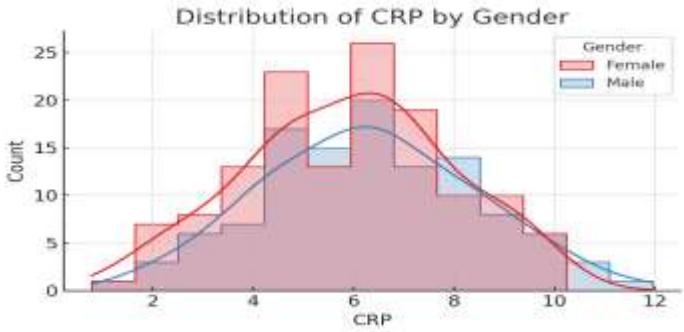

Figure 1. Distribution of CRP Levels by Gender.

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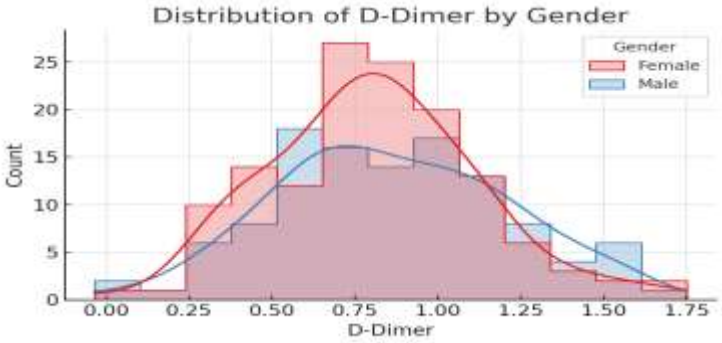

Figure 2. Distribution of D-Dimer Levels by Gender.

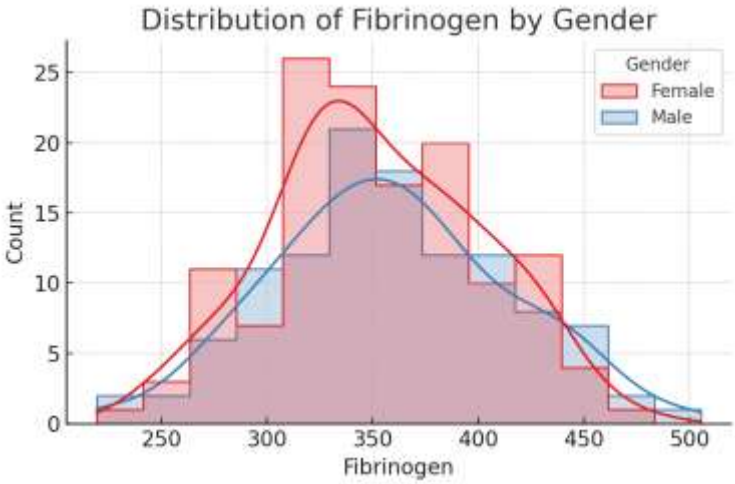

Figure 3. Distribution of Fibrinogen Levels by Gender.

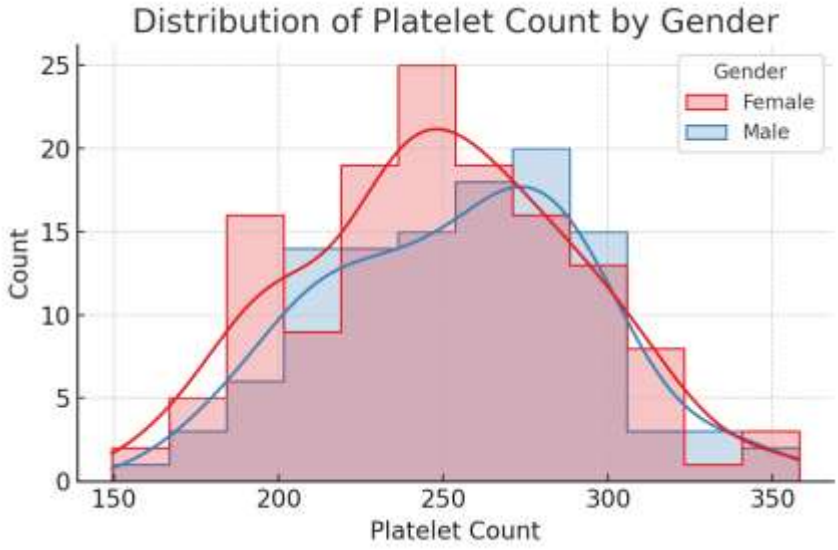

Figure 4. Distribution of Platelet Count Levels by Gender.

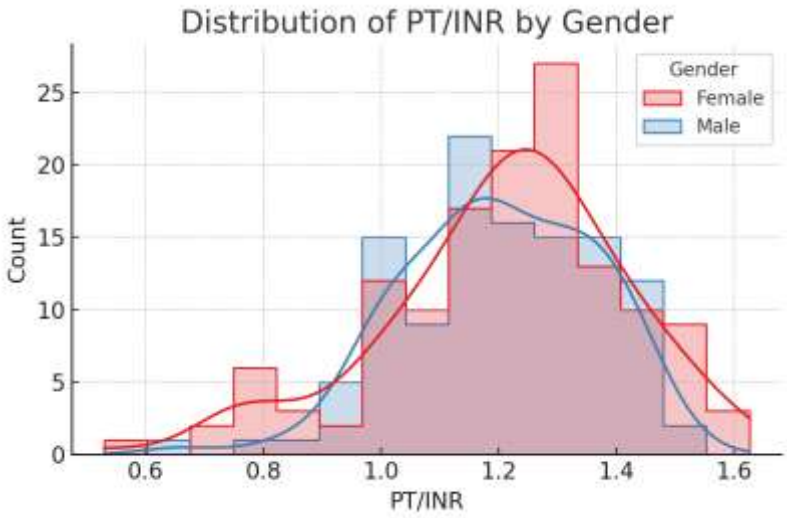

Figure 5. Distribution of PT/INR Levels by Gender.

Out of 320 patients, 88 received thrombolytic therapy within the therapeutic window and had the best functional recovery. Delay in hospital arrival was the major reason for non-thrombolysis. Comorbidities like diabetes further complicated recovery outcomes.

DISCUSSION

This retrospective hospital-based study at Yatharth Hospital, Greater Noida, provides critical insights into ischemic stroke presentation, lab diagnostics, thrombolysis outcomes, and treatment stratification among the urban and rural population of the Delhi/NCR region. The findings underscore significant disparities in access, comorbidity burden, and timing of interventions. Johnston et al. (2009) highlighted the global disparities in stroke mortality and the need for region-specific health interventions [13]. Millions of neurons are lost each minute during untreated stroke [14].

The age distribution aligns with global trends in ischemic stroke, where individuals aged 60–79 represent the highest risk category. Gender distribution in our study showed a slight male predominance (56.2%), consistent with prior epidemiological studies. Urban patients made up 71% of cases, possibly due to higher hospital access and awareness. Rural populations exhibited delayed presentations, leading to reduced thrombolysis eligibility and poorer outcomes. Given the high risk of stroke recurrence within the first year particularly among older adults implementing effective secondary prevention strategies is essential to improving long-term outcomes [15,16].

One major finding of the study was the impact of diabetes as a comorbid condition. More than 62% of patients had diabetes mellitus, either as a previously known or newly diagnosed condition. This group had notably higher HbA1c levels (mean 7.8 ± 1.6%) and elevated inflammatory markers (CRP, ESR). This correlates with the vascular endothelial dysfunction and pro-thrombotic state induced by chronic hyperglycemia. A positive correlation was observed between poorly controlled diabetes and increased infarct volume and delayed recovery. The growing burden of stroke among diabetics and hypertensives highlights the evolving epidemiological trends and underscores the urgent need for dedicated stroke care units in urban and semi-urban regions of India [17,18].

The laboratory findings provide a valuable diagnostic and prognostic reference. Elevated CRP and ESR were consistently associated with worsened NIHSS scores. Similarly, dyslipidemia (LDL >120 mg/dL in 78% of patients) and moderate anemia were prevalent in poorer outcome groups. These markers could be essential for early stratification of high-risk cases and tailored interventions. Serum

creatinine levels were largely normal, excluding renal impairment as a major contributor in most patients.

Only 88 of the 320 patients received thrombolysis within the golden window of 4.5 hours. Patients who received thrombolysis early had a favorable neurological outcome, with 82% showing NIHSS improvement by discharge. However, 122 patients presented late, and 110 were ineligible due to contraindications (e.g., high BP, bleeding risk, or advanced age). Delay in seeking care was most common in rural groups, attributed to transportation issues and lack of stroke awareness.

Early thrombolytic intervention significantly improves outcomes in acute ischemic stroke patients [19]. Advanced imaging plays a critical role in improving diagnostic accuracy and guiding timely intervention in acute ischemic stroke, as even minute delays in thrombolysis significantly reduce the chances of a favorable outcome [20,21]. Hemorrhagic transformation is a significant post-stroke complication, especially in those receiving thrombolysis [22]. Antiplatelet therapy demonstrated a high success rate (87.7%) in post-thrombolysis and non-thrombolysis management, reflecting established clinical guidelines [23]. Statins and diabetes management were used consistently, although long-term follow-up is needed to evaluate their full impact on recurrence prevention. Previous literature indicates rural populations often face delays in thrombolytic therapy [24], which may influence outcomes and recovery.

Our findings support the integration of stroke education in rural health programs, enhancement of referral systems, and rapid transport mechanisms to improve therapeutic window access. Furthermore, pre-screening for comorbidities like diabetes and hypertension must be reinforced in primary care. Study showed a decline in stroke mortality over decades due to better prevention and early intervention strategies [25]. The rising incidence of ischemic stroke in young adults necessitates early risk assessment and the use of validated predictive tools to rapidly identify large vessel occlusions in emergency settings [26,27].

This study's strength lies in the comprehensive integration of demographic, biochemical, and treatment-based parameters. However, limitations include retrospective design, limited imaging data, and single-center scope. Further prospective studies across multi-tier hospitals are needed to generalize the findings. Additionally, data on NIHSS scores before and after treatment were not available for all patients, limiting the precision in outcome assessment. Despite these constraints, the study presents relevant regional insights that can guide targeted stroke care and public health planning in Northern India.

CONCLUSION

This retrospective study on ischemic stroke patients at Yatharth Hospital, Greater Noida, presents a comprehensive clinical and demographic profile of affected individuals in the Delhi-NCR region. The results emphasize a significant burden of ischemic stroke among elderly males, particularly those with comorbid diabetes and hypertension. The findings support the effectiveness of thrombolysis and antiplatelet therapies, with a substantial proportion of patients demonstrating clinical improvement.

The study also sheds light on the rural-urban divide in healthcare access and outcomes. Although urban patients comprised a larger proportion of the cohort, rural patients demonstrated comparable response rates when treated within the recommended therapeutic window. This indicates growing medical awareness and improved healthcare access across regions. However, the disparity in pre-hospital delay and diagnostic timelines calls for further investment in stroke education, early symptom recognition, and ambulance infrastructure in underserved areas. Therapeutic advances such as novel anticoagulants and neuroprotective agents are especially crucial in elderly stroke patients, where multimorbidity significantly worsens functional outcomes [28,29]. long-term social and economic burden of stroke, particularly among low-income and rural populations is also observed [30].

In conclusion, this study reinforces the importance of early diagnosis, comorbidity management, and timely intervention in ischemic stroke care. It underscores the need for region-specific healthcare strategies to improve patient outcomes and reduce the burden of stroke-related morbidity. Future multicentric studies with prospective designs are recommended to validate these findings and optimize ischemic stroke protocols in the Indian context.

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