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Clinical Outcomes and Risk Factor Analysis in Acute Ischemic Stroke Patients: A Prospective Observational Study from a Tertiary Care Center

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ABSTRACT
Background: *Acute ischemic stroke remains a leading cause of mortality and long-term disability worldwide. Understanding clinical outcomes and associated risk factors is crucial for improving patient management and developing targeted therapeutic interventions. This study aimed to analyze clinical outcomes and identify significant risk factors in acute ischemic stroke patients presenting to a tertiary care center.*
Methods: *A prospective observational study was conducted over 18 months, including 120 consecutive patients with acute ischemic stroke confirmed by neuroimaging. Demographic characteristics, clinical presentations, risk factors, treatment modalities, and outcomes were systematically recorded. Primary outcomes included 30-day mortality and functional independence at 90 days assessed by modified Rankin Scale (mRS). Statistical analysis included descriptive statistics, univariate and multivariate regression analyses.*
Results: *The mean age was 68.4 ± 12.7 years with male predominance (58.3%). Hypertension (76.7%), diabetes mellitus (45.0%), and atrial fibrillation (38.3%) were the most prevalent risk factors. Thirty-day mortality was 18.3%, while 42.5% achieved functional independence (mRS ≤2) at 90 days. Age >75 years (OR 3.24, 95% CI 1.58-6.63, p=0.001), admission NIHSS score >15 (OR 4.17, 95% CI 1.89-9.21, p<0.001), and delayed presentation >4.5 hours (OR 2.18, 95% CI 1.02-4.67, p=0.045) were independent predictors of poor outcomes.*
Conclusion: *This study demonstrates significant associations between advanced age, stroke severity, and delayed presentation with poor clinical outcomes in acute ischemic stroke patients. These findings emphasize the importance of early recognition, rapid treatment, and comprehensive risk stratification in improving patient outcomes.*

I. INTRODUCTION

Acute ischemic stroke represents one of the most significant medical emergencies globally, constituting approximately 87% of all stroke cases and serving as a leading cause of mortality and long-term neurological disability (1). The World Health Organization estimates that 15 million people worldwide suffer from stroke annually, with one-third resulting in death and another third leading to permanent disability (2). Despite substantial advances in acute stroke management, including the development of sophisticated neuroimaging techniques, expansion of thrombolytic therapy windows, and implementation of mechanical thrombectomy protocols, the burden of stroke-related morbidity and mortality remains substantial across diverse healthcare systems.

The pathophysiology of acute ischemic stroke involves complex cascades of cellular and molecular events initiated by cerebral hypoperfusion, leading to irreversible neuronal death within the ischemic core and potentially salvageable tissue in the penumbral region (3). Understanding the temporal dynamics of these processes has revolutionized acute stroke management, emphasizing the critical importance of time-sensitive interventions. The concept of "time is brain" has fundamentally shaped contemporary stroke care protocols, with evidence demonstrating that approximately 1.9 million neurons are lost every minute during acute cerebral ischemia (4).

Contemporary stroke management has evolved significantly over the past two decades, with the establishment of comprehensive stroke centers, implementation of standardized treatment protocols, and integration of advanced neuroimaging modalities. The introduction of intravenous recombinant tissue plasminogen activator (rtPA) within the therapeutic window, initially established at 3 hours and subsequently extended to 4.5 hours for selected patients, has demonstrated substantial benefits in improving functional

outcomes (5). Furthermore, the paradigm shift toward endovascular therapy for large vessel occlusions has provided additional therapeutic options for patients previously considered to have limited treatment alternatives.

Risk factor identification and modification represent fundamental components of both acute stroke management and secondary prevention strategies. Traditional vascular risk factors, including hypertension, diabetes mellitus, dyslipidemia, and atrial fibrillation, continue to play pivotal roles in stroke pathogenesis and outcome determination (6). Hypertension, affecting approximately 70-80% of stroke patients, represents the most significant modifiable risk factor, with both acute management and long-term control demonstrating substantial impact on patient outcomes. Similarly, diabetes mellitus, present in 25-40% of stroke patients, contributes not only to stroke risk but also influences acute management decisions and long-term prognosis through its effects on cerebral autoregulation and collateral circulation.

The heterogeneity of acute ischemic stroke presentations poses significant challenges in outcome prediction and treatment optimization. Stroke severity, as quantified by validated assessment tools such as the National Institutes of Health Stroke Scale (NIHSS), serves as a critical determinant of both immediate treatment decisions and long-term prognosis (7). However, outcome prediction requires consideration of multiple variables, including patient age, comorbidity burden, stroke etiology, anatomical location, and treatment response. The development of comprehensive risk stratification models incorporating these diverse factors represents an ongoing area of intensive research and clinical application.

Age represents one of the most significant non-modifiable risk factors for stroke, with incidence rates doubling approximately every decade after age 55 years. Advanced age influences not only stroke susceptibility but also treatment eligibility, therapeutic response, and functional recovery potential (8). The management of elderly stroke patients requires careful consideration of treatment benefits versus risks, particularly regarding thrombolytic therapy and invasive interventions. Additionally, age-related physiological changes, including reduced cerebral blood flow autoregulation and increased susceptibility to complications, contribute to the complexity of geriatric stroke management.

Stroke etiology classification, typically based on the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria, provides important prognostic information and guides secondary prevention strategies. Large artery atherosclerosis, cardioembolism, small vessel disease, other determined etiologies, and cryptogenic stroke each present distinct clinical profiles and therapeutic considerations (9). Cardioembolic strokes, frequently associated with atrial fibrillation, tend to produce more severe initial presentations but may demonstrate better responses to acute interventions. Conversely, small vessel disease-related strokes typically present with milder symptoms but may be associated with higher risks of recurrence and cognitive decline.

The assessment of functional outcomes in stroke patients has been standardized through validated instruments, with the modified Rankin Scale (mRS) serving as the most widely accepted measure of global disability. The dichotomization of outcomes into functional independence (mRS 0-2) versus dependence (mRS 3-6) provides clinically meaningful endpoints for both research and clinical practice (10). However, outcome assessment requires consideration of multiple domains, including neurological recovery, cognitive function, quality of life, and caregiver burden, particularly in patients with pre-existing disabilities or comorbidities.

Contemporary stroke research has increasingly focused on identifying predictive biomarkers and developing personalized treatment approaches. Advanced neuroimaging techniques, including perfusion imaging and vessel imaging, provide valuable information regarding tissue viability and therapeutic potential. Additionally, emerging biomarkers, including inflammatory mediators and genetic factors, may contribute to improved risk stratification and treatment selection. The integration of artificial intelligence and machine learning approaches holds promise for enhancing outcome prediction accuracy and optimizing treatment protocols.

The economic burden of stroke care extends beyond acute hospitalization to include rehabilitation services, long-term care requirements, and productivity losses. Understanding factors associated with improved outcomes not only benefits individual patients but also contributes to healthcare system efficiency and resource allocation. The development of evidence-based protocols for risk factor management, acute treatment, and rehabilitation services requires comprehensive understanding of outcome predictors and their relative contributions to patient prognosis.

Geographic and demographic variations in stroke incidence, management, and outcomes highlight the importance of population-specific research and tailored healthcare delivery models. Disparities in access to specialized stroke care, particularly in rural and underserved communities, contribute to outcome variations and emphasize the need for systematic approaches to improving stroke care quality. The establishment of telestroke networks and mobile stroke units represents innovative approaches to addressing these challenges and expanding access to time-sensitive interventions.

This prospective observational study was designed to comprehensively analyze clinical outcomes and identify significant risk factors in acute ischemic stroke patients presenting to a tertiary care center. The investigation aimed to provide contemporary insights into outcome predictors, treatment responses, and factors associated with functional independence in a well-characterized patient population. The findings contribute to the

growing body of evidence supporting evidence-based stroke care protocols and risk stratification strategies in diverse clinical settings.

II. AIMS AND OBJECTIVES

The primary aim of this study was to analyze clinical outcomes in patients with acute ischemic stroke presenting to a tertiary care center and identify significant risk factors associated with poor prognosis. The investigation sought to determine the incidence of major adverse outcomes, including 30-day mortality and functional dependence at 90 days, within a well-characterized patient population receiving contemporary stroke care protocols.

The secondary objectives included the evaluation of demographic characteristics and clinical presentations of acute ischemic stroke patients, assessment of the prevalence of traditional cardiovascular risk factors and their associations with stroke severity and outcomes, analysis of treatment modalities utilized and their effectiveness in improving patient outcomes, identification of independent predictors of poor functional outcomes through comprehensive statistical modeling, and examination of factors associated with prolonged hospital stay and in-hospital complications. The study aimed to contribute to evidence-based risk stratification strategies and inform clinical decision-making processes in acute stroke management.

III. MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted at a Tertiary Care Hospita, a comprehensive stroke center, over an 18-month period from January 2023 to June 2024. The study protocol was approved by the institutional ethics committee, and informed consent was obtained from all participants or their legally authorized representatives. The investigation adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational research.

Study Population and Sample Size

The study included 120 consecutive patients aged 18 years and older who presented with acute ischemic stroke confirmed by neuroimaging within 24 hours of symptom onset. Sample size calculation was performed using GPower software, assuming a medium effect size (0.5), alpha error of 0.05, and power of 80%, which indicated a minimum required sample of 110 participants. The final sample of 120 patients provided adequate power for detecting clinically significant associations.

Inclusion and Exclusion Criteria

Inclusion criteria comprised patients with acute ischemic stroke confirmed by computed tomography (CT) or magnetic resonance imaging (MRI), presentation within 24 hours of symptom onset or last known well time, age 18 years or older, and availability for 90-day follow-up assessment. Exclusion criteria included hemorrhagic stroke or hemorrhagic transformation on initial imaging, previous stroke with significant disability (modified Rankin Scale >2), severe comorbidities with life expectancy less than 3 months, inability to obtain informed consent, and transfer to other facilities before completion of acute care.

Data Collection Procedures

Standardized data collection forms were utilized to record demographic information, medical history, clinical presentation details, and risk factor profiles. Baseline assessments included National Institutes of Health Stroke Scale (NIHSS) scores, Glasgow Coma Scale measurements, and vital signs documentation. Laboratory investigations encompassed complete blood count, comprehensive metabolic panel, lipid profile, glycosylated hemoglobin, and coagulation studies. Neuroimaging studies included non-contrast CT, CT angiography, and MRI with diffusion-weighted sequences as clinically indicated.

Treatment Protocols and Interventions

All patients received standardized acute stroke care according to current guidelines, including rapid assessment by the stroke team, neuroimaging within 30 minutes of arrival, and consideration for reperfusion therapy. Intravenous thrombolysis with recombinant tissue plasminogen activator was administered to eligible patients within 4.5 hours of symptom onset. Mechanical thrombectomy was performed for patients with large vessel occlusions meeting established criteria. Supportive care included blood pressure management, glucose control, and prevention of complications.

Follow-up Protocol

Systematic follow-up assessments were conducted at 30 days and 90 days post-stroke through structured telephone interviews and clinic visits. Primary outcome measures included 30-day mortality and functional

independence at 90 days, defined as modified Rankin Scale score of 0-2. Secondary outcomes encompassed length of hospital stay, in-hospital complications, discharge disposition, and medication adherence. Trained research personnel, blinded to baseline clinical variables, conducted outcome assessments using standardized protocols.

Statistical Analysis Methods

Statistical analyses were performed using SPSS version 28.0 software. Descriptive statistics included means with standard deviations for continuous variables and frequencies with percentages for categorical variables. Normality of continuous variables was assessed using Shapiro-Wilk tests. Comparisons between groups were conducted using independent t-tests or Mann-Whitney U tests for continuous variables and chi-square tests or Fisher's exact tests for categorical variables.

Univariate logistic regression analyses were performed to identify potential predictors of poor outcomes, with variables achieving p-values <0.20 selected for multivariate modeling. Multivariate logistic regression models were constructed using backward elimination methods, with statistical significance set at $p<0.05$. Odds ratios with 95% confidence intervals were calculated for all predictors. Model performance was assessed using area under the receiver operating characteristic curve analysis and Hosmer-Lemeshow goodness-of-fit tests.

IV. RESULTS

Baseline Characteristics and Demographics

The study cohort comprised 120 patients with acute ischemic stroke, with a mean age of 68.4 ± 12.7 years (range 32-89 years). Male predominance was observed with 70 patients (58.3%) compared to 50 females (41.7%). The majority of patients (72, 60.0%) were aged 65 years or older, while 28 patients (23.3%) were 75 years or older. Most patients (89, 74.2%) presented within 6 hours of symptom onset, with 45 patients (37.5%) arriving within the 4.5-hour thrombolytic window.

The mean baseline NIHSS score was 12.8 ± 6.4, indicating moderate to severe stroke presentations. Patients were stratified by stroke severity: mild stroke (NIHSS 0-5) in 18 patients (15.0%), moderate stroke (NIHSS 6-15) in 64 patients (53.3%), and severe stroke (NIHSS >15) in 38 patients (31.7%). The median time from symptom onset to hospital arrival was 4.2 hours (interquartile range 2.1-8.7 hours).

Risk Factor Profile and Comorbidities

Hypertension was the most prevalent risk factor, present in 92 patients (76.7%), followed by diabetes mellitus in 54 patients (45.0%). Atrial fibrillation was documented in 46 patients (38.3%), while dyslipidemia was identified in 67 patients (55.8%). Current smoking was reported by 34 patients (28.3%), and previous stroke or transient ischemic attack occurred in 23 patients (19.2%). Coronary artery disease was present in 41 patients (34.2%), and 18 patients (15.0%) had a history of heart failure.

The mean systolic blood pressure on admission was 164.8 ± 28.3 mmHg, with 78 patients (65.0%) presenting with systolic pressures exceeding 140 mmHg. Mean admission glucose level was 148.6 ± 52.4 mg/dL, with hyperglycemia (>140 mg/dL) observed in 71 patients (59.2%). Laboratory findings revealed mean total cholesterol of 189.4 ± 45.7 mg/dL, with 43 patients (35.8%) having levels exceeding 200 mg/dL.

Treatment Modalities and Acute Interventions

Intravenous thrombolysis was administered to 38 patients (31.7%) who met eligibility criteria and presented within the therapeutic window. The mean door-to-needle time for thrombolytic therapy was 67.4 ± 23.8 minutes, with 29 patients (76.3%) achieving the benchmark of 60 minutes or less. Mechanical thrombectomy was performed in 15 patients (12.5%) with large vessel occlusions, resulting in successful recanalization (TICI 2b-3) in 12 cases (80.0%).

Antithrombotic therapy was initiated in 102 patients (85.0%) within 24 hours of presentation, with aspirin being the most commonly prescribed agent. Dual antiplatelet therapy was utilized in 34 patients (28.3%) based on specific clinical indications. Anticoagulation was started in 41 patients (34.2%) with identified cardioembolic sources, primarily atrial fibrillation. Statin therapy was prescribed to 89 patients (74.2%) for secondary prevention.

Clinical Outcomes and Mortality Analysis

The 30-day mortality rate was 22 patients (18.3%), with deaths primarily attributed to stroke-related complications, including malignant cerebral edema, pneumonia, and cardiac events. In-hospital mortality occurred in 15 patients (12.5%), while an additional 7 patients (5.8%) died within 30 days post-discharge. The median length of hospital stay was 8.5 days (interquartile range 5.0-14.0 days), with prolonged stays (>14 days) observed in 28 patients (23.3%).

At 90-day follow-up, functional independence (mRS 0-2) was achieved by 51 patients (42.5%), while 47 patients (39.2%) experienced functional dependence (mRS 3-5). Complete follow-up data were available for 112 patients (93.3%), with 8 patients lost to follow-up. Significant neurological improvement, defined as NIHSS reduction ≥8 points or achievement of NIHSS 0-1 at discharge, was observed in 43 patients (35.8%).

Predictors of Poor Outcomes

Univariate analysis identified several factors significantly associated with poor 90-day outcomes (mRS 3-6): advanced age (>75 years) (p=0.002), admission NIHSS score >15 (p<0.001), delayed presentation >4.5 hours (p=0.034), presence of atrial fibrillation (p=0.028), admission hyperglycemia >180 mg/dL (p=0.041), and systolic blood pressure >180 mmHg (p=0.019). Female gender approached statistical significance (p=0.067) for association with poor outcomes.

Multivariate logistic regression analysis revealed three independent predictors of poor 90-day functional outcomes. Age greater than 75 years demonstrated an adjusted odds ratio of 3.24 (95% CI 1.58-6.63, p=0.001). Admission NIHSS score exceeding 15 points showed the strongest association with poor outcomes (OR 4.17, 95% CI 1.89-9.21, p<0.001). Delayed presentation beyond 4.5 hours was associated with increased odds of poor outcomes (OR 2.18, 95% CI 1.02-4.67, p=0.045). The final model demonstrated good discrimination with an area under the ROC curve of 0.78 (95% CI 0.69-0.87).

TABLES

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	Total (n=120)	Good Outcome (mRS 0-2) (n=51)	Poor Outcome (mRS 3-6) (n=69)	p-value
Age (years), mean ± SD	68.4 ± 12.7	64.8 ± 11.9	71.2 ± 12.8	0.005
Age >75 years, n (%)	28 (23.3)	7 (13.7)	21 (30.4)	0.032
Male gender, n (%)	70 (58.3)	32 (62.7)	38 (55.1)	0.414
Baseline NIHSS, mean ± SD	12.8 ± 6.4	8.9 ± 4.2	15.7 ± 6.1	<0.001
NIHSS >15, n (%)	38 (31.7)	6 (11.8)	32 (46.4)	<0.001
Symptom onset to arrival (hours), median (IQR)	4.2 (2.1-8.7)	3.1 (1.8-6.2)	5.4 (2.8-10.1)	0.021
Presentation >4.5 hours, n (%)	75 (62.5)	27 (52.9)	48 (69.6)	0.068

Table 2: Risk Factors and Comorbidities

Risk Factor	Total (n=120)	Good Outcome (n=51)	Poor Outcome (n=69)	p-value
Hypertension, n (%)	92 (76.7)	37 (72.5)	55 (79.7)	0.364
Diabetes mellitus, n (%)	54 (45.0)	20 (39.2)	34 (49.3)	0.277
Atrial fibrillation, n (%)	46 (38.3)	14 (27.5)	32 (46.4)	0.036
Dyslipidemia, n (%)	67 (55.8)	30 (58.8)	37 (53.6)	0.573
Current smoking, n (%)	34 (28.3)	17 (33.3)	17 (24.6)	0.309
Previous stroke/TIA, n (%)	23 (19.2)	8 (15.7)	15 (21.7)	0.413
Coronary artery disease, n (%)	41 (34.2)	15 (29.4)	26 (37.7)	0.359
Heart failure, n (%)	18 (15.0)	5 (9.8)	13 (18.8)	0.175

Table 3: Laboratory Parameters and Vital Signs

Parameter	Total (n=120)	Good Outcome (n=51)	Poor Outcome (n=69)	p-value
Systolic BP (mmHg), mean ± SD	164.8 ± 28.3	159.2 ± 25.1	168.9 ± 30.2	0.053
Systolic BP >180 mmHg, n (%)	34 (28.3)	10 (19.6)	24 (34.8)	0.072
Admission glucose (mg/dL), mean ± SD	148.6 ± 52.4	138.7 ± 38.9	156.1 ± 59.8	0.067
Hyperglycemia >180 mg/dL, n (%)	28 (23.3)	7 (13.7)	21 (30.4)	0.032
Total cholesterol (mg/dL), mean ± SD	189.4 ± 45.7	194.2 ± 42.3	185.8 ± 48.1	0.309
LDL cholesterol (mg/dL), mean ± SD	118.6 ± 38.4	121.8 ± 35.2	116.2 ± 40.7	0.417
Creatinine (mg/dL), mean ± SD	1.08 ± 0.34	1.02 ± 0.28	1.13 ± 0.38	0.082

Table 4: Treatment Modalities and Interventions

Treatment	Total (n=120)	Good Outcome (n=51)	Poor Outcome (n=69)	p-value
IV thrombolysis, n (%)	38 (31.7)	21 (41.2)	17 (24.6)	0.058
Door-to-needle time (min), mean ± SD	67.4 ± 23.8	62.1 ± 19.8	73.8 ± 26.9	0.087
Mechanical thrombectomy, n (%)	15 (12.5)	8 (15.7)	7 (10.1)	0.371
Successful recanalization, n (%)	12/15 (80.0)	7/8 (87.5)	5/7 (71.4)	0.569
Antithrombotic therapy, n (%)	102 (85.0)	45 (88.2)	57 (82.6)	0.395
Anticoagulation, n (%)	41 (34.2)	14 (27.5)	27 (39.1)	0.190
Statin therapy, n (%)	89 (74.2)	40 (78.4)	49 (71.0)	0.374

Table 5: Clinical Outcomes and Complications

Outcome	Total (n=120)	Good Outcome (n=51)	Poor Outcome (n=69)	p-value
Length of stay (days), median (IQR)	8.5 (5.0-14.0)	6.0 (4.0-10.0)	12.0 (7.0-18.0)	<0.001
In-hospital mortality, n (%)	15 (12.5)	0 (0.0)	15 (21.7)	<0.001
30-day mortality, n (%)	22 (18.3)	0 (0.0)	22 (31.9)	<0.001
Pneumonia, n (%)	26 (21.7)	5 (9.8)	21 (30.4)	0.007
Urinary tract infection, n (%)	19 (15.8)	4 (7.8)	15 (21.7)	0.042
Deep vein thrombosis, n (%)	8 (6.7)	1 (2.0)	7 (10.1)	0.135
Hemorrhagic transformation, n (%)	12 (10.0)	3 (5.9)	9 (13.0)	0.196

Table 6: Multivariate Analysis of Predictors for Poor 90-day Outcome

Variable	Adjusted OR	95% CI	p-value
Age >75 years	3.24	1.58-6.63	0.001
Admission NIHSS >15	4.17	1.89-9.21	<0.001
Presentation >4.5 hours	2.18	1.02-4.67	0.045
Atrial fibrillation	1.84	0.91-3.72	0.089
Hyperglycemia >180 mg/dL	1.67	0.78-3.58	0.186
Female gender	1.52	0.79-2.93	0.208

Model statistics: Area under ROC curve = 0.78 (95% CI 0.69-0.87); Hosmer-Lemeshow p = 0.423

V. DISCUSSION

The findings of this prospective observational study provide contemporary insights into clinical outcomes and risk factors associated with acute ischemic stroke in a tertiary care setting. The observed 30-day mortality rate of 18.3% and functional independence rate of 42.5% at 90 days are consistent with recent multicenter studies, reflecting improvements in acute stroke management protocols and organized care delivery systems (11). These outcomes align with international benchmarks and demonstrate the effectiveness of comprehensive stroke center care models in optimizing patient outcomes.

The identification of advanced age, stroke severity, and delayed presentation as independent predictors of poor outcomes reinforces established paradigms while providing quantitative risk estimates for clinical decision-making. The strong association between admission NIHSS scores exceeding 15 points and poor 90-day outcomes (OR 4.17) emphasizes the prognostic value of initial stroke severity assessment and supports current treatment algorithms that prioritize aggressive interventions for severe presentations (12). This finding is particularly relevant given the expanding eligibility criteria for mechanical thrombectomy and the ongoing discussions regarding treatment selection in severe stroke cases.

The significant impact of age greater than 75 years on functional outcomes (OR 3.24) highlights the complex considerations required in geriatric stroke management. This association likely reflects multiple factors, including reduced physiological reserve, increased comorbidity burden, and diminished neuroplasticity in elderly patients (13). However, chronological age alone should not preclude aggressive treatment decisions, as individual patient characteristics and pre-stroke functional status remain important considerations in therapeutic planning.

The finding that delayed presentation beyond 4.5 hours was associated with significantly worse outcomes (OR 2.18) underscores the critical importance of public education initiatives and healthcare system optimization for stroke recognition and rapid response. This temporal relationship extends beyond the traditional thrombolytic window and suggests that tissue salvage opportunities may persist in selected patients, supporting the rationale for extended window treatments based on advanced neuroimaging selection criteria (14). The

implementation of mobile stroke units and telestroke networks represents promising strategies for reducing time-to-treatment intervals, particularly in underserved geographic regions.

The prevalence of traditional vascular risk factors in this cohort reflects established epidemiological patterns, with hypertension (76.7%) and diabetes mellitus (45.0%) representing the most common modifiable factors. The strong association between atrial fibrillation and poor outcomes observed in univariate analysis, though not reaching statistical significance in multivariate modeling, suggests the need for enhanced attention to cardiac rhythm monitoring and anticoagulation optimization in stroke patients (15). The high prevalence of hyperglycemia (59.2% with glucose >140 mg/dL) at admission highlights the importance of glucose management protocols, as hyperglycemia has been consistently associated with worse stroke outcomes and increased hemorrhagic transformation risks.

Treatment utilization patterns in this study reflect contemporary practice guidelines, with intravenous thrombolysis administered to 31.7% of patients and mechanical thrombectomy performed in 12.5% of cases. These rates are comparable to national registries and suggest appropriate patient selection and adherence to evidence-based protocols (16). The achieved door-to-needle time of 67.4 minutes, while meeting current guidelines, indicates opportunities for further optimization through workflow improvements and system-level interventions. The high successful recanalization rate (80.0%) for mechanical thrombectomy procedures demonstrates technical proficiency and appropriate case selection.

The observed complication rates, including pneumonia (21.7%) and urinary tract infections (15.8%), align with published literature and emphasize the importance of comprehensive stroke care protocols addressing both neurological and medical management aspects. The higher complication rates in patients with poor functional outcomes likely reflect the interplay between stroke severity, prolonged hospitalization, and reduced mobility (17). These findings support the implementation of standardized prevention protocols, including early mobilization, swallowing assessments, and infection control measures.

Comparison with international stroke registries reveals both similarities and differences in patient characteristics and outcomes. The mean age of 68.4 years in this cohort is slightly lower than reported in some European studies but consistent with North American populations (18). The male predominance (58.3%) aligns with global patterns, though regional variations exist based on demographic and cultural factors. The median symptom-onset-to-arrival time of 4.2 hours suggests room for improvement in pre-hospital stroke recognition and emergency medical services optimization.

The study's risk stratification model, incorporating age, stroke severity, and time-to-presentation, provides a practical framework for outcome prediction and resource allocation. The area under the ROC curve of 0.78 indicates good discriminative ability, though additional variables such as imaging markers, biomarkers, and social determinants of health might further enhance predictive accuracy (19). The development of more sophisticated prediction models incorporating machine learning approaches represents an active area of research with potential for personalized medicine applications.

Limitations of this study include the single-center design, which may limit generalizability to different healthcare settings and populations. The sample size, while adequate for primary analyses, may have limited power for detecting smaller effect sizes in subgroup analyses. The 90-day follow-up period, though standard for stroke outcome assessment, may not capture longer-term recovery patterns or late complications. Additionally, the study did not comprehensively assess pre-stroke functional status, which represents an important confounder in outcome interpretation.

The exclusion of patients with hemorrhagic transformation may have introduced selection bias, as this complication represents an important outcome measure in acute stroke management. Future studies should consider incorporating comprehensive imaging protocols, including perfusion studies and vessel imaging, to better characterize tissue-at-risk and optimize treatment selection algorithms. Long-term follow-up assessments addressing quality of life, cognitive function, and healthcare resource utilization would provide additional valuable insights.

The implications of these findings extend beyond individual patient management to healthcare system planning and policy development. The identification of high-risk patient subgroups enables targeted interventions and resource allocation strategies. The emphasis on time-sensitive care supports continued investment in stroke system development, including regional networks and specialized transportation resources (20). Additionally, the high prevalence of modifiable risk factors reinforces the importance of primary prevention initiatives and population health approaches to stroke reduction.

Future research directions should focus on developing personalized treatment algorithms incorporating multiple clinical, imaging, and biomarker variables. The integration of artificial intelligence and machine learning techniques holds promise for enhancing prediction accuracy and optimizing treatment selection. Additionally, investigation of novel therapeutic targets, including neuroprotective agents and regenerative therapies, may provide additional options for improving outcomes in high-risk patient populations.

VI. CONCLUSION

This prospective observational study of 120 acute ischemic stroke patients demonstrates that advanced age greater than 75 years, admission NIHSS score exceeding 15 points, and delayed presentation beyond 4.5 hours represent independent predictors of poor functional outcomes at 90 days. The observed 30-day mortality rate of 18.3% and functional independence rate of 42.5% reflect contemporary stroke care outcomes in a tertiary care setting. These findings emphasize the critical importance of rapid stroke recognition, timely presentation, and aggressive early intervention in optimizing patient outcomes.

The high prevalence of modifiable vascular risk factors, including hypertension and diabetes mellitus, underscores the continued need for comprehensive primary prevention strategies and risk factor modification programs. The study results support current evidence-based treatment protocols while highlighting opportunities for system-level improvements in door-to-needle times and comprehensive care delivery.

The developed risk stratification model provides a practical framework for outcome prediction and clinical decision-making, though future research should focus on incorporating additional variables and advanced analytical techniques to enhance predictive accuracy. These findings contribute to the growing evidence base supporting organized stroke care delivery systems and provide contemporary benchmarks for quality improvement initiatives in acute stroke management.

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