

BIOMEDICAL SCIENCES

Treatment Outcomes and the Relevant Factors of Patients with Acute Ischemic Stroke treated at Thong Nhat Hospital in Ho Chi Minh City

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Abstract

Background: Acute ischemic stroke (AIS) is a leading cause of disability and mortality globally. Treatment outcomes for AIS patients can vary widely based on several factors, including demographic characteristics, clinical presentations, and access to timely interventions.

Objective: This study aims to evaluate the treatment outcomes of AIS patients at Thong Nhat Hospital and identify relevant factors influencing these outcomes.

Method: A retrospective cross-sectional study was conducted, including AIS patients admitted to Thong Nhat Hospital from Jan, 2023 to March, 2024. Data on patient demographics, clinical presentations, risk factors, treatment methods, and outcomes were collected and analyzed. Key outcomes included modified Rankin Scale when discharged and after 90 days of treatment and the related factors which can affect the recovery prognosis.

Result: Among the 158 AIS patients studied, 79 patients received reperfusion therapy while 79 others did not. Significant differences in treatment outcomes were observed based on sociodemographic characteristics, clinical symptoms, laboratory tests results and time to treatment. Patients who received reperfusion therapy demonstrated better functional outcomes (mRS scores) at discharge and 3 months post-treatment compared to those who did not. Additionally, factors such as age group (OR 22.688; 95% CI 1.293 – 398.198, $p = 0.033$) and initial NIHSS score (OR 2.281; 95% CI 1.103 – 4.715, $p = 0.026$) were found to influence treatment outcomes significantly.

Conclusion: The study highlights the critical role of timely and appropriate treatment in improving outcomes for AIS patients. Identifying and understanding the relevant factors influencing these outcomes can help optimize treatment protocols and enhance patient care at Thong Nhat Hospital. Further research is warranted to explore the long-term effects of these factors and refine patient management strategies for better clinical outcomes.

Keywords: Acute Ischemic Stroke (AIS), reperfusion therapy, recombinant tissue plasminogen activator (rtPA), mechanical thrombectomy, modified Rankin scale (mRS).

Introduction

Acute ischemic stroke (AIS) represents a significant medical emergency and a major cause of morbidity and mortality worldwide, representing a significant burden on healthcare systems, especially in developing countries like Vietnam [1–3]. Prompt and effective treatment is crucial to minimize the damage caused by the interruption of blood flow to the brain [3, 4]. Reperfusion therapy, including intravenous thrombolysis with recombinant tissue plasminogen activator (rtPA) and mechanical thrombectomy, has revolutionized

the management of AIS, offering the potential for substantial recovery when administered within an appropriate time window [5–7]. However, the effectiveness of this treatment can vary widely depending on numerous factors, including patient demographics, clinical characteristics, and hospital protocols [8–10].

This study aims to evaluate the treatment outcomes of patients with AIS treated at Thong Nhat Hospital and to identify the relevant factors that may impact these outcomes. By examining patient data, clinical presentation, treatment modalities, and follow-up

results, this research seeks to contribute valuable insights into improving stroke management practices and patient care at both the local and national levels.

Methods

Study Design

This was a single-center, retrospective cross-sectional study conducted at Thong Nhat Hospital in Ho Chi Minh City, Vietnam between January 2023 and June 2024.

Study Population

Patients were eligible for inclusion if they were (a) diagnosed with AIS according to the Vietnamese Ministry of Health's 2020 guidelines. Inclusion required patients to be (b) ≥ 18 years old (c) with sudden onset of neurological symptoms confirmed by imaging (CT or MRI) as cerebral infarction. Patients were required to (d) have completed at least 3 months of follow-up treatment at the time of data collection. Exclusion criteria included (a) unclear onset of symptoms, (b) stroke occurring during sleep, (c) out-of-hospital cardiac arrest, (d) critical conditions coexisting with AIS, (e) pre-existing neurological disabilities (mRS ≥ 2), and (f) other brain conditions such as tumors or traumatic brain injury.

Sample Method

A sample size of 158 patients was determined to be adequate for detecting differences in primary outcomes. Convenient sampling was employed, including patients treated between January 2023 and March 2024, with data collected retrospectively from electronic and paper medical records. Collected data included patient demographics, clinical characteristics at the time of admission, imaging results, details of the treatment received, and outcomes assessed at the 3-month follow-up. Cases with incomplete follow-up were managed through telephone interviews to obtain missing follow-up data when possible.

Statistical Analyses

Data were analyzed using SPSS version 22.0. Descriptive statistics were used to summarize patient demographics and clinical characteristics. Categorical variables were expressed as frequencies and percentages. Continuous variables were presented as mean \pm standard deviation or median (min-max) based on distribution. Logistic regression was performed to identify factors associated with treatment outcomes. A p-value ≤ 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Ethics Committees for Medical and Biological Research of Thong Nhat Hospital and Tan Tao University in Tay Ninh.

Table 1: Participants Characteristics.

Factors	All Patients (n = 158)	Rate (%)
<i>Patients Demographics and Baseline Characteristics</i>		
Age (years)*	64.91 \pm 13.2 (29–92)	
Sex		
Male	101	63.9
Female	57	36.1
Age group		
< 65 years old	74	46.8
≥ 65 years old	84	53.2
<i>Sociodemographic Factors</i>		
Living alone	35	22.2
Area of living		
City	128	81
Others	30	19
Having health insurance	147	93
Awareness of stroke symptoms	129	81.6
Occupation		
Manual laborers	22	13.9
Intellectual workers	13	8.2
Self-employed	123	77.8
Total	158	100

* Data are means \pm SDs (min–max).

Result

Patient Characteristics

A total of 158 patients with acute ischemic stroke (AIS) were included in this study. The mean age of the cohort was 64.91 \pm 13.2 years, with a range from 29 to 92 years. Patients aged 65 years and older constituted 53.2% of the study population. The majority of the patients were male (63.9%), resulting in a male-to-female ratio of 1.77:1.

A significant proportion of the patients (22.2%) lived alone. The majority resided in the city (81%), with 93% of the patients having health insurance coverage. Notably, 81.6% of the patients were aware of stroke symptoms before their event. The study population included a diverse range of occupations, with the majority being self-employed (77.8%). Participant characteristics are summarized in [Table 1](#).

Stroke Characteristics

Most patients (75.3%) experienced stroke symptoms while at rest, with a smaller percentage reporting

stroke onset upon waking (4.4%) or during physical exertion (1.3%). The majority of patients arrived at the hospital within 4.5 hours (39.2%) or between 6-24 hours (35.4%) after symptom onset. The detailed information of treatment window time is showed in **Figure 1**.

Hypertension was the most prevalent comorbidity, observed in 79.7% of patients. Other notable risk factors included dyslipidemia (47.5%), prior stroke (43.0%), and diabetes mellitus (36.1%). Additionally, 31.0% of patients were current smokers. Among the 37 patients with cardiac comorbidities, atrial fibrillation was most common (45.9%), followed by coronary artery disease (27.0%).

Table 2: Risk Factors and Comorbidities.

Factors	All Patients (n = 158)	Rate (%)
Hypertension	126	79.7
Diabetes	57	36.1
Dyslipidemia	75	47.5
Cardiac comorbidities	37	23.4
Smoke	49	31
Stimulants use	1	0.6
TIA	2	1.3
Prior stroke	68	43
Family-related stroke history	0	0
Anticoagulants use	12	7.6
Antiplatelet agents use	16	10.1
Treated with reperfusion therapy before	0	0
Total	158	100

Clinical Presentation and Vital Signs

The most frequent symptoms at stroke onset were hemiparesis (88%), facial drooping (47.5%) and slurred speech (32.3%). The vast majority of patients (97.5%) experienced a sudden onset of these symptoms. The mean systolic blood pressure at admission was 155.86

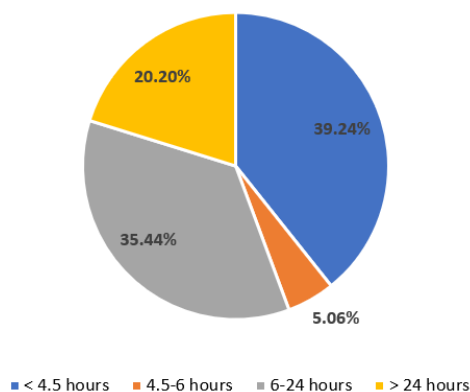


Figure 1: Time to Hospital Presentation (n=158).

± 26.33 mmHg, and the mean diastolic blood pressure was 89.13 ± 15.48 mmHg. Other vital signs, such as heart rate, respiratory rate, and oxygen saturation, were generally within normal ranges, although hypertension was prevalent in 81.6% of patients. The data obtained at the time of patient admission are shown in **Table 3**.

Table 3: Patient admission data.

Symptoms	All Patients (n = 158)	Rate (%)
<i>Onset symptoms</i>		
Headache	6	3.8
Dizziness	24	15.2
Hemiparesis	139	88
Emesis	2	1.3
Convulsion	0	0
Face drooping	75	47.5
Cognitive disorder	7	4.4
Syncope	4	2.5
Slurred speech	51	32.3
Others	13	8.2
Total	158	100
<i>Vital signs*</i>		
Mean SBP (mmHg)	155.86 ± 26.33 (90–240)	
Mean DBP (mmHg)	89.13 ± 15.48 (40–170)	
Pulse rate (bpm)	85.00 ± 11.08 (50–143)	
Temperature (°C)	36.89 ± 0.42 (36–38.7)	
Respiratory rate (breaths/min)	19.39 ± 1.86 (16–30)	
Oxygen saturation (SpO2)	96.73 ± 1.35 (91–99)	

* Data are means ± SDs (min–max).

Clinical and Neurological Assessment

The most common symptoms observed during clinical examination were hemiparesis (94.9%), facial drooping (68.4%), and slurred speech (55.7%). Remarkably, all symptoms showed significant improvement after 3 months of treatment.

At admission, the mean GCS was 14.25 ± 1.70, indicating that most patients had relatively preserved consciousness upon presentation. After 3 months of treatment, the GCS significantly improved to 14.98 ± 0.24 (p < 0.05).

The mean NIHSS score at admission was 7.69 ± 5.24, indicative of moderate stroke severity. This score improved significantly within 24 hours post-admission (4.68 ± 3.96) and further decreased after 3 months of treatment to 2.22 ± 1.91 (p < 0.05).

Table 4 shown specific findings through clinical assessment.

Table 4: Clinical assessment results.

Symptoms	Admission (<i>n</i> = 158)	3 months after treatment (<i>n</i> = 154)
Number (%)		
<i>Clinical symptoms</i>		
Hemiparesis	150 (94.9)	102 (66.2)
Quadriplegia	0 (0)	0 (0)
Cognitive disorder	39 (24.7)	1 (0.7)
Sensory disorder	35 (22.2)	1 (0.7)
Face drooping	108 (68.4)	11 (7.1)
Ataxia	4 (2.5)	1 (0.7)
Slurred speech	88 (55.7)	24 (15.6)
Others	2 (1.3)	2 (1.3)
<i>Level of consciousness (LOC)</i>		
Deep coma	0 (0)	0 (0)
Light coma	4 (2.5)	0 (0)
Moderate consciousness disturbance	11 (7)	0 (0)
Light consciousness disturbance	23 (14.6)	1 (0.7)
Normal consciousness	120 (75.9)	153 (96.8)
Death	0 (0)	4 (2.5)
<i>Stroke severity</i>		
Light	54 (34.2)	130 (84.4)
Moderate	88 (55.7)	24 (15.6)
Severe	16 (10.1)	0 (0)
Very severe	0 (0)	0 (0)
Total	158	154

Laboratory and Imaging Findings

Several laboratory abnormalities were observed:

- Hyperglycemia (Glucose ≥ 7 mmol/L) was present in 45.6% of patients.
- Elevated HbA1c levels ($\geq 6.5\%$) were found in 13.3% of those tested.
- Dyslipidemia was common, with elevated total cholesterol (15.2%), low HDL-C (29.1%), and high LDL-C levels (10.8%) frequently observed.

Atrial fibrillation is the most common abnormality (48.6%) based on the ECG results, following with extrasystoles (37.8%). Meanwhile, among those with abnormal TTE and TEE results, heart failure is the condition with the highest frequency (52.4%). AIS patients with carotid artery and vertebral - basilar artery stenosis revealed by Doppler ultrasonography account for 42.4% of the total, with the carotid artery having a higher prevalence than the vertebrobasilar artery.

Brain CT was the most frequently utilized imaging modality (38.6%), followed by MRI (23.4%). Both modalities were used in 38% of cases. Among patients with documented vessel occlusions, the middle cerebral artery (MCA) was the most commonly affected (51.9%).

The mean ASPECTS score was 8.23 ± 1.20 , and the mean pc-ASPECTS score was 6.95 ± 0.67 , indicating that most patients had relatively minor ischemic changes.

Detailed paraclinical findings are summarized in **Table 5** and **Figure 2**.

Table 5: Paraclinical findings (part 1).

Symptoms	Patients
<i>Blood test results*</i>	
Glucose (mmol/L)	7.88 ± 3.69 (3.1 – 23.3)
HbA1c (%)	7.64 ± 1.9 (5.6 – 12.4)
Total cholesterol (mmol/L)	4.88 ± 1.4 (2.0 – 9.6)
Triglyceride (mmol/L)	2.11 ± 1.34 (0.5 – 7.7)
HDL-C (mmol/L)	1.11 ± 0.36 (0.28 – 4.0)
LDL-C (mmol/L)	2.85 ± 1.12 (0.51 – 7.25)
Platelet (K/uL)	250.02 ± 94.62 (84 – 876)
INR (s)	1.1 ± 0.35 (0.95 – 2.73)
PT (s)	12.26 ± 2.41 (10.1 – 25.8)
APTT (s)	29.88 ± 5.57 (11 – 55.9)
<i>ECG characteristics</i>	
<i>Number (percentage, %)</i>	
Abnormal ECG	37 (23.4)
Abnormalities (<i>N</i> = 37)	
Atrial fibrillation	18 (48.6)
ST elevation	2 (5.4)
Extrasystoles	14 (37.8)
Sinus node dysfunction	2 (5.4)
AV block	2 (5.4)
Sinus tachycardia	1 (2.7)
Left-shifted QRS	2 (5.4)
<i>Transthoracic and transesophageal echocardiography (TTE and TEE)</i>	
Abnormal TTE and TEE	21 (13.3)
Abnormalities (<i>N</i> = 21)	
Heart failure	11 (52.4)
Moderate/severe mitral stenosis	1 (4.8)
Atrial/ventricular thrombus	7 (33.3)
Vegetation	1 (4.8)
Pacemaker	4 (19)
Hypertrophic cardiomyopathy	1 (4.8)
Thoracic aortic dissection	1 (4.8)

* Data are means \pm SDs (min – max).

Table 5: Paraclinical findings (part 2).

Symptoms	Patients
<i>Doppler Ultrasound of Carotid and Vertebral-Basilar Arteries</i>	
Presence of stenosis	67 (42.4)
Carotid artery stenosis	50 (31.6)
Same side as the lesion	24 (48)
Opposite site of the lesion	6 (12)
Both sides	20 (40)
Vertebral-basilar artery stenosis	34 (21.5)
Same side as the lesion	9 (26.5)
Opposite site of the lesion	9 (26.5)
Both sides	16 (47)
<i>CT scan and MRI findings</i>	
Cerebral vascular occlusion	54 (34.2)
Parenchymal brain injury site	
Pons	11 (7)
ACC	21 (13.3)
PCC	109 (69)
ASPECTS score in ACC injury*	8.23 ± 1.2 (5 – 10)
pc-ASPECTS score in PCC injury*	6.95 ± 0.67 (6 – 8)

* Data are means ± SDs (min – max).

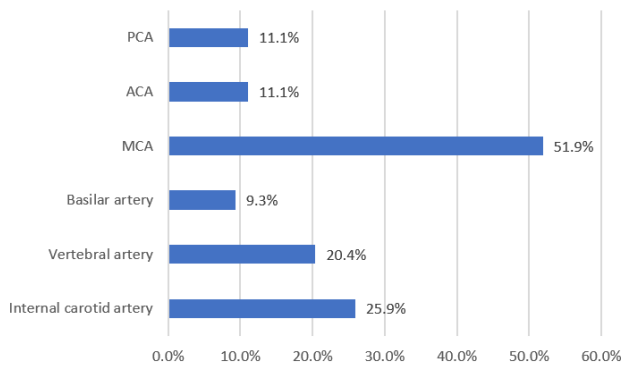


Figure 2: Site of cerebral artery occlusion.

Treatment Modalities and Clinical Outcomes

Half of the study population (50%) received reperfusion therapy, including intravenous thrombolysis (rt-PA) in 46.8% of cases, mechanical thrombectomy in 40.5%, and a combination of both in 12.7%.

The mean mRS score at discharge was 1.94 ± 1.47, which significantly improved to 1.14 ± 1.41 after 3 months of treatment (p < 0.05). At the 3-month follow-up, 85.7% of patients had a favorable outcome (mRS ≤ 2), compared to 65.2% at discharge (p < 0.05). Besides, when comparing the treatment result using mRS between patients treated with and without reperfusion therapy, patients who received reperfusion therapy demonstrated much better functional outcomes at discharge and 3 months post-treatment. All of the

treatment results and comparison are demonstrated in **Table 6** and **Table 7**.

Table 6: Treatment Outcome.

Characteristics	Admission (n = 158)	3 months after treatment (n = 154)	P-value
mRS score*	1.94 ± 1.47 (0 – 6)	1.14 ± 1.41 (0 – 6)	0.00@
<i>Number (percentage, %)</i>			
Post-treatment Recovery ability			
Good recovery (mRS ≤ 2)	103 (65.2)	132 (85.7)	0.00#
Risk of disability/death (mRS > 2)	55 (34.8)	22 (14.3)	
Total	158	154	

* Data are means ± SDs (min – max).

@ Independent T-test.

Chi-square test.

Table 7: Comparison of treatment outcome between patients who were treated with and without reperfusion therapy.

Characteristics	Reperfusion therapy (N = 79)	Optimal medical treatment alone (N = 79)	P-value
mRS score [¥]			
Admission	1.50 ± 1.20	2.13 ± 1.43	0.032@
3 months after treatment	1.10 ± 1.28	1.75 ± 1.54	0.033@

¥ Data are means ± SDs.

@ Independent T-test.

Factors Associated with Outcomes: Multivariate logistic regression model showed that age group (OR 22.688; 95%CI 1.293 – 398.198, p = 0.033) and initial NIHSS score (OR 2.281; 95%CI 1.103 – 4.715, p = 0.026) were significantly associated with poorer outcomes (p < 0.05).

Discussion

The study provides valuable insights into the clinical, paraclinical, and treatment characteristics of patients with AIS and the outcomes of different treatment modalities, especially focusing on the impact of reperfusion therapy. By comparing baseline characteristics, stroke-related factors, and treatment outcomes, we can better understand the determinants of recovery in AIS patients and identify predictors of favorable outcomes.

The mean age of the study was 64.91 ± 13.2 years, and patients aged 65 years and older represented 53.2% of the study population. This is consistent with the well-established association between age and stroke incidence, as older age is one of the most significant non-modifiable risk factors for stroke. Similar findings have been reported in studies conducted both domestically and internationally. For instance, the study by Le Duc Thuan *et al.* (2022) [11] and Nguyen Quang Anh (2023) [5] also found a higher prevalence of stroke in the elderly population, which aligns with international data from studies like Rajeel Imran *et al.* (2021) [12]. Furthermore, the predominance of male patients (63.9%) in our study is also consistent with findings in other regions [13, 14], indicating that men may be at higher risk of stroke compared to women, likely due to a higher prevalence of risk factors such as smoking and hypertension.

Hypertension was the most common comorbidity, affecting 79.7% of the patients, followed by dyslipidemia (47.5%) and diabetes (36.1%). These findings are consistent with the literature, as hypertension is widely recognized as the leading modifiable risk factor for AIS [11, 15, 16]. Previous studies, such as Zhang *et al.* (2016) [17] and Mariana *et al.* (2022) [18], have also identified hypertension, diabetes, and dyslipidemia as key contributors to stroke risk and poorer outcomes. The prevalence of atrial fibrillation (48.6%) among patients with cardiac comorbidities further highlights the importance of cardiac health in stroke management, as atrial fibrillation is a known contributor to cardioembolic stroke [19]. These risk factors were also observed in a significant portion of patients in other studies in both domestic and international settings [6, 20–22].

A significant portion of patients (39.2%) arrived at the hospital within the first 4.5 hours after symptom onset, which is the optimal time for administering reperfusion therapy. This aligns with established evidence, such as that presented in the NINDS trial [21], where early intervention within this therapeutic window is associated with improved outcomes. However, 35.4% of patients in this study presented later, between 6–24 hours after symptom onset, which may have contributed to less favorable outcomes due to the delayed opportunity for effective thrombolysis [11, 18].

Hemiparesis (88%) and facial drooping (47.5%) were the most frequently observed symptoms at stroke onset, with sudden symptom onset in 97.5% of patients. These findings are consistent with the classical presentation of AIS and underscore the importance of rapid recognition of stroke symptoms for timely intervention [2, 16, 18, 23]. The mean NIHSS score at admission was 7.69 ± 5.24 , indicative of moderate stroke severity. Notably, this score decreased to 2.22 ± 1.91 after 3 months of treatment ($p < 0.05$). These improvements reflect the effectiveness of the treatments administered, particularly reperfusion therapy, in reducing stroke severity and enhancing recovery [20, 24].

Our study showed that hyperglycemia and dyslipidemia were common laboratory abnormalities in AIS patients, both of which have been widely recognized as contributors to poor outcomes [11, 24–26]. In terms of imaging, the mean ASPECTS score of 8.23 ± 1.20 indicates that most patients had relatively minor ischemic changes at admission. This finding aligns with studies that highlight the utility of ASPECTS in predicting outcomes, with lower scores correlating with poorer recovery [5, 15, 22, 27, 28]. Additionally, middle cerebral artery (MCA) occlusion was the most commonly affected vessel, consistent with the known distribution of ischemic strokes, where the MCA is often involved due to its anatomical location and the blood supply it provides [5, 16, 22, 27, 28].

Half of the patients in this study received reperfusion therapy, including intravenous thrombolysis (rt-PA) and mechanical thrombectomy. The mean mRS score at discharge was 1.94 ± 1.47 , which significantly improved to 1.14 ± 1.41 after 3 months of treatment ($p < 0.05$). Notably, patients who received reperfusion therapy had significantly better outcomes compared to those who received optimal medical treatment alone. This is consistent with existing evidence, such as the findings of the MR CLEAN trial [22], which demonstrated the superiority of mechanical thrombectomy combined with intravenous thrombolysis over medical management alone in improving functional outcomes in stroke patients. Similarly, a study by Mai Duy Tôn *et al.* (2023) [20] also emphasized the favorable outcomes associated with reperfusion therapies in stroke patients, especially in reducing mRS scores and improving the rate of good recovery ($mRS \leq 2$) at 3 months.

Multivariate analysis identified two independent predictors of poor outcomes: age group (≥ 65 years) and initial NIHSS score. Older age (OR 22.688; 95%CI 1.293–398.198) was significantly associated with poorer recovery, consistent with the body of evidence indicating that elderly patients are more likely to have worse functional outcomes after stroke. This finding is in agreement with studies such as Rewell *et al.* (2017) [29] and Zhang *et al.* (2016) [17], which also reported that older patients tend to have poorer recovery, likely due to a combination of increased comorbidities, decreased physiological reserve, and higher stroke severity. The NIHSS score, a widely used measure of stroke severity, was also a strong predictor of outcomes in our study, with higher initial scores correlating with worse recovery (OR 2.281; 95%CI 1.103–4.715). This finding is consistent with the established literature that links higher NIHSS scores at admission with poorer long-term outcomes.

Limitation

- 1) **Single-center design:** Our study was conducted at a single hospital, which may limit the generalizability of the results. Multi-center studies are needed to confirm our findings in different populations and settings.

- 2) **Retrospective design:** The retrospective design may introduce selection bias and limit the ability to establish causal relationships between treatment modalities and outcomes. Additionally, some variables were missing during data sampling from retrospective medical records, leading to potential inaccuracies.
- 3) **Unmeasured confounding factors:** Although multivariate analysis was performed, there may still be unmeasured confounding factors that could influence the observed relationships.
- 4) **Sample size:** While the sample size was sufficient to detect differences in primary outcomes, it may not be adequate for subgroup analyses, especially for less common variables.

Conclusion

This study provides important insights into the clinical, paraclinical, and treatment characteristics of acute ischemic stroke (AIS) patients, highlighting the critical role of reperfusion therapy. Age group (OR 22.688; 95%CI 1.293 – 398.198, $p = 0.033$) and initial stroke severity (NIHSS score) (OR 2.281; 95%CI 1.103 – 4.715, $p = 0.026$) were significant predictors of poor outcomes, with older patients and those with higher NIHSS scores showing worse recovery. Early intervention within the 4.5-hour window significantly improved outcomes, while delayed presentation was associated with less favorable results. Reperfusion therapies, including intravenous thrombolysis and mechanical thrombectomy, led to better functional recovery, consistent with findings from other studies. These results underscore the importance of timely treatment and managing risk factors to optimize outcomes in AIS patients.

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Ethics approval and consent to participate

The study was approved by the Ethics Committees for Medical and Biological Research of Thong Nhat Hospital and Tan Tao University in Tay Ninh.

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None

Competing interests

None of the authors have conflicts of interest to declare.

List of Abbreviations

ACA	Anterior cerebral artery
ACC	Anterior cerebral circulation
AIS	Acute ischemic stroke
DBP	Diastolic blood pressure
ECG	Electrocardiogram
GCS	Glasgow Coma Scale
LOC	Level of consciousness
MCA	Middle cerebral artery
mRS	Modified Rankin Score
NIHSS	National Institutes of Health Stroke Scale
PCA	Posterior cerebral artery
PCC	Posterior cerebral circulation
rtPA	Recombinant tissue plasminogen activator
SBP	Systolic blood pressure
TEE	Transesophageal echocardiography
TIA	Transient ischemic attack
TTE	Transthoracic echocardiography

References

- [1] L. Đ. Hinh, “Chẩn đoán sớm cơn đột quỵ não,” *Nội san Hội Thần kinh học Việt Nam*, pp. 3–7, 2010.
- [2] L. V. Thinh, “Nghiên cứu đặc điểm lâm sàng, yếu tố nguy cơ và nguyên nhân nhồi máu não ở bệnh nhân dưới 50 tuổi,” *Y học thực hành*, vol. 811, pp. 106–115, 2012.
- [3] L. V. Thanh, “Điều trị tiêu sợi huyết khối đường tĩnh mạch trên 121 bệnh nhân nhồi máu não cấp trong 3 giờ đầu tại tp.hcm,” in *Hội nghị Đột quỵ Việt Nam*, (Hồ Chí Minh), 2010.
- [4] G. W. Albers *et al.*, “A multicenter randomized controlled trial of endovascular therapy following imaging evaluation for ischemic stroke (defuse 3),” *Int J Stroke*, vol. 12, pp. 896–905, 2017. DOI: [10.1177/1747493017701147](https://doi.org/10.1177/1747493017701147).
- [5] N. Q. Anh, “Nghiên cứu đặc điểm hình ảnh học và đánh giá hiệu quả của kỹ thuật lấy huyết khối cơ học ở bệnh nhân nhồi máu não cấp,” *Tạp chí trường Đại học Y Hà Nội*, 2023.
- [6] W. Hacke *et al.*, “Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke,” *New*

- England Journal of Medicine*, vol. 359, pp. 1317–1329, 2008. DOI: [10.1056/NEJMoa0804656](https://doi.org/10.1056/NEJMoa0804656).
- [7] R. G. Nogueira et al., “Thrombectomy 6 to 34 hours after stroke with a mismatch between deficit and infarct,” *New England Journal of Medicine*, vol. 378, pp. 11–21, 2018. DOI: [10.1056/NEJMoa1706442](https://doi.org/10.1056/NEJMoa1706442).
- [8] V. D. Luu, L. H. Kien, and e. a. Tuan, “Safety and efficacy of a direct aspiration first-pass technique with large-bore catheters for acute ischemic stroke in vietnam: Experience of a single center,” *Asian Journal of Neurosurgery*, vol. 15, no. 2, pp. 306–310, 2020. DOI: [10.4103/ajns.AJNS_263_19](https://doi.org/10.4103/ajns.AJNS_263_19).
- [9] M. D. Ginsberg, “The cerebral collateral circulation: Relevance to pathophysiology and treatment of stroke,” *Neuropharmacology*, vol. 134, pp. 280–292, 2018. DOI: [10.1016/j.neuropharm.2017.08.003](https://doi.org/10.1016/j.neuropharm.2017.08.003).
- [10] E. O. Terecoasă, R. A. Radu, A. Negrilă, et al., “Pre-hospital delay in acute ischemic stroke care: Current findings and future perspectives in a tertiary stroke center from romania—a cross-sectional study,” *Medicina (Kaunas)*, vol. 58, no. 8, p. 1003, 2022. DOI: [10.3390/medicina58081003](https://doi.org/10.3390/medicina58081003).
- [11] L. Đ. Thuan, “Đặc điểm lâm sàng, cận lâm sàng, kết quả điều trị người bệnh nhồi máu não cấp mức độ nhẹ,” in *Hội nghị khoa học toàn quốc chuyên ngành đột quỵ và các bệnh thần kinh liên quan lần thứ IX*, 2022.
- [12] R. Imran, G. A. Mohamed, and F. Nahab, “Acute reperfusion therapies for acute ischemic stroke,” *Journal of Clinical Medicine*, vol. 10, no. 16, p. 3677, 2021. DOI: [10.3390/jcm10163677](https://doi.org/10.3390/jcm10163677).
- [13] M. D. Ton and D. V. Phuong, “Kết quả điều trị nhồi máu não ở các bệnh viện khu vực miền bắc việt nam,” *Tạp chí Nghiên cứu Y học*, vol. 168, no. 7, pp. 153–160, 2023. DOI: [10.52852/tcncyh.v168i7.1753](https://doi.org/10.52852/tcncyh.v168i7.1753).
- [14] K. Toyoda et al., “Routine use of intravenous low-dose recombinant tissue plasminogen activator in Japanese patients: general outcomes and prognostic factors from the SAMURAI register,” *Stroke*, vol. 40, no. 11, pp. 3591–3595, 2009. DOI: [10.1161/STROKEAHA.109.562991](https://doi.org/10.1161/STROKEAHA.109.562991).
- [15] P. P. Sung, “Kết quả điều trị nhồi máu não trong giai đoạn từ 3 đến 4.5 giờ,” Master’s thesis, Đại học Y Hà Nội, Hà Nội, 2019.
- [16] T. K. T. Nguyen and N. T. Bui, “Clinical characteristics and multiphase computed tomographic angiography image in patients with acute ischemic stroke at Can Tho Central General Hospital in 2021–2023,” *CTJUMP*, pp. 85–92, September 2023. DOI: [10.58490/ctump.2023i63.977](https://doi.org/10.58490/ctump.2023i63.977).
- [17] X. Zhao, “Risk factors and outcomes in ischemic stroke patients,” *Journal of Stroke*, 2016.
- [18] M. A. Moraes, F. C. Mussi, L. S. Muniz, et al., “Clinical characterization, disability, and mortality in people with strokes during 90 days,” *Rev Bras Enferm*, vol. 75, p. e20201383, October 2021. DOI: [10.1590/0034-7167-2020-1383](https://doi.org/10.1590/0034-7167-2020-1383).
- [19] K. Kimura, K. Minematsu, T. Yamaguchi, and Japan Multicenter Stroke Investigators’ Collaboration (J-MUSIC), “Atrial fibrillation as a predictive factor for severe stroke and early death in 15,831 patients with acute ischaemic stroke,” *Journal of Neurology, Neurosurgery & Psychiatry*, vol. 76, pp. 679–683, May 2005. DOI: [10.1136/jnnp.2004.048827](https://doi.org/10.1136/jnnp.2004.048827).
- [20] M. D. Ton, N. D. Chinh, and H. B. Hai, “Kết quả điều trị nhồi máu não cấp và yếu tố tiên lượng tử vong tại một số đơn vị đột quỵ não ở hà nội,” *Tạp chí Nghiên cứu Y học*, vol. 167, no. 6, pp. 79–87, 2023. DOI: [10.52852/tcncyh.v167i6.1655](https://doi.org/10.52852/tcncyh.v167i6.1655).
- [21] The National Institute of Neurological Disorders and Stroke (NINDS) rt-PA Stroke Study Group, “Tissue plasminogen activator for acute ischemic stroke,” *New England Journal of Medicine*, vol. 333, pp. 1581–1588, 1995. DOI: [10.1056/NEJM199512143332401](https://doi.org/10.1056/NEJM199512143332401).
- [22] O. A. Berkhemer et al., “A randomized trial of intra-arterial treatment for acute ischemic stroke,” *New England Journal of Medicine*, vol. 372, pp. 11–20, 2015. DOI: [10.1056/NEJMoa1411587](https://doi.org/10.1056/NEJMoa1411587).
- [23] European Stroke Organisation, “Intravenous thrombolysis.” <https://eso-stroke.org/intravenous-thrombolysis/>, 2021. Accessed: 7 August 2021.
- [24] T. D. Pham, D. T. Mai, V. P. Đào, and A. T. Nguyen, “Đặc điểm lâm sàng, cận lâm sàng và kết quả điều trị tái tưới máu ở bệnh nhân trẻ tuổi bị nhồi máu não cấp,” *Tạp chí Y học Việt Nam*, vol. 522, February 2023. DOI: [10.51298/vmj.v522i1.4224](https://doi.org/10.51298/vmj.v522i1.4224).
- [25] S. Wada, S. Yoshimura, et al., “Outcome prediction in acute stroke patients by continuous glucose monitoring,” *Journal of the American Heart Association*, vol. 7, p. e008744, April 2018. DOI: [10.1161/JAHA.118.008744](https://doi.org/10.1161/JAHA.118.008744).
- [26] L. G. Stead, R. M. Gilmore, et al., “Hyperglycemia as an independent predictor of worse outcome in non-diabetic patients presenting with acute ischemic stroke,” *Neurocritical Care*, vol. 10, no. 2, pp. 181–186, 2009. DOI: [10.1007/s12028-008-9080-0](https://doi.org/10.1007/s12028-008-9080-0).
- [27] M. Goyal et al., “Randomized assessment of rapid endovascular treatment of ischemic stroke (ESCAPE),” *New England Journal of Medicine*, vol. 372, pp. 1019–1030, 2015. DOI: [10.1056/NEJMoa1414905](https://doi.org/10.1056/NEJMoa1414905).
- [28] J. L. Saver et al., “Stent-retriever thrombectomy after intravenous t-pa vs. t-pa alone in stroke (SWIFT PRIME),” *New England Journal of Medicine*, vol. 372, pp. 2285–2295, 2015. DOI: [10.1056/NEJMoa1415061](https://doi.org/10.1056/NEJMoa1415061).
- [29] R. S. Smith, “Stroke recovery in elderly patients: A comprehensive analysis,” *Stroke*, 2017.