

Outcomes of intravenous alteplase 0.9 mg/kg in acute ischemic stroke at 19-8 hospital

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ABSTRACT

Objectives: To describe the characteristics, time metrics, in-hospital outcomes, and associated factors in patients with acute ischemic stroke treated with intravenous alteplase 0.9 mg/kg at 19-8 Hospital.

Methods: Retrospective case series of 50 consecutive patients treated within 4.5 hours of onset from April 2022 to August 2025.

Results: The mean admission National Institutes of Health Stroke Scale (NIHSS) score was 9.6 ± 3.9 . The median onset-to-door and door-to-needle times were 98.5 and 36 minutes; 79.2% were treated within 60 minutes of arrival, and door-to-needle time decreased from 50 minutes (2022) to 30 minutes (2024–2025) ($p = 0.034$). NIHSS decreased from 8.5 to 6 at 1 hour ($p < 0.001$). Among 34 patients who completed treatment, 79.4% had a modified Rankin Scale (mRS) score of 0–2 at discharge, with no symptomatic intracranial hemorrhage or death. The 16 patients transferred on the treatment day had more severe stroke (median NIHSS 12 vs 7) and 56.2% had large vessel occlusion. In univariable analysis, admission NIHSS ≥ 10 and arterial occlusion were associated with an unfavorable outcome.

Conclusions: The in-hospital workflow was fast and improved over time, whereas prehospital delay remained long. Patients who completed treatment showed early neurological improvement without symptomatic hemorrhage.

Keywords: acute ischemic stroke, alteplase, thrombolysis, door-to-needle time, NIHSS.

I. INTRODUCTION

Stroke caused approximately 11.9 million incident cases and 7.3 million deaths worldwide in 2021.¹ Since the NINDS and ECASS III trials, intravenous alteplase 0.9 mg/kg within 4.5 hours of onset has been the cornerstone of reperfusion therapy,^{2,3} with a benefit that diminishes with every minute of delay.⁴

Trial results cannot be directly extrapolated to every hospital,

because patient characteristics, workflow speed, and access to endovascular therapy differ. In Vietnam, thrombolysis data come mainly from central stroke centers,⁵ whereas data from general hospitals without thrombectomy capability, such as 19-8 Hospital (Ministry of Public Security), which has provided alteplase since 2021, remain scarce.

This study aimed (1) to describe the clinical and imaging characteristics and the time metrics of acute stroke care, including the trend in door-to-needle time, in patients treated with intravenous alteplase 0.9 mg/kg at 19-8 Hospital; and (2) to evaluate the change in National Institutes of Health Stroke Scale (NIHSS) score at 1 hour and at discharge, the proportion with a modified Rankin Scale (mRS) score of 0–2 at discharge, complications, and factors associated with outcome, and to compare patients who completed treatment with those transferred early.

II. PATIENTS AND METHODS

2.1. Patients

Records of patients with acute ischemic stroke treated with intravenous alteplase at the Department of Neuropsychiatry, 19-8 Hospital, from April 2022 to August 2025 were reviewed.

Inclusion criteria: age ≥ 18 years; acute ischemic stroke diagnosed according to the 2020 Ministry of Health guidelines (Decision No. 5331/QĐ-BYT); alteplase 0.9 mg/kg (maximum 90 mg) within 4.5 hours of onset; and complete documentation of key times, dose, NIHSS score, and pretreatment imaging. **Exclusion criteria:** mechanical thrombectomy or surgery at our hospital immediately after thrombolysis; an alteplase dose other than 0.9 mg/kg or another thrombolytic agent; and lost records or missing key information.

2.2. Methods

Study design: retrospective descriptive case

series with in-hospital follow-up; all consecutive eligible records during the study period were included, giving 50 patients for analysis.

Treatment protocol: 10% of the dose was given as a 1-minute bolus and 90% infused over 60 minutes; blood pressure was kept $< 185/110$ mmHg before and $< 180/105$ mmHg for 24 hours after treatment, according to the American Heart Association/American Stroke Association (AHA/ASA) guidelines.⁶ Patients with large vessel occlusion were transferred to a thrombectomy-capable center after alteplase.

Variables and definitions: data included demographics, risk factors, time intervals (onset-to-door, door-to-CT [target ≤ 25 minutes], door-to-needle [target ≤ 60 minutes], and onset-to-needle), NIHSS, laboratory tests, computed tomography (CT) and vascular imaging, and Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification. NIHSS was assessed at admission, at 1 hour after treatment, and at discharge; discharge mRS was determined retrospectively from the medical records. Major improvement was a decrease of ≥ 4 NIHSS points or NIHSS 0–1; deterioration was an increase of ≥ 4 points; a good outcome was mRS 0–2. Large vessel occlusion was occlusion of the internal carotid artery or M1 segment. Recanalization was graded by the Mori scale in patients with arterial occlusion; reocclusion was renewed occlusion of a previously recanalized artery. Hemorrhagic transformation was classified by ECASS criteria (HI1–2, PH1–2) and symptomatic intracranial hemorrhage by ECASS II.⁷

Analysis groups: patients transferred or discharged within 5 hours of alteplase (on the day of treatment) formed the early-transfer group (group 2); the others formed the completed-treatment group (group 1). Discharge NIHSS, mRS, intracranial hemorrhage, and associated

factors were analyzed in group 1, and other variables in all patients.

Statistical analysis: Data were cleaned according to predefined rules (implausible values that could not be verified were treated as missing) and analyzed with Stata 12.0. Data are presented as mean ± standard deviation or median (interquartile range, IQR). The Mann–Whitney, Wilcoxon signed-rank, χ^2 , and Fisher’s exact tests were used as appropriate. Associated factors were assessed by univariable logistic regression (odds ratios [ORs] with 95% confidence intervals [CIs]) or Fisher’s exact test for zero cells; with only 7 unfavorable outcomes, multivariable analysis was not performed. Temporal trends were tested with Spearman’s correlation; $p < 0.05$ was considered significant.

2.3. Research ethics

The study protocol was approved by Hanoi Medical University, and the Board of Directors of 19-8 Hospital granted access to the medical records. This was a retrospective study with no intervention in treatment; personal information was coded and kept confidential.

III. RESULTS

The study included 50 patients, of whom 34 completed treatment at our hospital (group 1) and 16 were transferred or discharged on the day of treatment (early-transfer group, group 2). All patients received the intended dose of 0.9 mg/kg (actual dose 0.88–0.93 mg/kg; total dose 52.2 ± 6.8 mg).

Table 1. General and clinical characteristics of the study population ($n = 50$)

Characteristic	Value
Mean age (years); minimum–maximum	64.3 ± 14.1; 25–89
Age < 65 / 65–80 / > 80 years, n (%)	25 (50.0) / 19 (38.0) / 6 (12.0)
Male sex, n (%)	34 (68.0)

Characteristic	Value
Hypertension / previous ischemic stroke / diabetes / atrial fibrillation, n (%)	35 (70.0) / 12 (24.0) / 11 (22.0) / 10 (20.0)
Hemiparesis / central facial palsy / dysarthria–aphasia, n (%)	50 (100) / 44 (88.0) / 43 (86.0)
Drowsiness on admission, n (%)	16 (32.0)
Systolic blood pressure on admission (mmHg)	155.5 ± 23.5
Blood pressure > 185/110 mmHg on admission, n (%)	4 (8.0)
Blood glucose > 10 mmol/L, n (%)	9 (18.0)
Admission NIHSS score, mean; median (IQR)	9.6 ± 3.9; 8.5 (7.0–12.0)
NIHSS 5–15 / 16–20 / ≥ 21 points, n (%)	45 (90.0) / 4 (8.0) / 1 (2.0)

Table 2. Time intervals in the acute stroke care pathway

Time interval (minutes)	n	Median (IQR)	Target achieved, n (%)
Onset-to-door	48	98.5 (60.0–133.2)	≤ 60 min: 13 (27.1)
Door-to-CT	48	13.0 (11.0–16.2)	≤ 25 min: 46 (95.8)
Door-to-needle	48	36.0 (28.0–50.2)	≤ 60 min: 38 (79.2)
Onset-to-needle	50	150.0 (102.0–183.8)	< 180 min: 34 (68.0)

Note: $n = 48$ because two records had invalid admission times. The median door-to-needle time decreased from 50 minutes in 2022 to 39 minutes in 2023 and 30 minutes in 2024 and 2025 ($p = -0.31$; $p = 0.034$). In the 10 cases with a door-to-needle time > 60 minutes, door-to-CT time was 9–25 minutes.

On CT, 23 patients (46.0%) had normal findings and 26 (52.0%) had at least one early ischemic sign, including a hyperdense artery

sign in 9 (18.0%); CT findings were not recorded in 1 patient, and none had hypodensity > 1/3 of the middle cerebral artery territory. Arterial occlusion was found on vascular imaging in 21 patients (42.0%): internal carotid artery in 3, M1 in 7, M2 in 5, and other sites in 6. The hyperdense artery sign was present in 7 of the 10 patients with large vessel occlusion, and patients with arterial occlusion had higher admission NIHSS scores (median 12 vs 7; $p < 0.001$). By TOAST, 24 patients (48.0%) had small vessel occlusion, 18 (36.0%) large artery atherosclerosis, none cardioembolism, and 8 (16.0%) were not classified.

Table 3. Changes in NIHSS score after treatment

Parameter	Overall (n = 50)	Group 1 (n = 34)	Group 2 (n = 16)
Admission NIHSS, median (IQR)	8.5 (7.0–12.0)	7.0 (6.0–9.0)	12.0 (10.8–14.2)
NIHSS at 1 hour, median (IQR)	6.0 (4.0–10.0)	5.0 (4.0–6.0)	11.5 (9.8–14.2)
p (1 hour vs admission)*	< 0.001	< 0.001	0.002
NIHSS at discharge, median (IQR)	–	2.0 (2.0–3.0)	–
p (discharge vs 1 hour)*	–	< 0.001	–
Major improvement at 1 hour, n (%)	8 (16.0)	8 (23.5)	0
Deterioration at 1 hour, n (%)	0	0	0
Major improvement at discharge, n (%)	–	32 (94.1)	–

Note: *Wilcoxon signed-rank test. Patients with large vessel occlusion had no major improvement at 1 hour (0/10) and a smaller 1-hour NIHSS reduction (mean 1.4 vs 2.4 points; $p = 0.03$). In group 1, NIHSS decreased further from a median of 7 on admission to 2 at discharge.

Table 4. Outcomes at discharge and complications

Parameter	n (%)
Outcome at discharge (group 1, n = 34)	
mRS 0–1	14 (41.2)
mRS 0–2	27 (79.4)
mRS 3–5	7 (20.6)
Death	0
mRS at discharge, mean	1.8
Recanalization in patients with arterial occlusion (n = 21)	
Mori grade 2–3 (partial or complete recanalization)	7 (33.3)
Mori grade 2–3 in patients with large vessel occlusion (n = 10)	0
Complications (n = 50; in-hospital follow-up complete only in group 1)	
Hemorrhagic transformation on follow-up CT (HI1, asymptomatic), group 1 (n = 34)	1 (2.9)
Symptomatic intracranial hemorrhage / parenchymal hematoma	0 / 0
Mucocutaneous bleeding / urinary tract bleeding	3 (6.0) / 3 (6.0)
Allergic reaction, anaphylaxis	0
Pneumonia	3 (6.0)
Reocclusion (all in group 2)	2 (4.0)

Note: In group 1, nearly four in five patients were functionally independent at discharge. In group 2, the median NIHSS score at 1 hour, shortly before transfer, was 11.5 (9.8–14.2), and 15 of 16 patients had mRS 3–4 at transfer.

Compared with group 1, group 2 had a higher admission NIHSS score (median 12 vs 7; $p < 0.001$) and more frequent drowsiness (62.5% vs 17.6%; $p = 0.003$), large vessel occlusion (56.2% vs 2.9%; $p < 0.001$), and atrial fibrillation (43.8% vs 8.8%; $p = 0.007$), with no major improvement at 1 hour (0 vs 23.5%; $p = 0.04$); age (median 69.0 vs 63.5 years; $p = 0.49$) and door-to-needle time (30.5 vs 39.0 minutes; $p = 0.14$) did not differ.

Table 5. Univariable analysis of factors associated with a good outcome (mRS 0–2) at discharge in group 1 (n = 34)

Factor	Present: good outcome/total	Absent: good outcome/total	OR (95% CI)	p
Admission NIHSS $\geq$ 10 points	1/8	26/26	–	< 0.001*
Arterial occlusion on imaging	4/8	23/26	0.13 (0.02–0.82)	0.04*
Age $\geq$ 65 years	11/15	16/19	0.52 (0.10–2.77)	0.44
Female sex	10/12	17/22	1.47 (0.24–9.04)	0.68
Onset-to-needle time $\geq$ 180 minutes	8/11	19/23	0.56 (0.10–3.10)	0.51
Systolic blood pressure $\geq$ 160 mmHg	15/17	12/17	3.13 (0.51–19.04)	0.22
Blood glucose > 10 mmol/L	6/8	21/26	0.71 (0.11–4.65)	0.73
Previous ischemic stroke	6/10	21/24	0.21 (0.04–1.23)	0.09

Note: *Fisher’s exact test; OR not estimable for NIHSS $\geq$ 10 (zero cell). Admission and 1-hour NIHSS scores were correlated with discharge mRS ($\rho = 0.59$ and 0.66 , respectively; both $p < 0.001$).

IV. DISCUSSION

Our patients were similar in age and sex to those in the Bach Mai study⁵ and had baseline severity comparable to that in ECASS III.³ Atrial fibrillation was first detected after stroke onset in 4 of 10 cases, and the absence of cardioembolic cases on TOAST despite 10 patients with atrial fibrillation most likely reflects retrospective misclassification.

The in-hospital workflow was fast and improved over time: the median door-to-needle time was 36 minutes and 79.2% of patients were treated within 60 minutes, meeting the guideline benchmark;⁶ delays occurred after CT and could be reduced by parallel family counseling, early drug preparation, and early blood pressure control. In contrast, the median onset-to-door time was 98.5 minutes and only 68.0% of patients were treated within 3 hours, compared with 92.1% in the Bach Mai study.⁵ Given the time-dependent benefit of alteplase,⁴ prehospital delay is the main target

for improvement through public education and prehospital stroke alerts.

The NIHSS score decreased at 1 hour without deterioration; the modest rate of major early improvement (16.0%) is consistent with the NINDS trial, in which benefit became clear only at 3 months.² The 79.4% rate of mRS 0–2 in group 1 (mean mRS 1.8) was comparable to the Bach Mai study (mean mRS 1.96)⁵ but reflects a milder, selected group assessed at discharge rather than at 90 days. No symptomatic intracranial hemorrhage occurred (6.4% in NINDS and 2.4% in ECASS III),^{2,3} although underdetection in group 2 cannot be excluded and the sample was too small to rule out a rate of 2–4%.

None of the 10 patients with large vessel occlusion showed major early improvement or recanalization, consistent with the Bach Mai study⁵ and with the benefit of thrombectomy in this population;⁸ without post-transfer data, the drip-and-ship model could not be evaluated, but the hyperdense artery sign (7 of 10 patients) may help identify candidates for early transfer. Admission NIHSS was the factor most clearly associated with outcome, in line with previous studies;^{4,5} the association with arterial occlusion may be confounded by stroke severity, and with

only 7 unfavorable outcomes the study lacked power to detect other associations.

Limitations include the single-center retrospective design without a control group, possible misclassification of TOAST subtype and mRS, the small sample, outcome assessment only at discharge, and missing post-transfer data for the 16 most severely affected patients; outcomes in group 1 therefore do not represent all treated patients.

V CONCLUSION

Patients treated with alteplase 0.9 mg/kg at 19-8 Hospital had a mean age of 64.3 years and predominantly moderate stroke. The in-hospital workflow was fast (median door-to-needle time 36 minutes; 79.2% within 60 minutes) and improved over time, whereas prehospital delay remained long (median onset-to-door time 98.5 minutes).

NIHSS decreased within 1 hour without deterioration; among patients who completed treatment, 79.4% had mRS 0–2 at discharge, with no symptomatic intracranial hemorrhage or death. In univariable analysis, admission NIHSS $\geq$ 10 and arterial occlusion were associated with an unfavorable outcome.

RECOMMENDATIONS

Public education and prehospital stroke alerts should be strengthened, and patients with large vessel occlusion should be considered for prompt transfer for thrombectomy.⁶ Future studies should collect post-transfer and 90-day outcomes.

REFERENCES

1. GBD 2021 Stroke Risk Factor Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet Neurol.* 2024;23(10):973-1003.
2. National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke. *N Engl J Med.* 1995;333(24):1581-1587.
3. Hacke W, Kaste M, Bluhmki E, et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. *N Engl J Med.* 2008;359(13):1317-1329.
4. Emberson J, Lees KR, Lyden P, et al. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. *Lancet.* 2014;384(9958):1929-1935.
5. Pham Xuan Thang. Ket qua dieu tri nhoi mau nao cap tuan hoan truoc bang alteplase lieu 0,9 mg/kg tai Trung tam Than kinh Bach Mai [Outcomes of alteplase 0.9 mg/kg for acute anterior circulation ischemic stroke at the Neurology Center, Bach Mai Hospital]. Master's thesis. Hanoi Medical University; 2025. (in Vietnamese)
6. Powers WJ, Rabinstein AA, Ackerson T, et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update to the 2018 guidelines for the early management of acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke.* 2019;50(12):e344-e418.
7. Hacke W, Kaste M, Fieschi C, et al. Randomised double-blind placebo-controlled trial of thrombolytic therapy with intravenous alteplase in acute ischaemic stroke (ECASS II). *Lancet.* 1998;352(9136):1245-1251.
8. Goyal M, Menon BK, van Zwam WH, et al. Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials. *Lancet.* 2016;387(10029):1723-1731.