

Tenecteplase Versus Alteplase in Mild Noncardioembolic Stroke: Functional Outcomes and Early Neurological Deterioration

Zongjie Shi

Zhejiang Provincial People's Hospital

Zhimin Yu

Changshan County Hospital of traditional Chinese medicine

Fang Liu

Zhejiang Provincial People's Hospital

Ruozhen Yuan

Zhejiang Provincial People's Hospital

Yongmei Fan

Zhejiang Provincial People's Hospital

Shunyuan Guo

Zhejiang Provincial People's Hospital

Xinzhao Jiang

jiangxinzhao19@163.com

Zhejiang Provincial People's Hospital

Research Article

Keywords: Tenecteplase, Intravenous thrombolysis, Acute ischemic stroke

Posted Date: October 22nd, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10484703/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background: Patients with mild ischemic stroke represent a substantial proportion of thrombolysis candidates, yet the optimal thrombolytic strategy in this population remains uncertain. We compared the efficacy and safety of tenecteplase and alteplase in patients with mild noncardioembolic acute ischemic stroke.

Methods In this retrospective cohort study, consecutive patients with mild noncardioembolic ischemic stroke who received intravenous thrombolysis were included. Patients were treated with either tenecteplase or alteplase according to clinical practice. The primary outcome was favorable functional outcome defined as a modified Rankin Scale (mRS) score of 0–1 at 90 days. Ordinal logistic regression was used to evaluate the shift across the entire mRS distribution. Secondary outcomes included functional independence (mRS 0–2), early neurological deterioration (END), early neurological improvement (ENI), and symptomatic intracerebral hemorrhage (sICH).

Results Among 134 patients included in the analysis, 54 received tenecteplase and 80 received alteplase. Favorable functional outcome (mRS 0–1) at 90 days occurred in 83.3% of patients treated with tenecteplase and 67.5% treated with alteplase ($P = 0.040$). After adjustment for age, baseline NIHSS score, and admission glucose level, the association was not statistically significant (adjusted OR 2.27; 95% CI 0.89–5.77; $P = 0.086$). Ordinal analysis demonstrated a significant shift toward better functional outcomes with tenecteplase (common OR 0.216; 95% CI 0.099–0.455; $P < 0.001$). END occurred less frequently with tenecteplase (14.8% vs 31.2%; $P = 0.030$), and ENI was more frequent with tenecteplase (16.7% vs 0.0%; $P < 0.001$). sICH occurred in 6.2% of alteplase-treated patients and 0.0% of tenecteplase-treated patients ($P = 0.080$).

Conclusions In patients with mild noncardioembolic acute ischemic stroke, tenecteplase was associated with a more favorable distribution of functional outcomes and less early neurological deterioration compared with alteplase. The higher rate of symptomatic intracranial hemorrhage with alteplase warrants further investigation.

Introduction

Acute ischemic stroke (AIS) remains a major global health burden, causing substantial mortality and long-term disability.^{1,2} Intravenous thrombolysis (IVT) with alteplase improves outcomes in AIS,^{3–5} but patients with mild neurological deficits at admission ($\text{NIHSS} \leq 5$), who account for nearly half of all cases, are often excluded from thrombolysis trials due to perceived risks.⁶ However, mild stroke is not always benign; approximately one-quarter of patients experience unfavorable functional outcomes at 90 days.^{6–9} Early neurological deterioration (END) is a key predictor of subsequent disability in this population.⁷

Tenecteplase (TNK), a genetically modified variant of alteplase with greater fibrin specificity and a longer half-life, allows single-bolus administration.¹⁰ Cohort studies suggest that TNK achieves higher 24-hour reperfusion rates, improved functional outcomes, and a lower risk of systemic bleeding compared with alteplase.^{11–13} Nevertheless, most available evidence has focused on patients with large vessel occlusion or moderate-to-severe stroke, and data regarding patients with mild non-cardioembolic stroke remain limited.

In this study, we aimed to compare the efficacy and safety of TNK and alteplase in patients with mild non-cardioembolic ischemic stroke, with particular attention to functional outcomes and early neurological deterioration.

Methods

Study Design and Population

This study was a retrospective analysis of a prospectively maintained stroke registry at Zhejiang Provincial People's Hospital (2023–2025). Consecutive patients with acute ischemic stroke were screened for eligibility. Patients were included if they were aged > 18 years, had mild neurological deficits defined as a National Institutes of Health Stroke Scale (NIHSS) score of 0–5 at admission [8], were classified as having non-cardioembolic stroke according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria,¹⁴ and received intravenous thrombolysis with either alteplase or TNK within 4.5 hours of symptom onset. Exclusion criteria included transient ischemic attack or stroke mimics, history of or newly diagnosed atrial fibrillation, and patients who underwent mechanical thrombectomy.

Patients were categorized according to the thrombolytic agent received (alteplase or TNK). The choice of thrombolytic therapy was determined by the treating physician. Patients treated with intravenous TNK received a single weight-based bolus of 0.25 mg/kg (maximum dose 25 mg). Patients treated with alteplase received a standard dose of 0.9 mg/kg (maximum 90 mg), administered as an initial bolus of 10% of the total dose followed by infusion of the remaining dose over 60 minutes.¹⁵

Outcome Definitions

The primary efficacy outcome was excellent functional outcome at 90 days, defined as a modified Rankin Scale (mRS) score of 0–1. Secondary outcomes included favorable functional outcome at 90 days (mRS 0–2), early neurological improvement (ENI) at 24 hours (defined as a decrease of ≥ 2 points in the NIHSS score), and early neurological deterioration (END) at 24 hours (defined as an increase of ≥ 2 points in the NIHSS score not attributable to intracranial hemorrhage).⁸

Safety outcomes included symptomatic intracranial hemorrhage (sICH) and any bleeding event during hospitalization. sICH was defined as intracranial hemorrhage confirmed on head CT associated with neurological deterioration indicated by an increase of ≥ 4 points in the NIHSS score.

Data Collection

Demographic and clinical variables were extracted from the registry database, including age, sex, vascular risk factors (hypertension, diabetes mellitus, hyperlipidemia, smoking status, prior stroke, and coronary heart disease), baseline NIHSS score, blood pressure, admission blood glucose level, lipid profile, stroke etiology according to TOAST classification, and door-to-needle time.

Statistical Analysis

Baseline characteristics and clinical outcomes were compared between the TNK and alteplase groups. Continuous variables are presented as mean $\pm$ standard deviation (SD) for normally distributed data or median (interquartile range [IQR]) for non-normally distributed data, while categorical variables are expressed as counts and percentages. Between-group comparisons were performed using the Student t test or Mann–Whitney U test for continuous variables, and the Pearson χ^2 test or Fisher's exact test for categorical variables, as appropriate.

Multivariable logistic regression analysis was performed to evaluate the association between thrombolytic treatment and excellent functional outcome at 90 days (mRS 0–1), adjusting for age, baseline NIHSS score, and admission blood glucose level. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs).

To assess the overall distribution of functional outcomes, ordinal logistic regression analysis (proportional odds model) was conducted to evaluate the shift across the entire range of 90-day mRS scores. The results were expressed as common odds ratios with corresponding 95% confidence intervals. Prespecified subgroup analyses were performed to explore the consistency of treatment effects on excellent functional outcome (mRS 0–1) and early neurological deterioration. Subgroup effects were estimated using logistic regression models and presented as odds ratios with 95% confidence intervals.

All statistical analyses were performed using SPSS Statistics (version 25.0; IBM Corp., Armonk, NY, USA) and R software (version 4.5.0). A two-sided P value < 0.05 was considered statistically significant.

Ethics Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Zhejiang Provincial People's Hospital. The requirement for informed consent was waived due to the retrospective nature of the analysis.

Results

Study Population

A total of 134 patients with mild noncardioembolic ischemic stroke were included in the final analysis, including 54 patients treated with TNK and 80 treated with alteplase (Fig. 1).

Baseline Characteristics

Baseline characteristics were generally well balanced between the two groups (Table 1). The mean age was 64.4 ± 11.9 years in the TNK group and 67.8 ± 12.6 years in the alteplase group ($P = 0.40$), and male patients accounted for 61% and 71%, respectively ($P = 0.22$). Vascular risk factors, including hypertension, diabetes mellitus, hyperlipidemia, current smoking, and prior stroke, did not differ significantly. Baseline systolic and diastolic blood pressures were comparable. Admission glucose levels were significantly higher in the TNK group (10.1 ± 4.2 vs. 7.7 ± 3.3 mmol/L; $P = 0.02$). Triglyceride levels were modestly higher in the TNK group ($P = 0.04$), whereas other lipid parameters were similar. Door-to-needle time did not differ between groups. Stroke severity was mild and comparable at baseline, as reflected by similar NIHSS and mRS scores. The distribution of presumed stroke etiology was also similar between groups.

Table 1
Characteristics of study participants.

Baseline characteristics	TNK(n = 54)	Alteplase(n = 80)	P
Age (years) (mean (SD))	64.4 ± 11.9	67.8 ± 12.6	0.40
Male, n (%)	33(0.61)	57(0.71)	0.22
Current smoking , n (%)	14(0.26)	29(0.36)	0.21
Hypertension, n (%)	40(0.74)	68(0.85)	0.12
Diabetes, n (%)	22(0.41)	23(0.29)	0.15
Hyperlipidemia, n (%)	16(0.30)	21 (0.26)	0.67
Pre-stroke, n (%)	13(0.24)	22(0.28)	0.66
Systolic blood pressure at treatment, median (IQR), mmHg	161.0 ± 26.3	165.1 ± 25.8	0.86
Diastolic blood at treatment, median (IQR), mmHg	90.1 ± 20.7	90.0 ± 19.3	0.30
Blood glucose level at treatment, median (IQR), mmol/L	10.1 ± 4.2	7.7 ± 3.3	0.02
Lp(a), mg/dL	236.5 ± 316.4	269.1 ± 275.0	0.23
LDL (mmol/l)	2.3 ± 0.8	2.6 ± 0.7	0.31
Triglycerides(mmol/l)	1.6 ± 1.3	1.4 ± 0.7	0.04
Door-to-needle (DTN), median (IQR), min	49.2 ± 12.3	42.9 ± 23.4	0.23
mRS score at treatment, median (IQR)	2.1 ± 1.0	2.8 ± 0.9	0.54
NIHSS score at treatment, median (IQR)	2.8 ± 1.4	2.8 ± 1.3	0.84
Presumed stroke cause			0.84
Large artery atherosclerosis	16(0.30)	26(0.32)	
Small artery occlusion	25(0.46)	38(0.48)	
Others	13(0.24)	16(0.20)	

Primary Outcome

At 90 days, a higher proportion of patients treated with TNK achieved excellent functional outcome (mRS 0–1) compared with those treated with alteplase (83.3% vs. 67.5%; $P = 0.040$) (Table 2). In multivariable logistic regression adjusting for age, baseline NIHSS score, and admission glucose level, TNK treatment was associated with higher odds of excellent functional outcome, although the association did not reach statistical significance (adjusted OR 2.27; 95% CI 0.89–5.77; $P = 0.086$) (Table S1).

Ordinal logistic regression analysis of the entire 90-day mRS distribution demonstrated a significant shift toward better functional outcomes in the TNK group compared with alteplase (common OR 0.216; 95% CI 0.099–0.455; $P < 0.001$) (Table S1). The distribution of 90-day mRS scores is illustrated in Fig. 2. Subgroup analysis of excellent functional outcome (mRS 0–1) is presented in Fig. 3, showing generally consistent treatment effects.

Secondary Outcomes

The proportion of patients achieving mRS 0–2 at 90 days was significantly higher in the TNK group (96.3% vs. 81.2%; $P = 0.010$). END occurred less frequently in the TNK group (14.8% vs. 31.2%; $P = 0.030$). In contrast, ENI was observed more frequently in the TNK group (16.7% vs. 0.0%; $P < 0.001$). Subgroup analysis of early neurological deterioration is shown in Figure S1. The protective effect of TNK on END was more pronounced in patients with door-to-needle time ≥ 45 minutes and those with NIHSS 0–3 at admission (both P for interaction < 0.05).

Safety Outcomes

Symptomatic intracerebral hemorrhage was observed in 5 of 80 patients (6.2%) in the alteplase group and in 0 of 54 patients (0.0%) in the TNK group ($P = 0.080$). Any bleeding events were also more frequent in the alteplase group (6.2% vs. 0.0%; $P = 0.080$), although this difference did not reach statistical significance (Table 2).

Table 2
Clinic outcomes of included patients.

Outcome	TNK(n = 54)	Alteplase(n = 80)	P
Primary outcome			
mRS score 0–1 at 90d	45(0.83)	54(0.68)	0.04
Secondary outcomes			
mRS score 0–2 at 90 d	52(0.96)	65(0.81)	0.10
Early neurological deterioration (NIHSS score increase ≥ 2 within 24h after treatment) [†]	2(0.04)	11(0.13)	0.05
Early neurological improvement (NIHSS score decrease ≥ 2 within 24 h after treatment) [‡]	9(0.17)	0(0.00)	0.00
Safety outcomes			
Symptomatic intracerebral hemorrhage	0(0.00)	1(0.01)	0.41
Any bleeding events	0(0.00)	5(0.63)	0.06

[†]Early neurological improvement was defined as a decrease in NIHSS score of 2 between baseline and 24 hours; [‡]Early neurological deterioration was defined as an increase in NIHSS score of 2 between baseline and 24 hours, but not as a result of cerebral hemorrhage.

Discussion

In this retrospective cohort study focusing on patients with mild non-cardioembolic acute ischemic stroke, we compared clinical outcomes between TNK and alteplase following intravenous thrombolysis. The principal finding was that TNK was associated with a significantly more favorable distribution of functional outcomes at 90 days, as demonstrated by the adjusted ordinal shift analysis across the full modified Rankin Scale spectrum. Although the adjusted binary logistic regression for excellent functional outcome (mRS 0–1) did not reach statistical significance, a consistent trend toward improved functional recovery was observed with TNK. In addition, TNK treatment was associated with a lower incidence of early neurological deterioration (14.8% vs. 31.2%; $P = 0.030$) while demonstrating a lower rate of symptomatic intracranial hemorrhage (0.0% vs. 6.2%). These findings suggest that TNK may provide clinical benefit in patients with mild non-cardioembolic stroke without increasing hemorrhagic complications.

A notable observation in our study was the reduced rate of END in patients treated with TNK. END is an important determinant of poor outcomes in patients with mild stroke and may occur despite initially mild deficits.⁹ In non-cardioembolic stroke, mechanisms such as progressive thrombosis, branch

atheromatous disease, and distal embolization may contribute to neurological worsening.^{16–18} Therefore, therapies that promote more effective early reperfusion may help stabilize neurological function. The reduced rate of END observed in the TNK group may partly explain the more favorable distribution of functional outcomes in our study.

Our findings are broadly consistent with previous studies evaluating TNK in acute ischemic stroke.¹⁹ Randomized trials such as the EXTEND-IA TNK trial demonstrated improved reperfusion with TNK compared with alteplase in patients undergoing thrombectomy,²⁰ while the pragmatic AcT trial showed that TNK was noninferior to alteplase in terms of functional outcomes at 90 days.¹⁵ However, evidence in patients with mild non-cardioembolic stroke remains limited. The ARAMIS trial, which compared alteplase with DAPT in minor nondisabling stroke, reported a higher rate of symptomatic intracranial hemorrhage with alteplase-based thrombolysis (1.4% vs. 0.1%).⁸ In contrast, in our study, TNK was associated with no symptomatic intracranial hemorrhage in this cohort, suggesting a favorable safety profile in patients with mild non-cardioembolic stroke.

The potential advantages of TNK may be related to its pharmacological properties, including higher fibrin specificity, greater resistance to plasminogen activator inhibitor-1, and a longer half-life, allowing administration as a single intravenous bolus.²¹ These characteristics may enhance thrombus dissolution and facilitate early microvascular reperfusion, which could be particularly relevant in mild non-cardioembolic stroke where distal or small-vessel occlusions are common.

Our findings should be interpreted in the context of several recent studies comparing TNK and alteplase in mild stroke. Kang et al., in a Chinese cohort of 226 patients with NIHSS ≤ 5 , similarly reported superior functional outcomes with TNK at discharge (adjusted OR 3.59)²². However, that study assessed outcomes at discharge rather than at 90 days and did not stratify by stroke etiology. Zhao et al. found no significant difference in 90-day mRS 0–1 between TNK and alteplase (22.2% vs 19.3%; aOR 1.42)²³, but their cohort included patients with cardioembolic stroke, which may explain the substantially lower overall rate of excellent outcomes compared with our non-cardioembolic cohort. A recent US-based study reported a higher risk of intracerebral hemorrhage with TNK in mild stroke (10.3% vs 7.4%)²⁴. However, that study used a broader hemorrhagic endpoint (any intracranial hemorrhage) rather than the more restrictive sICH definition employed in our analysis, included patients with cardioembolic stroke, and has to date been published only as a conference abstract. These differences in outcome definition, study population, and publication status may partly explain the apparent discrepancy in safety signals between the two studies. To our knowledge, the present study is the first to focus specifically on patients with mild non-cardioembolic stroke and to evaluate both early neurological deterioration and early neurological improvement as key secondary endpoints in the comparison of TNK versus alteplase.

Several limitations should be acknowledged. First, this was a retrospective single-center study with a relatively modest sample size, and residual confounding cannot be fully excluded despite multivariable adjustment. Second, detailed imaging data regarding vessel occlusion and recanalization were not

systematically available. Third, treatment allocation was not randomized and was determined by physician discretion, which may introduce selection bias. Fourth, the observed sICH rate of 6.2% in the alteplase group is notably higher than typically reported in mild stroke populations and warrants cautious interpretation. Nevertheless, our findings provide real-world evidence suggesting that TNK may improve functional outcome distribution and reduce early neurological deterioration without increasing hemorrhagic complications in patients with mild noncardioembolic stroke. Larger prospective studies and randomized trials are warranted to confirm these observations.

Conclusion

In patients with mild noncardioembolic acute ischemic stroke, TNK was associated with improved functional outcome distribution and lower early neurological deterioration without increasing hemorrhagic risk compared with alteplase. The higher rate of symptomatic intracranial hemorrhage observed with alteplase in this cohort warrants further investigation.

Declarations

Acknowledgments and Sources of Funding

None

Conflicts of interest

The authors have no conflicts of interest.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Zhejiang Provincial People's Hospital. The requirement for informed consent was waived due to the retrospective nature of the analysis.

Author Contribution

Zongjie Shi: Conceptualization, Methodology, Formal analysis Zhimin Yu: Investigation, Data curation Fang Liu: Writing original draft. Ruozhen Yuan: Resources, Investigation. Yongmei Fan: Data curation, Shunyuan Guo: Conceptualization, Supervision. Xinzhao Jiang: Writing — review & editing.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. Campbell BCV, Khatri P, Stroke. *Lancet*. 2020;396:129–42. 10.1016/s0140-6736(20)31179-x.
2. Cui Y, Li XQ, Chen HS. Dual antiplatelet instead of intravenous thrombolysis for minor nondisabling acute ischemic stroke: A perspective from China. *J Transl Int Med*. 2024;12:1–4. 10.2478/jtim-2023-0138.
3. Hacke W, Kaste M, Bluhmki E, Brozman M, Dávalos A, Guidetti D, Larrue V, Lees KR, Medeghri Z, Machnig T, et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. *N Engl J Med*. 2008;359:1317–29. 10.1056/NEJMoa0804656.
4. Yan S, Zhou Y, Lansberg MG, Liebeskind DS, Yuan C, Yu H, Chen F, Chen H, Zhang B, Mao L, et al. Alteplase for Posterior Circulation Ischemic Stroke at 4.5 to 24 Hours. *N Engl J Med*. 2025;392:1288–96. 10.1056/NEJMoa2413344.
5. Luo Z, Zhou Y, He Y, Yan S, Chen Z, Zhang X, Chen Y, Tong LS, Zhong W, Hu H, et al. Treatment with intravenous alteplase in ischaemic stroke patients with onset time between 4.5 and 24 hours (HOPE): protocol for a randomised, controlled, multicentre study. *Stroke Vasc Neurol*. 2024;9:318–23. 10.1136/svn-2022-002154.
6. Khatri P, Kleindorfer DO, Devlin T, Sawyer RN Jr., Starr M, Mejilla J, Broderick J, Chatterjee A, Jauch EC, Levine SR, et al. Effect of Alteplase vs Aspirin on Functional Outcome for Patients With Acute Ischemic Stroke and Minor Nondisabling Neurologic Deficits: The PRISMS Randomized Clinical Trial. *JAMA*. 2018;320:156–66. 10.1001/jama.2018.8496.
7. Sykora M, Krebs S, Miksova D, Badic I, Gattringer T, Fandler-Höfler S, Marko M, Greisenegger S, Knoflach M, Lang W, et al. IV Thrombolysis vs Early Dual Antiplatelet Therapy in Patients With Mild Noncardioembolic Ischemic Stroke. *Neurology*. 2023;101:e933–9. 10.1212/wnl.0000000000207538.
8. Chen HS, Cui Y, Zhou ZH, Zhang H, Wang LX, Wang WZ, Shen LY, Guo LY, Wang EQ, Wang RX, et al. Dual Antiplatelet Therapy vs Alteplase for Patients With Minor Nondisabling Acute Ischemic Stroke: The ARAMIS Randomized Clinical Trial. *JAMA*. 2023;329:2135–44. 10.1001/jama.2023.7827.
9. Sung SM, Kang YJ, Cho HJ, Kim NR, Lee SM, Choi BK, Cho G. Prediction of early neurological deterioration in acute minor ischemic stroke by machine learning algorithms. *Clin Neurol Neurosurg*. 2020;195:105892. 10.1016/j.clineuro.2020.105892.
10. Jiang X, Yuan R, Ye J, Wang X, Shi Z, Guo S. Comparison of the safety and efficacy of dual antiplatelet therapy versus tenecteplase in patients with minor nondisabling acute ischemic stroke. *Sci Rep*. 2025;15:1685. 10.1038/s41598-025-85969-1.
11. Parsons M, Spratt N, Bivard A, Campbell B, Chung K, Miteff F, O'Brien B, Bladin C, McElduff P, Allen C, et al. A randomized trial of tenecteplase versus alteplase for acute ischemic stroke. *N Engl J Med*. 2012;366:1099–107. 10.1056/NEJMoa1109842.

12. Huang X, Cheripelli BK, Lloyd SM, Kalladka D, Moreton FC, Siddiqui A, Ford I, Muir KW. Alteplase versus tenecteplase for thrombolysis after ischaemic stroke (ATTEST): a phase 2, randomised, open-label, blinded endpoint study. *Lancet Neurol.* 2015;14:368–76. 10.1016/s1474-4422(15)70017-7.
13. Warach SJ, Ranta A, Kim J, Song SS, Wallace A, Beharry J, Gibson D, Cadilhac DA, Bladin CF, Kleinig TJ, et al. Symptomatic Intracranial Hemorrhage With Tenecteplase vs Alteplase in Patients With Acute Ischemic Stroke: The Comparative Effectiveness of Routine Tenecteplase vs Alteplase in Acute Ischemic Stroke (CERTAIN) Collaboration. *JAMA Neurol.* 2023;80:732–8. 10.1001/jamaneurol.2023.1449.
14. Adams HP Jr., Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, Marsh EE 3. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. *Stroke.* 1993;24:35–41. 10.1161/01.str.24.1.35.
15. Menon BK, Buck BH, Singh N, Deschaintre Y, Almekhlafi MA, Coutts SB, Thirunavukkarasu S, Khosravani H, Appireddy R, Moreau F, et al. Intravenous tenecteplase compared with alteplase for acute ischaemic stroke in Canada (AcT): a pragmatic, multicentre, open-label, registry-linked, randomised, controlled, non-inferiority trial. *Lancet.* 2022;400:161–9. 10.1016/s0140-6736(22)01054-6.
16. Yu WM, Abdul-Rahim AH, Cameron AC, Kőrv J, Sevcik P, Toni D, Lees KR. The Incidence and Associated Factors of Early Neurological Deterioration After Thrombolysis: Results From SITS Registry. *Stroke.* 2020;51:2705–14. 10.1161/strokeaha.119.028287.
17. Seners P, Ben Hassen W, Lapergue B, Arquizan C, Heldner MR, Henon H, Perrin C, Strambo D, Cottier JP, Sablot D, et al. Prediction of Early Neurological Deterioration in Individuals With Minor Stroke and Large Vessel Occlusion Intended for Intravenous Thrombolysis Alone. *JAMA Neurol.* 2021;78:321–8. 10.1001/jamaneurol.2020.4557.
18. Kim JM, Moon J, Ahn SW, Shin HW, Jung KH, Park KY. The Etiologies of Early Neurological Deterioration after Thrombolysis and Risk Factors of Ischemia Progression. *J Stroke Cerebrovasc Dis.* 2016;25:383–8. 10.1016/j.jstrokecerebrovasdis.2015.10.010.
19. Bielinski TM, Kline KE, Badger GN, Bohl VN, Hemmer S, Stedman W, Li J, Schirmer CM, Goren O, Hendrix P. Early reperfusion with tenecteplase vs alteplase before stroke thrombectomy: impact of clot burden, thrombus characteristics, and collateral status. *J Neurol.* 2026;273:58. 10.1007/s00415-025-13576-1.
20. Campbell BCV, Mitchell PJ, Churilov L, Yassi N, Kleinig TJ, Dowling RJ, Yan B, Bush SJ, Dewey HM, Thijs V, et al. Tenecteplase versus Alteplase before Thrombectomy for Ischemic Stroke. *N Engl J Med.* 2018;378:1573–82. 10.1056/NEJMoa1716405.
21. Tanswell P, Modi N, Combs D, Danays T. Pharmacokinetics and pharmacodynamics of tenecteplase in fibrinolytic therapy of acute myocardial infarction. *Clin Pharmacokinet.* 2002;41:1229–45. 10.2165/00003088-200241150-00001.

22. Qin Y, Zhu L, Han X, Kang T, Cao Y, Xu T, Shi J. Short-term outcomes of intravenous tenecteplase compared with alteplase for mild acute ischemic stroke. Clin Neurol Neurosurg. 2025;257:109038. 10.1016/j.clineuro.2025.109038.

23. Zhao W, Zhang X, Zhao Y, Zhao R, Liu Y. Comparative effectiveness and safety of tenecteplase versus alteplase for intravenous thrombolysis in acute ischemic stroke: a retrospective study. Front Neurol. 2025;16:1691168. 10.3389/fneur.2025.1691168.

24. Hong L, Bannoud M, Ibelaidene M, Woo D, Novák D. Abstract WMP10: Evaluating Tenecteplase Versus Alteplase in Acute Ischemic Stroke Management: Real-World Insights for Clinical Decision-Making. Stroke. 2025.

Figures

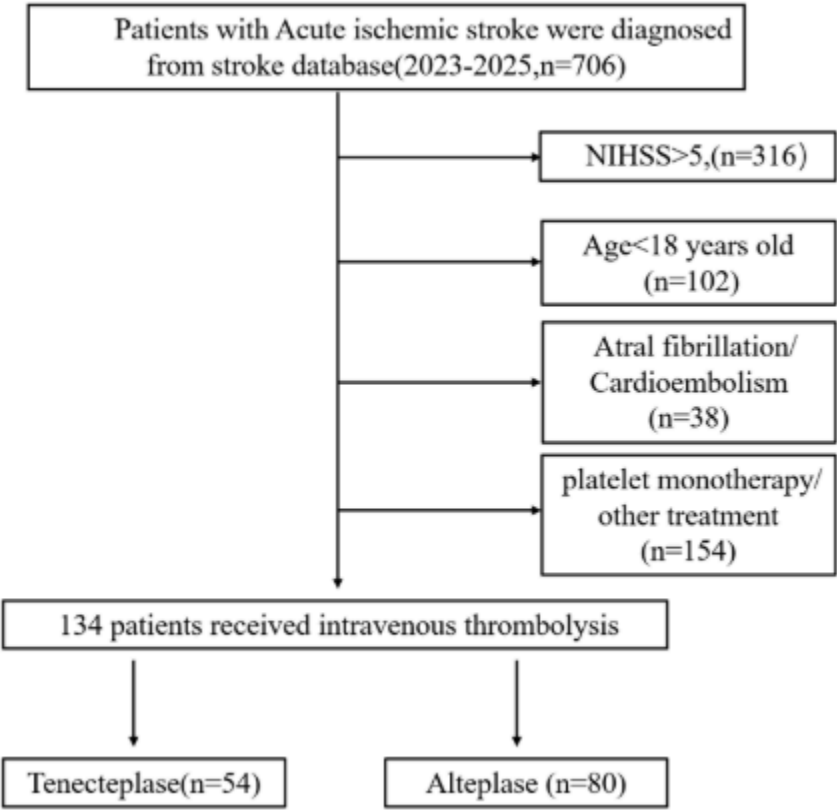


Figure 1

Flow chart of participants.

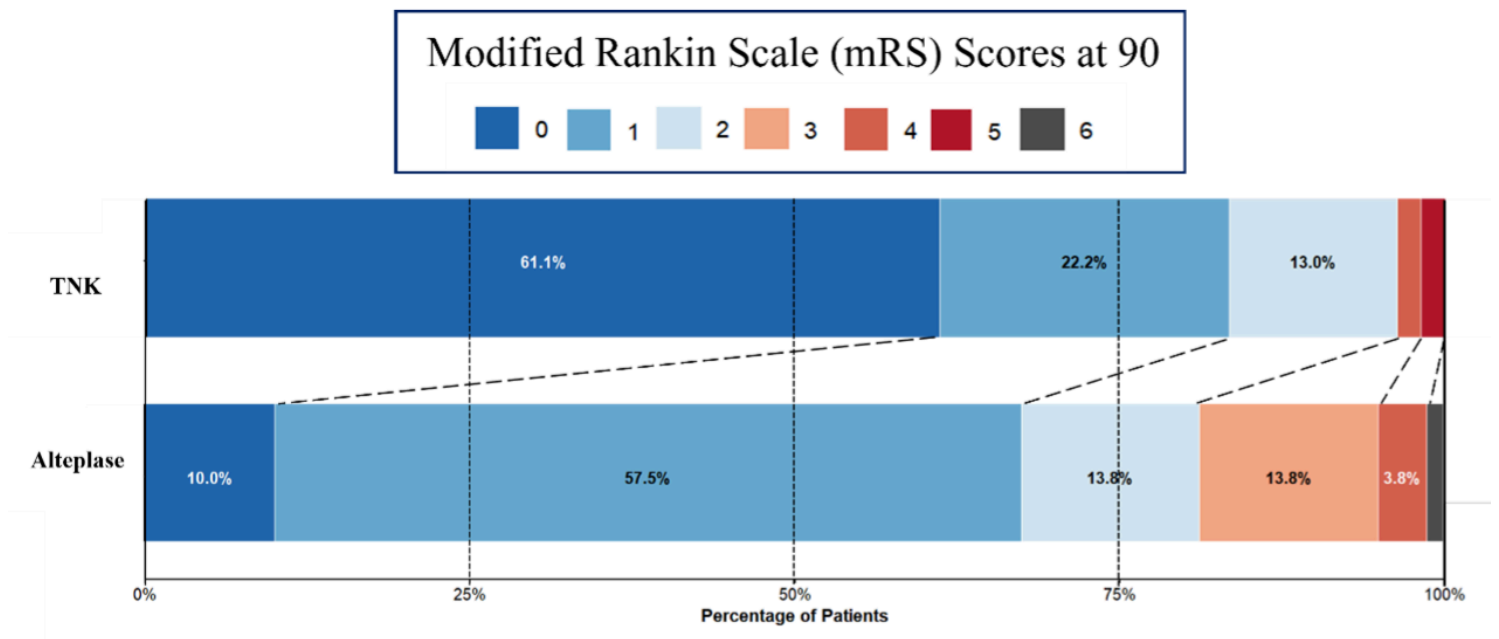


Figure 2

Distribution of Functional Outcomes

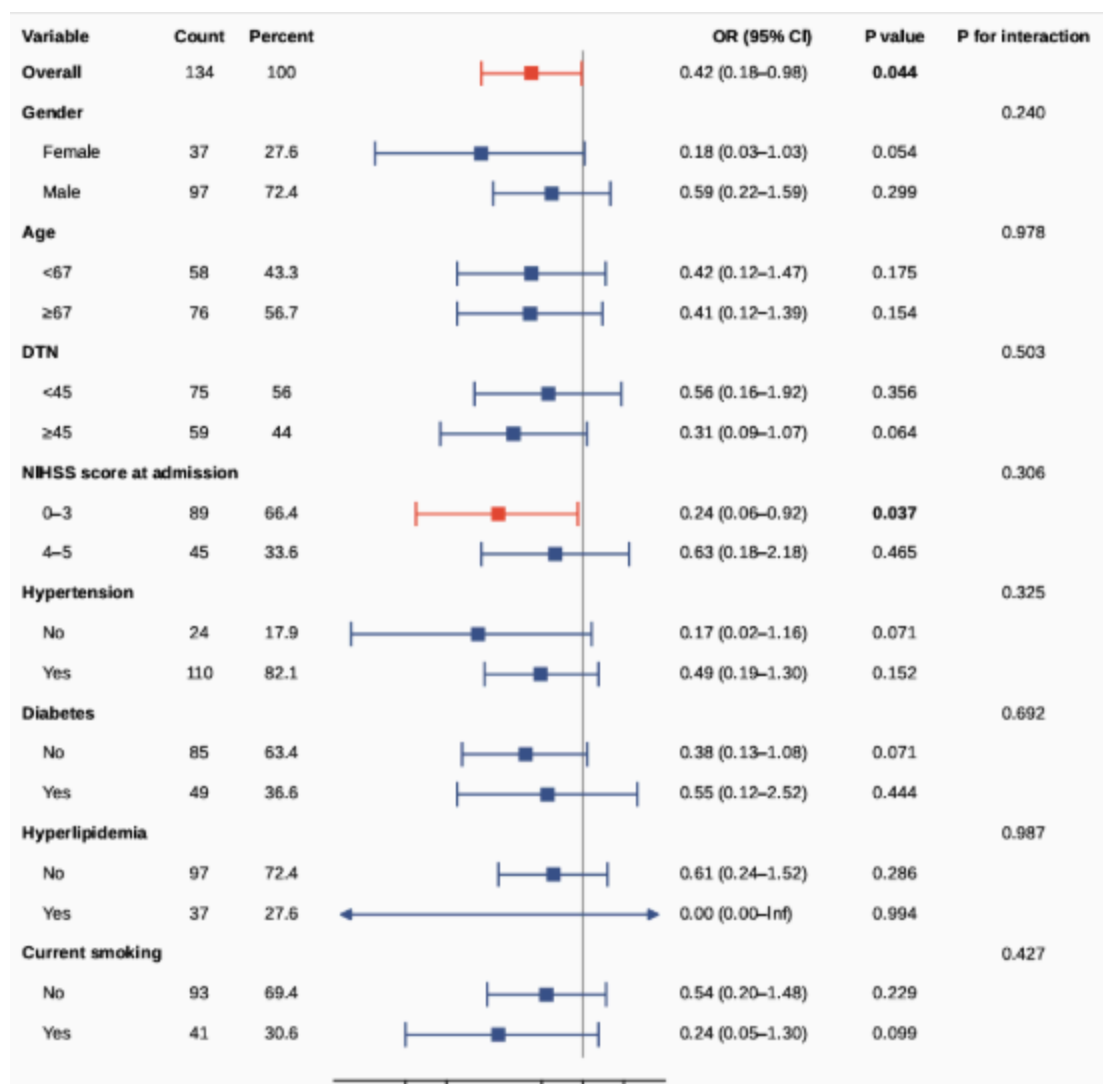


Figure 3

Subgroup analysis of favorable functional outcome at 90 days

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [supplementarymaterial.docx](#)