Archives of Academic Emergency Medicine. 2026; 14(1): e16

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ORIGINAL RESEARCH

Comparing RAMA-LVO with other Prehospital Large-Vessel Occlusion Prediction Scales in Suspected Acute Stroke; A Retrospective Cross-sectional Study

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Received: February 2026; Accepted: March 2026; Published online: 24 May 2026

Abstract: **Introduction:** Stroke is a leading global cause of disability, with large-vessel occlusion (LVO) representing a significant proportion of ischemic strokes and requiring timely endovascular thrombectomy (EVT) for optimal outcomes. This study aimed to validate and compare RAMA-LVO with other prehospital LVO prediction scales. **Methods:** This retrospective, single-center diagnostic accuracy study included adult patients who were triaged as suspected acute stroke in the emergency department (ED) of a university hospital. Four prehospital LVO prediction scales including RAMA-LVO, Rapid Arterial oCclusion Evaluation (RACE), Field Assessment Stroke Triage for Emergency Destination (FAST-ED), and Los Angeles Motor Scale (LAMS) were calculated from documented neurological assessments and compared against confirmed vascular imaging findings. Diagnostic performance was evaluated using the area under the receiver operating characteristic curve (AUROC), with comparative analysis by DeLong's test and calibration plots to assess model fit. **Results:** Of the 1,463 patients with suspected acute stroke, 853 patients met the inclusion criteria, with 124 (14.54%) confirmed to have large-vessel occlusion (LVO), most commonly involving the M1 segment of the middle cerebral artery. Patients with LVO were older ($p < 0.001$), had higher National Institutes of Health Stroke Scale (NIHSS) scores ($p < 0.001$), and were more likely to receive intravenous thrombolysis or endovascular thrombectomy ($p < 0.001$) compared with non-LVO patients. Among the four prehospital LVO scales, FAST-ED showed the highest discriminative performance (AUROC = 0.873), closely followed by RAMA-LVO (AUROC = 0.858), while RAMA-LVO demonstrated the highest sensitivity but slightly lower specificity relative to other scales. **Conclusion:** The RAMA-LVO score demonstrated strong accuracy for identifying acute LVO stroke, comparable to FAST-ED, and may serve as a practical prehospital triage tool for directing patients to thrombectomy-capable centers, especially in regions with transfer delays.

Keywords: Acute ischemic stroke; Cerebrovascular Occlusion; Prehospital stroke assessment; Vascular neurology; Clinical decision rules

Cite this article as: Charascharungkiat T, Wangviboonchai V, Yuksen C, et al. Comparing RAMA-LVO with other Prehospital Large-Vessel Occlusion Prediction Scales in Suspected Acute Stroke; A Retrospective Cross-sectional Study. Arch Acad Emerg Med. 2026; 14(1): e16. https://doi.org/10.22037/aaem.v14i1.2928.

1. Introduction

According to the Global Burden of Disease Study 2019 (1), stroke accounted for more than 143 million disability-adjusted life years (DALYs), ranking among the top three causes of disability worldwide. Among patients with ischemic stroke, approximately 24–31% present with large-artery atherosclerosis or large-vessel occlusion (LVO) (2, 3). The HERMES meta-analysis provided definitive evidence supporting endovascular thrombectomy (EVT) within 6 hours after symptom onset for acute anterior-circulation LVO, while the AURORA meta-analysis extended the therapeutic window to 24 hours in carefully selected patients (4, 5). Subsequently, a pooled meta-analysis of four randomized controlled trials demonstrated the benefit of EVT for basilar artery occlusion (6), confirming its efficacy in both anterior and posterior circulation stroke. Despite strong evidence, access to EVT remains limited, particularly in developing countries: for example, in the UK only 3% of stroke patients received EVT (7), and in Thailand, this service is largely limited to major tertiary hospitals in central urban areas. Moreover, evidence indicates that inter-hospital transfer delays independently worsen outcomes in patients undergoing EVT (8). This highlights the importance of reliable prehospital LVO screening scales, which can help predict which patients are most likely to have LVO and guide emergency medical services in selecting the appropriate destination. In recognition of this need, the 2019 AHA/ASA guideline update recommended that emergency medical systems develop severity-based stroke triage algorithms to identify patients most likely to benefit from direct transfer to a thrombectomy-capable hospital (9). Real-world policy evaluations have

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also demonstrated the impact of severity-based prehospital triage. In Chicago, the introduction of an emergency medical services (EMS) policy incorporating an LVO screening tool and allowing direct transport to comprehensive stroke centers increased EVT utilization from 4.8% to 13.6% among patients presenting within six hours, without adversely affecting thrombolysis rates or treatment times (10).

Several clinical scoring systems have been developed to predict LVO, including the Rapid Arterial oCclusion Evaluation (RACE) (11), Field Assessment Stroke Triage for Emergency Destination (FAST-ED) (12), and Los Angeles Motor Scale (LAMS) (13). When applied in prehospital settings, these tools demonstrate high overall accuracy (79-89%) and high specificity (85–93%), but relatively low sensitivity (38–60%) (14). Consistent findings have been reported across multiple external validation studies. Chiu et al. evaluated nine prehospital stroke scales and found a wide range of sensitivities, from 44.56% to 93.68%, across different thresholds (15). Similarly, Puolakka et al. compared several scales using prehospital data and observed moderate diagnostic accuracy with consistently high specificity (16). In an Asian cohort, Thu et al. reported comparable results, showing high accuracy but limited sensitivity within six hours of onset (17). Collectively, these studies suggest that while prehospital LVO scales are useful for identifying high-risk patients, they still miss a notable proportion of true cases.

The RAMA-LVO score, derived at Ramathibodi Hospital, incorporates six predictors: atrial fibrillation, neglect, facial palsy, aphasia, gaze deviation, and cerebellar signs (18). In its original study, the score showed excellent predictive performance, with likelihood ratios of 2.33 and 45.5 for the moderate- and high-score groups, respectively. However, it has not yet been externally validated. At present, no consensus exists regarding which LVO prediction tool should be considered the reference standard. This study aimed to validate and compare the RAMA-LVO score with other established LVO prediction scales for predicting LVO in suspected stroke cases in the prehospital setting.

2. Methods

2.1. Study design and setting

Between January 2023 and December 2024, we conducted a retrospective, single-center diagnostic accuracy study at the emergency department (ED) of a university hospital in Bangkok, Thailand. We included patients triaged with suspected acute stroke. Patients presenting within 24 hours of symptom onset were evaluated by an emergency physician and underwent non-contrast computed tomography (CT) scan and CT angiography. Neurologists were available in the ED and were consulted immediately for assessment and treatment decisions. Intravenous thrombolysis eligibility followed national and American Heart Association/American Stroke Association (AHA/ASA) guidelines, and patients eligible for endovascular thrombectomy were promptly referred to neuro-interventionists.

Ethical approval was obtained from the Human Research Ethics Committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (IRB COA. MURA2025/88), granted on January 23, 2025. The Institutional Review Boards at Mahidol University adhere to international standards for human research protection, including the Declaration of Helsinki, the Belmont Report, the Council for International Organizations of Medical Sciences (CIOMS) Guidelines, and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP). All personal identifiers were removed and replaced with study-specific codes to ensure confidentiality. Owing to the retrospective design, the requirement for informed consent was waived by the ethics committee.

2.2. Participants

The study included all adult patients (aged ≥18 years) triaged as acute stroke in the ED during the study period. Patients were excluded if they presented more than 24 hours after the last known well time, lacked vascular imaging data, were initially determined by the emergency physician not to have a stroke, had neurological deficits secondary to trauma, or had incomplete medical records. Although suspected acute stroke was defined as symptom onset within 7 days for triage purposes, only patients presenting within 24 hours were included in the final analysis.

2.3. Data collection

All parameters were manually retrieved from the Ramathibodi Electronic Medical Record (RAMA EMR). Demographic data included age, sex, prior documentation of atrial fibrillation, and baseline functional status assessed by the modified Rankin Scale (mRS). Stroke-related variables included the last-Known-well–to-door time, wake-up stroke status, National Institutes of Health Stroke Scale (NIHSS) score on presentation, final diagnosis at discharge, and site of large-vessel occlusion. Treatment and in-hospital time metrics comprised the door-to-needle time for intravenous thrombolysis and the door-to-groin puncture time for endovascular thrombectomy.

The component items of four prehospital large-vessel occlusion (LVO) prediction scales, including RAMA-LVO, RACE, FAST-ED, and LAMS were documented according to the initial neurological assessments performed jointly by emergency physicians in collaboration with neurologists in the ED.

As these scales were not applied prospectively in the prehospital setting, each score was retrospectively calculated from the documented neurological findings and NIHSS component items recorded at the time of ED evaluation. All vascular imaging results were reviewed and confirmed in collaboration with neurologists and neuroradiologists to ensure diagnostic accuracy. The presence or absence of LVO on vascular imaging was recorded as the diagnostic outcome.

2.4. Definitions

LVO: LVO was defined as a new occlusion involving the internal carotid artery (ICA), the M1 or M2 segment of the middle cerebral artery (MCA), the P1 segment of the posterior cerebral artery (PCA), or the basilar artery.

RAMA-LVO score: (18) The RAMA-LVO score consists of six clinical parameters: atrial fibrillation (1 point), neglect (2.5 points), facial palsy (2.5 points), aphasia (3 points), gaze deviation (2 points), and cerebellar signs (1 point). The total score is the sum of all components and is stratified into three risk levels: low risk (< 3), moderate risk (3–6), and high risk (> 6).

RACE scale: (11) The Rapid Arterial Occlusion Evaluation (RACE) scale includes facial palsy, arm motor function, leg motor function, head and gaze deviation, aphasia (if right hemiparesis), and agnosia (if left hemiparesis). Each item is scored from 0 to 2, except for head and gaze deviation. The maximum score is 9. Pérez de la Ossa et al. demonstrated that a cut-off score of ≥ 5 yields high sensitivity and specificity for detecting large-vessel occlusion.

FAST-ED score: (12) The Field Assessment Stroke Triage for Emergency Destination (FAST-ED) score includes facial palsy (0–1), arm weakness (0–2), speech changes or aphasia (0–2), eye deviation (0–2), and denial or neglect (0–2), with a maximum total of 9 points. Each parameter is adapted from the NIHSS for rapid prehospital evaluation. A threshold of ≥ 4 has been shown to provide optimal discrimination for large-vessel occlusion.

LAMS score: (13) The Los Angeles Motor Scale (LAMS) assesses facial droop (0–1), arm drift (0–2), and grip strength (0–2), yielding a maximum total score of 5. It focuses on motor function as a rapid proxy for stroke severity. A score ≥ 4 has been associated with high specificity for large-vessel occlusion.

2.5. Sample size estimation

The sample size was determined using data from the primary study that developed the RAMA-LVO score (18). Calculations were performed using the formula for sample size estimation in studies of ROC index accuracy, as described by Hajian-Tilaki in “Sample size estimation in diagnostic test studies of biomedical informatics” (19), applying the sample size formula for studies assessing the accuracy of the area under the receiver operating characteristic curve (AUROC). The assumptions were set as follows: $\alpha = 0.05$ ($Z\alpha/2 = 1.96$), marginal error (precision) = 0.05, expected AUROC = 0.925, and prevalence of large-vessel occlusion = 24.21%.

Based on these parameters, a total sample size of 322 patients (78 with large-vessel occlusion and 244 without large-vessel occlusion) was required to ensure adequate power to demonstrate the discriminatory performance of the test with a precision of ±0.05 at a 95% confidence level.

2.6. Statistical analysis

All analyses were performed using STATA version 18.0 (StataCorp LLC, College Station, TX, USA). Patients were categorized into two groups according to the presence or absence of large-vessel occlusion. Categorical variables were expressed as frequencies and percentages, while continuous variables were summarized as means with standard deviations (SD) for normally distributed data or medians with interquartile ranges (IQR) for non-normally distributed data. Data normality was assessed using histograms and distribution plots. Differences between groups were analyzed using the Fisher’s exact test for categorical variables and the independent t-test for normally distributed continuous variables. For non-normally distributed data, the Mann–Whitney U test (Wilcoxon rank-sum test) was applied. A two-tailed p-value < 0.05 was considered statistically significant.

To evaluate the ability of LVO prediction tools to distinguish between patients who had and did not have LVO, the area under the receiver operating characteristic curve (AUROC), along with its 95% confidence intervals (CI), was calculated. Comparative analysis of AUROC values was performed using DeLong’s test. Calibration plots were employed to assess how well the predicted outcomes aligned with actual results. Prognostic accuracy at predefined cut-off thresholds was determined by calculating sensitivity, specificity, predictive values, and likelihood ratios. Pairwise comparisons of sensitivity and specificity between each prehospital scale were conducted using McNemar’s test. A two-tailed p-value < 0.05 was considered statistically significant. All analyses were conducted using a complete case approach, with no imputation for missing data.

3. Results

3.1. Baseline characteristics of studied cases

Among 1,463 ED visits for suspected acute stroke, 424 patients arrived more than 24 hours after the last known well time, 36 had no vascular imaging available, 36 presented with trauma-related neurological deficits, 66 were determined by emergency physicians to have stroke mimics, and 48 had incomplete medical records. After applying these exclusion criteria, 853 visits (58.30%) were eligible for analysis. Among these, 124 patients (14.54%) were diagnosed with acute large-vessel occlusion (LVO). The study flow is illustrated in Supplementary Figure 1. The demographic characteristics, stroke-related variables, and in-hospital time metrics are summarized in Table 1. Patients with large-vessel occlusion were significantly older than those without (71.77 ± 14.46 vs. 65.32 ± 15.04 years; p < 0.001), while sex distribution did not differ between groups. Atrial fibrillation was strongly associated with large-vessel occlusion (26.61% vs. 7.82%; p < 0.001), whereas good pre-stroke functional status (mRS 0–2) was comparable between groups (84.68% vs. 90.40%; p = 0.058).

Regarding stroke presentation, the median last-known-well–to-door time was significantly shorter in patients with large-vessel occlusion compared with those without (5.00 [IQR: 2.02–12.05] vs. 6.53 [IQR: 2.90–13.17] hours; p = 0.036), and wake-up stroke accounted for 46.66% of all patients. The median NIHSS score was significantly higher in patients with large-vessel occlusion compared with those without (13.5 [IQR: 7–20] vs. 3 [IQR: 1–5]; p < 0.001). Among the 124 patients with large-vessel occlusion, the most common occlusion site was the M1 segment of the middle cerebral artery (58.06%), followed by the M2 segment (17.74%), internal carotid artery (12.90%), P1 segment (7.26%), and basilar artery (4.03%). The overall final diagnoses at discharge were 62.95% ischemic stroke (including LVO), 9.5% intracerebral hemorrhage, 7.74% transient ischemic attack (TIA), and 19.81% stroke mimics.

Regarding treatment and in-hospital time metrics, intravenous thrombolysis was administered to 25.00% of patients with large-vessel occlusion and 3.84% of those without (p < 0.001). Endovascular thrombectomy was performed in 38.71% of patients with LVO. The median door-to-needle time for intravenous thrombolysis was comparable between groups (47 [IQR: 38–64] vs. 47 [IQR: 32–63.5] minutes; p = 0.710). Among patients who underwent endovascular thrombectomy, the median door-to-groin puncture time was 159 [IQR: 147.5–190.5] minutes.

3.2. Predictive performance of studied scales

Prehospital LVO scales and the proportions exceeding diagnostic thresholds by LVO status are presented in Table 2. Among all tools, FAST-ED showed the highest discriminative ability (AUROC = 0.873; 95% CI: 0.839–0.907), followed by RAMA-LVO (AUROC = 0.858; 95% CI: 0.819–0.897), RACE (AUROC = 0.839; 95% CI: 0.800–0.878), and LAMS (AUROC = 0.827; 95% CI: 0.788–0.866). The receiver operating characteristic (ROC) curves are shown in Figure 2.

Pairwise AUROC comparisons using DeLong's test revealed that FAST-ED performed significantly better than RACE and LAMS (p = 0.012 and p < 0.001, respectively), while no difference was observed between FAST-ED and RAMA-LVO (p = 0.202).

Calibration plots (Figure 3) demonstrated good model calibration across all prehospital scales, with Observed-to-Expected (O:E) ratios approximating 1, indicating strong agreement between predicted and observed LVO outcomes.

Table 3 summarizes the predictive accuracy of each prehospital LVO scale, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and positive and negative likelihood ratios (PLR and NLR). Sensitivity varied widely but remained modest (47.6% for RACE to 71.8% for RAMA-LVO), whereas specificity was consistently high (85.7%–93.4%). Pairwise McNemar tests revealed that RAMA-LVO had significantly higher sensitivity but lower specificity compared to all other scales (p < 0.001 for all). RACE and FAST-ED demonstrated the highest specificities (93.4% and 92.9%, respectively) but lower sensitivities (47.6% and 52.4%, respectively). Positive predictive values ranged from 46.1% to 55.6%, and negative predictive values exceeded 91% for all scales. Positive likelihood ratios were strongest for FAST-ED (7.35; 95% CI: 5.38–10.0) and RACE (7.23; 95% CI: 5.2–10.1), indicating superior ability to rule in LVO in high-probability cases.

4. Discussion

This study aimed to validate the RAMA-LVO score and compare its diagnostic performance with other established prehospital large-vessel occlusion (LVO) prediction tools. In our analysis, the RAMA-LVO score demonstrated strong discriminatory performance, with balanced sensitivity and high specificity. Although the FAST-ED scale yielded the highest overall AUROC among the four prehospital tools, pairwise comparison showed no significant difference between FAST-ED and RAMA-LVO. Taken together, these findings indicate that both scores perform comparably well in distinguishing patients with and without large-vessel occlusion.

The demographic characteristics of our study population were similar to those reported in prehospital studies, reflecting the case-mix that paramedics typically encounter in the field. The proportion of LVO among all suspected stroke cases in our cohort was 14.54%, with acute ischemic stroke being the most common diagnosis, followed by stroke mimics, closely matching the findings of Nguyen et al., Dekker et al, and the PRESTO study by Venema **E**. et al. (14, 20, 21). This concordance is expected, as prior studies and our study included all patients with a clinical suspicion of acute stroke, irrespective of the final etiologic diagnosis (ischemic, hemorrhagic, or stroke mimic).

Patients with LVO were significantly older than those without, consistent with findings in the Thai population from Yuksen et al. (18). Atrial fibrillation was also strongly associated with LVO, as similarly reported by Yuksen et al. and Nguyen et al. (14, 18). This information is particularly valuable in prehospital assessment because it can usually be obtained easily from patients or their relatives. Among LVO cases, the M1 segment of the middle cerebral artery was the most common occlusion site, followed by the M2 segment, internal carotid artery, and posterior circulation (posterior cerebral or basilar artery), paralleling observations by Nguyen et al. (14).

The sensitivity, specificity, positive predictive value, and negative predictive value observed in our study are consistent with previous reports showing that prehospital LVO scales generally have high specificity but variable and relatively low sensitivity (14, 17, 20-23). This pattern suggests that while these tools can effectively identify patients likely to have an LVO, some true cases may still be missed in prehospital screening. In this regard, the RAMA-LVO score, which demonstrated the highest sensitivity among all scales, may reduce the likelihood of missed LVO cases. However, this advantage comes at the cost of a higher false-positive rate, potentially increasing the number of patients referred to com-

prehensive stroke centers and thereby adding to the workload at higher-level stroke facilities.
In real-world practice, several system-level factors should be considered when selecting the most suitable prehospital LVO scale for a given region. For instance, if inter-hospital transfer delays between primary and comprehensive stroke centers are substantial, a scale with higher sensitivity may be more appropriate, as it allows direct transport to thrombectomy-capable centers and reduces time to endovascular treatment. Conversely, in regions where comprehensive stroke centers are already operating near capacity, using a scale with lower specificity could result in unnecessary referrals, overwhelming tertiary facilities. Therefore, the choice of prehospital LVO scale should be tailored to each healthcare system's logistics, hospital density, and available resources to achieve an optimal balance between early detection and system efficiency.

5. Limitations

Our study has several limitations. First, its retrospective design introduces the possibility of information bias, as neurological findings were reconstructed from ED documentation rather than being assessed prospectively. This design also creates verification bias, because only patients who underwent vascular imaging were included, which may slightly elevate the observed LVO prevalence and overrepresent more severe stroke presentations. A prospective study directly assessing each component of the prehospital scales in real time would provide a more accurate reflection of how these scores perform in the field, where time constraints often limit detailed neurological assessment before imaging is obtained.
Second, as a single-center study, the findings may not be generalizable to other healthcare settings or populations. External validation in independent hospitals or prehospital systems is needed to determine whether the RAMA-LVO score and other comparator scales perform consistently across different regions, patient populations, and operational environments.
Third, this study was conducted in the emergency department setting, whereas prehospital LVO scales are primarily designed for use in the prehospital phase to guide triage decisions. Hence, future prospective multicenter studies conducted in prehospital environments are needed to ensure validity and real-world applicability.
Fourth, all vascular imaging was interpreted by board-certified neuroradiologists who were not blinded to clinical information. This may introduce diagnostic review bias and potentially influence the classification of LVO. Future blinded imaging review, ideally with adjudication panels, would strengthen diagnostic certainty.
Finally, no inter-rater reliability assessment was performed among prehospital personnel with different training levels. Because consistent application of neurological assessments is essential for field use, future studies should include formal inter-rater reliability evaluation among paramedics and other prehospital providers to determine the reproducibility of each scale in real-world prehospital conditions.
Despite these limitations, the demographic and clinical characteristics of our cohort were comparable to those reported in studies conducted by paramedics, supporting the relevance of our findings to prehospital practice.

6. Conclusions

The RAMA-LVO score demonstrated good discriminatory power for identifying patients with acute LVO stroke. A cut-point of ≥ 3 provided a balanced trade-off between sensitivity and specificity, supporting its use for early identification and direct transfer to comprehensive stroke centers—particularly in settings with prolonged inter-hospital transfer delays such as Bangkok. Among the four prehospital scales evaluated, FAST-ED and RAMA-LVO showed the highest overall discriminative performance, making them practical tools for guiding emergency medical services in triage and transport decisions. Future implementation studies should evaluate how these tools perform when integrated into prehospital workflows and assess their impact on treatment timelines and outcomes. The choice of scoring system and cut-off threshold should ultimately reflect local healthcare infrastructure, inter-facility transport efficiency, and resource capacity.

7. Declarations

7.1. Acknowledgments

None.

7.2. Authors' contributions

TC, VW, CY, CJ, and CP wrote the main manuscript, and we followed TRIPOD Checklist for prediction model validation research. TC, VW, CJ, and WT initiated the research question and completed the IRB submission. TC, CJ and VW performed data collection and data analysis, made tables and figures, and wrote the introduction, results, discussion, and limitations sections. CP and CJ performed data analysis, edited tables and figures, reviewed data, and addressed the corresponding author. CY and CJ are associated professors and research advisors at Mahidol University, who provided revisions and guidance to the manuscript. All authors read and approved the final version of the manuscript.

7.3. Ethical considerations

This study was approved by The Committee on Human Rights Related to Research, Faculty of Medicine, Ramathibodi Hospital, Mahidol University (IRB COA. MURA2025/88).

7.4. Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

7.5. Funding Source

No funding was obtained for this study.

7.6. Competing interests

The authors declare that they have no competing interests.

7.7. Using artificial intelligence chatbots

During the preparation of this manuscript, the author(s) used ChatGPT-5.2 and Grammarly's AI to assist with grammar checking and language refinement. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the final manuscript.

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Table 1: Baseline demographic, clinical, and treatment characteristics of patients with or without large-vessel occlusion (LVO)

Characteristics	**Total (N = 853)**	**LVO present (N = 124)**	**LVO absent (N = 729)**	**P-value**
Demographic				
Age	66.26 ± 15.12	71.77 ± 14.46	65.32 ± 15.04	<0.001
Sex (male)	395 (46.31)	49 (39.52)	346 (47.46)	0.119
Atrial fibrillation	90 (10.55)	33 (26.61)	57 (7.82)	<0.001
Modified Rankin Scale ≤ 2	764 (89.57)	105 (84.68)	659 (90.40)	0.058
Stroke characteristics				
Last known well (hours)	6.32 (2.70-13.10)	5.00 (2.02-12.05)	6.53 (2.90-13.17)	0.036
Wake-up stroke	398 (46.66)	63 (50.81)	335 (45.95)	0.331
NIHSS	3 (1, 6)	13.5 (7, 20)	3 (1, 5)	<0.001
Reperfusion therapy				
Intravenous Thrombolysis	59 (6.92)	31 (25.00)	28 (3.84)	<0.001
Endovascular Thrombectomy	48 (5.63)	48 (38.71)	0	NA
Both treatments	17 (1.99)	17 (13.71)	0	NA
In-hospital performance				
Door-to-Needle time	47 (34-64)	47 (38-64)	47 (32-63.5)	0.710
Door-to-Groin puncture time	159 (147.5-190.5)	159 (147.5-190.5)	0	NA

Data are presented as mean ± standard deviation, frequency (%), or median (interquartile range). NIHSS: National Institutes of Health Stroke Scale.

Table 2: Prehospital large-vessel occlusion (LVO) scale scores categorized by occlusion status and proportion of patients meeting pre-specified cut-off points

Prehospital scales	**Total (N = 853)**	**LVO present (N = 124)**	**LVO absent (N = 729)**	**P-value**
RAMA-LVO				
Median (IQR)	0 (0-2.5)	4.5 (2.5-7)	0 (0-1)	<0.001
RAMA-LVO ≥ 3	193 (22.63)	89 (71.77)	104 (14.27)	<0.001
RACE				
Median (IQR)	1 (0-2)	4 (2-6)	0 (0-1)	<0.001
RACE ≥ 5	107 (12.54)	59 (47.58)	48 (6.58)	<0.001
FAST-ED				
Median (IQR)	1 (0-2)	4 (2-6)	1 (0-1)	<0.001
FAST-ED ≥ 4	117 (13.72)	65 (52.42)	52 (7.13)	<0.001
LAMS				
Median (IQR)	1 (0-2)	4 (2-4)	1 (0-2)	<0.001
LAMS ≥ 4	125 (14.65)	63 (50.81)	62 (8.50)	<0.001

IQR: interquartile range; RACE: Rapid Arterial oCclusion Evaluation; FAST-ED: Field Assessment Stroke Triage for Emergency Destination; LAMS: Los Angeles Motor Scale.

Table 3: The screening performance characteristics of each prehospital large-vessel occlusion (LVO) scale at predefined cut-off points

Characteristics	**RAMA-LVO ≥ 3**	**RACE ≥ 5**	**FAST-ED ≥ 4**	**LAMS ≥ 4**
Sensitivity	71.8 (63.0-79.5)	47.6 (38.5-56.7)	52.4 (43.3-61.5)	50.8 (41.7-59.9)
Specificity	85.7 (83.0-88.2)	93.4 (91.4-95.1)	92.9 (90.8-94.6)	91.5 (89.2-93.4)
PPV	46.1 (38.9-53.4)	55.1 (45.2-64.8)	55.6 (46.1-64.7)	50.4 (41.3-59.5)
NPV	94.7 (92.7-96.3)	91.3 (89.0-93.2)	92.0 (89.8-93.8)	91.6 (89.4-93.5)
PLR	5.03 (4.08-6.2)	7.23 (5.20-10.10)	7.35 (5.38-10.0)	5.97 (4.45-8.02)
NLR	0.33 (0.25-0.44)	0.56 (0.47-0.66)	0.51 (0.43-0.62)	0.54 (0.45-0.64)

PPV: Positive Predictive Value; NPV: Negative Predictive Value; PLR: Positive Likelihood Ratio, NLR: Negative Likelihood Ratio; RACE: Rapid Arterial oCclusion Evaluation; FAST-ED: Field Assessment Stroke Triage for Emergency Destination; LAMS: Los Angeles Motor Scale.

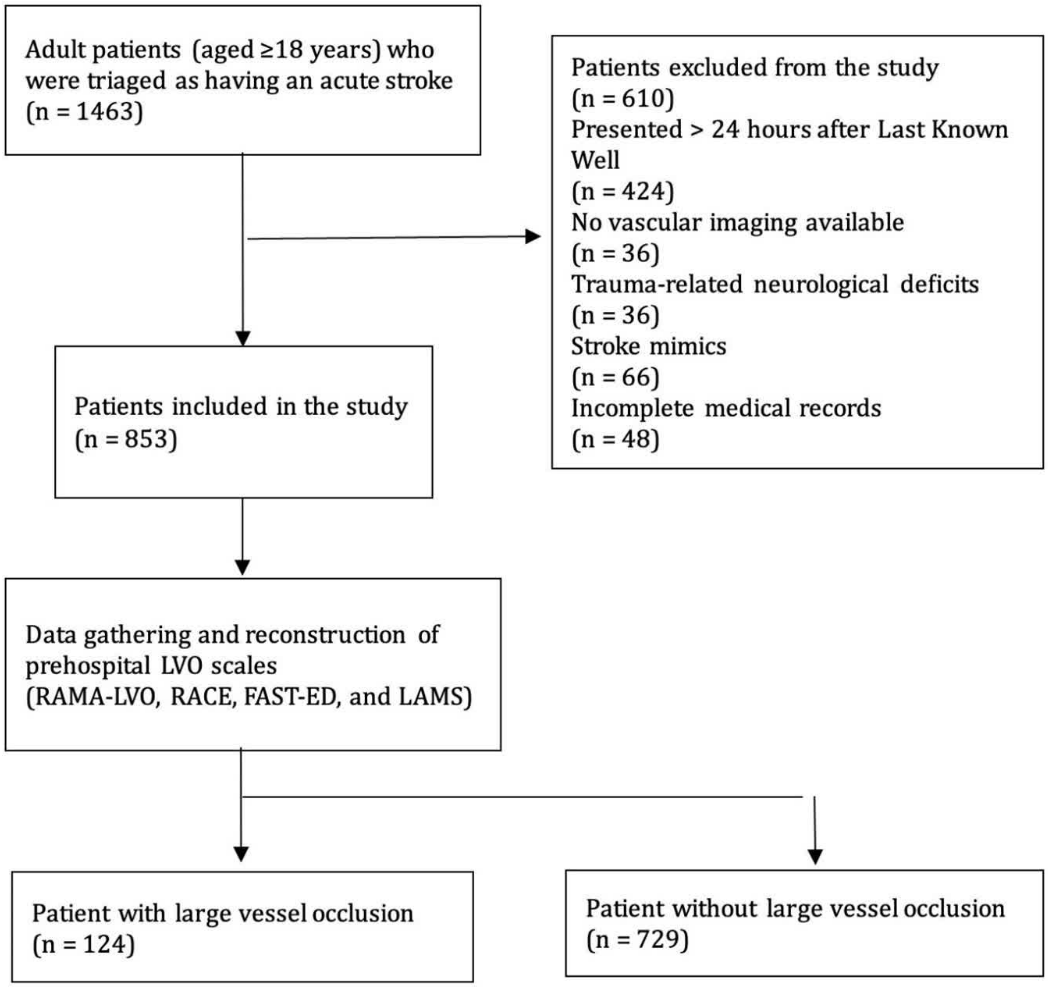

Figure 1: Flow diagram of included and excluded patients in the study. LVO: large-vessel occlusion.

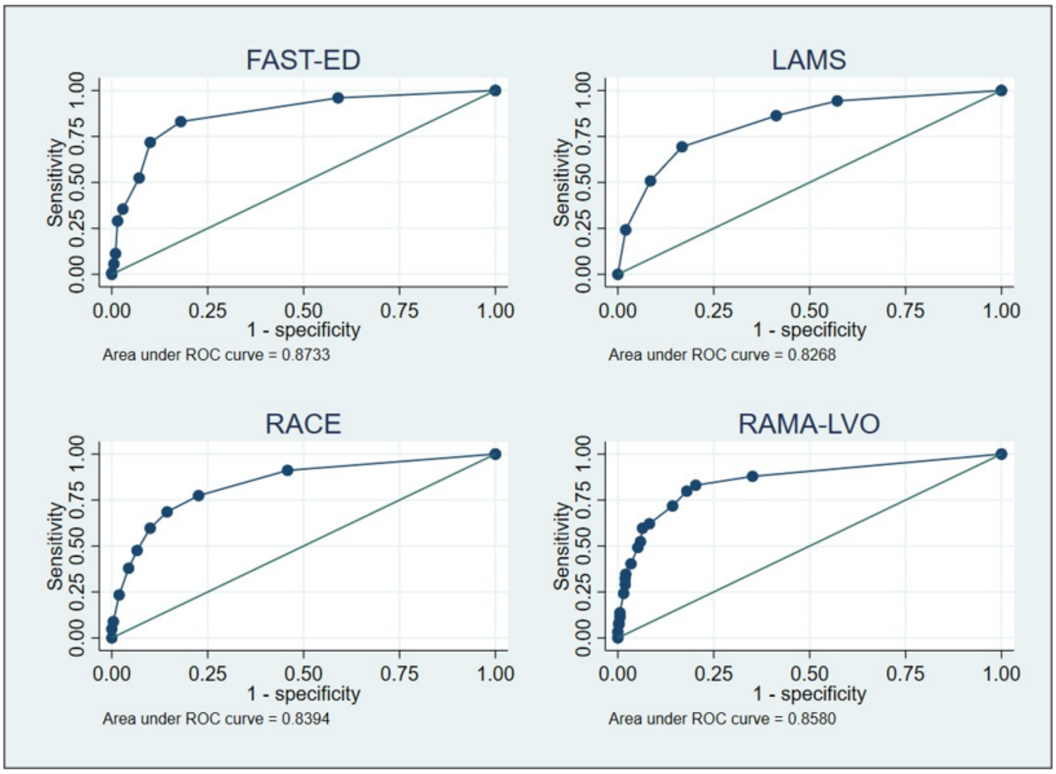

Figure 2: Area under the receiver operating characteristic (ROC) curve of each prehospital large-vessel occlusion (LVO) scale. RACE: Rapid Arterial oCclusion Evaluation; FAST-ED: Field Assessment Stroke Triage for Emergency Destination; LAMS: Los Angeles Motor Scale.

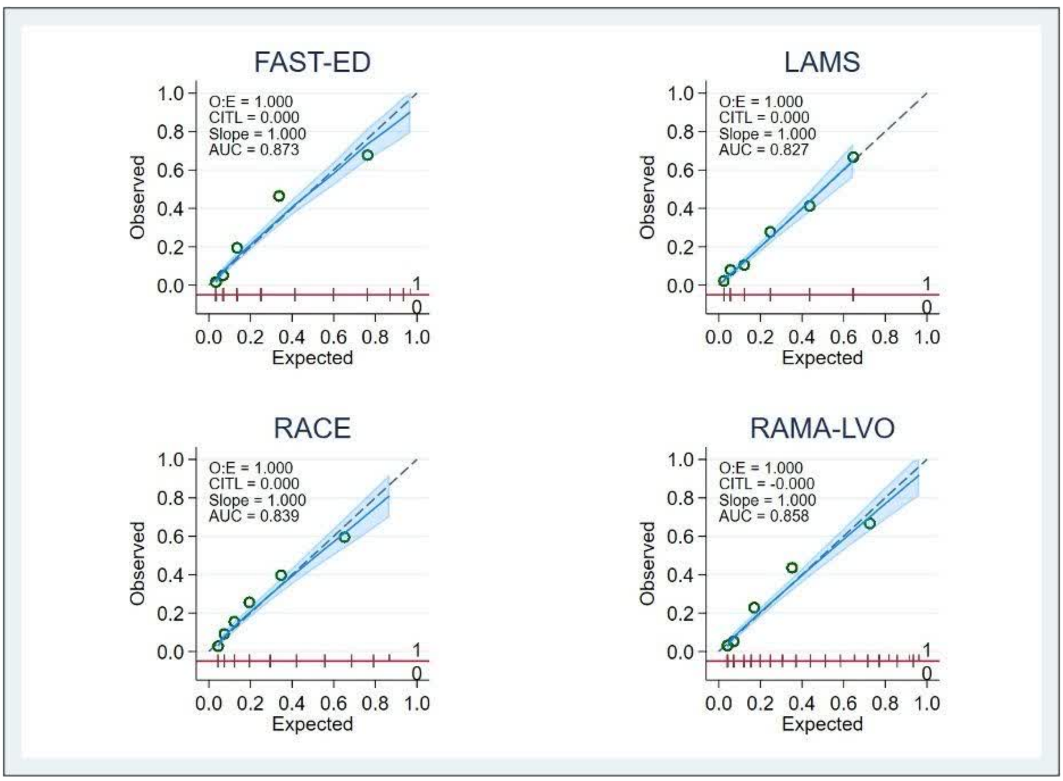

Figure 3: Calibration plots of prehospital large-vessel occlusion (LVO) prediction scales. RACE: Rapid Arterial oCclusion Evaluation; FAST-ED: Field Assessment Stroke Triage for Emergency Destination; LAMS: Los Angeles Motor Scale; O:E: Observed-to-Expected; AUC: area under the curve; CITL: calibration-in-the-large.