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Successful thrombectomy improves functional outcome in tandem occlusions with a large ischemic core

Cover Title: Large core with tandem occlusion

Benjamin Gory, MD, PhD; Stephanos Finitzis, MD, PhD; Jean-Philippe Desilles, MD, PhD; Arturo Consoli, MD; Mikael Mazighi, MD, PhD; Gaultier Marnat, MD; Igor Sibon, MD, PhD; Raoul Pop, MD, PhD; Nicolas Raposo MD PhD; Valérie Wolff, MD, PhD; Christophe Cognard, MD, PhD; Sébastien Richard, MD, PhD; Solène Moulin, MD, PhD; Sébastien Soize, MD, PhD; Bertrand Lapergue, MD, PhD; Jean-Marc Olivot, MD, PhD; on behalf of the ETIS Registry Investigators*

*A list of the ETIS Investigators is given in the Appendix.

Department of Diagnostic and Therapeutic Neuroradiology (B.G.), Université de Lorraine, IADI, INSERM U1254, CHRU-Nancy, F-54000 Nancy, France; Department of Neuroradiology, Aristotle University of Thessaloniki, Ahepa Hospital, Thessaoniki, Greece; Department of Interventional Neuroradiology (J.P.D., M.M.), Rothschild Foundation, Paris, France; Department of Diagnostic and Interventional Neuroradiology (A.C.), Foch Hospital, Versailles Saint-Quentin en Yvelines University, Suresnes, France; Department of Diagnostic and Interventional Neuroradiology (G.M.), University Hospital of Bordeaux, Bordeaux, France; Department of Neurology (I.S.), Stroke Center, University Hospital of Bordeaux, Bordeaux, France; Department of Interventional Neuroradiology (R.P.), University Hospital of Strasbourg, Strasbourg, France; Department of Neurology (N.R., J.M.O.), Acute Stroke Unit, CIC 1436-UMR 1214, CHU Toulouse, Toulouse, France; Stroke Unit (V.W.), University Hospital of Strasbourg, Strasbourg, France; Department of Neuroradiology (C.C.), CHU Toulouse, Toulouse, France; Department of Neurology (S.R.), Stroke Unit, Université de Lorraine, INSERM U1116, CHRU-Nancy, F-54000 Nancy, France; Department of Neurology (S.M.), Hôpital Maison Blanche, University Hospital, of Reims Université Reims Champagne-Ardenne; Department of Neuroradiology (S.S.), Hôpital Maison Blanche, University Hospital of Reims, Université Reims Champagne-Ardenne; Department of Neurology (B.L.), Foch Hospital, Versailles Saint-Quentin en Yvelines University, Suresnes, France

Successful thrombectomy improves functional outcome in tandem occlusions with a large ischemic core

ABSTRACT

Background Emergent stenting in tandem occlusions and mechanical thrombectomy (MT) of acute ischemic stroke related to large vessel occlusion (LVO-AIS) with a large core are being tested independently. We aim to assess the impact of reperfusion with MT in LVO-AIS patients with a large core and a tandem occlusion and to compare the safety of reperfusion between large core with tandem and non-tandem occlusions in current practice.

Methods We analyzed data of all consecutive patients included in the prospective Endovascular Treatment in Ischemic Stroke Registry in France between January 2015 and March 2023 who presented with a pretreatment ASPECTS 0-5 and angiographically proven tandem occlusion. Primary end point was a favorable outcome defined by a modified Rankin Scale (mRS) 0-3 at 90 days.

Results Among 262 included patients with a tandem occlusion and ASPECTS 0-5, 203 (77.5%) patients had a successful reperfusion (modified Thrombolysis In Cerebral Infarction mTICI 2b-3). Reperfused patients had a favorable shift in the overall mRS score distribution (aOR 1.57 [1.22-2.03]; $P < 0.001$), higher rates of mRS 0-3 (aOR 7.03 [2.60-19.01]; $P < 0.001$) and mRS 0-2 at 90 days (aOR 3.85 [1.39-10.68]; $P = 0.009$) compared to non-reperfused. There was a trend between the occurrence of successful reperfusion and a decreased rate of symptomatic intracranial hemorrhage (aOR 0.5 [0.22-1.13]; $P = 0.096$). Similar safety outcomes were observed after large core reperfusion in tandem and non-tandem occlusions.

Conclusions Successful reperfusion was associated with higher rate of favorable outcome in large core LVO-AIS with a tandem occlusion with a safety profile similar to non-tandem occlusion.

Introduction

Mechanical thrombectomy (MT) revolutionized the treatment of patients with acute ischemic stroke due to large-vessel occlusion (LVO-AIS) of the anterior circulation.¹ Tandem occlusion and large core have been common exclusion criteria from the randomized controlled trials (RCTs) demonstrating the benefit of MT compared to medical therapy alone. In line with previous retrospective studies,^{2,3} and with the results of The Recovery by Endovascular Salvage for Cerebral Ultra-Acute Embolism–Japan Large Ischemic Core Trial (RESCUE-Japan LIMIT) trial suggest that MT may improve the rate of functional recovery in LVO-AIS patients with a large core, defined as pretreatment Alberta Stroke Program Early Computed Tomographic Score (ASPECTS) value of 3 to 5.⁴ Tandem occlusion is also frequently an exclusion criteria in other ongoing RCTs assessing the safety and benefit of MT in patients with a large ischemic core on pretreatment imaging. The endovascular treatment and adjuvant pharmacological therapy for stroke due to a tandem occlusion is not well defined to date with more difficult treatment and intracranial occlusion access and higher rate of procedural complications, such as embolus in new territory and perforations.⁵ Thus, it is not an uncommon situation to manage LVO-AIS patients with tandem occlusion and a large ischemic core in clinical practice. With this as a background, we aimed to investigate whether the occurrence of successful reperfusion with MT improved the prognosis of large core LVO-AIS complicating a tandem occlusion and whether the safety of reperfusion differed between patients with tandem occlusions compared to non-tandem occlusions.

Methods

All data and materials have been made publicly available in a repository and can be accessed on reasonable request.

The ETIS Registry

We analysed data of all consecutive anterior circulation stroke patients with a known stroke onset, baseline ASPECTS 0-5 and a tandem occlusion of the anterior circulation treated by MT with or without prior intravenous thrombolysis from January 1st, 2015 to March 31st, 2023, included in the Endovascular Treatment in Ischemic Stroke (ETIS) Registry (NCT03776877). ETIS is an ongoing national multicentric prospective observational registry including all adult patients with acute ischemic stroke due to large vessel occlusion detected by neuroimaging (MRI or CT). Tandem occlusion was defined as a proximal intracranial occlusion (distal intracranial ICA or M1-M2 segment of the middle cerebral artery) and a cervical ICA lesion (complete occlusion or high-grade stenosis) on the first angiographic run, and large core as a pretreatment ASPECTS score 0-5. Endovascular management of tandem occlusion was left at the discretion of the operator, including no treatment, balloon angioplasty, stenting with or without antiplatelet therapy. Imaging follow-up was performed at 24 hours and a dual antiplatelet therapy was given in the absence of intracranial bleeding according to the practice of the center in the setting of carotid stenting. Intracranial occlusions group included patients with occlusion of the intracranial internal carotid artery and/or M1 segment of the middle cerebral artery.

Data Collection

Patient demographics, main vascular risk factors, imaging findings, vital signs before thrombectomy, clinical severity of stroke (assessed at admission and 24 hours after thrombectomy), time from symptom onset to imaging, 90-day clinical outcome, and intracranial haemorrhage development were recorded as baseline variables. Time

from symptom onset to groin puncture and successful reperfusion, procedural complications, endovascular technique, and details of anesthesia were recorded. The management of the cervical lesion was performed at the discretion of the interventionist. Every patient admitted for a clinical suspicion of stroke was evaluated with MRI if not contraindicated. One neuroradiologist for each center (>10 years of experience), blinded to the results of thrombectomy and clinical follow-up, evaluated the MRI scans. Each center performed the same imaging protocol including the same sequences (DWI, FLAIR, T2 Gradient Echo and 3D TOF MRA). ASPECTS score on the pre-treatment imaging was evaluated prospectively, blinded to the results of the thrombectomy and clinical outcome. Each ASPECTS region was scored 0 if abnormal and 1 if normal. Affected regions were further dichotomized according to hemisphere location. To be considered as abnormal, the DWI hyperintense signal had to be confluent and occupying >30% of the region. Arterial occlusion site and status were monitored with conventional angiography during the endovascular procedure. Reperfusion were reported using the modified Thrombolysis in Cerebral Infarction (mTICI) grade and was assessed by one neuroradiologist for each center (>10 years of experience). Successful reperfusion was defined as a mTICI 2b-3 grade at the end of MT. All patients underwent CT or MRI 24 hours after MT to assess haemorrhagic complications. Trained research nurses unaware of the study group assignments assessed the modified Rankin Scale (mRS) at 90 days, during face-to-face interviews or via telephone conversations with the patient, their relatives, or their general practitioner.

Outcome Definitions

Intracranial hemorrhage (ICH) was classified according to the European Cooperative Acute Stroke Study II criteria (hemorrhagic infarction 1 and 2; parenchymal

hematoma [PH] 1 and 2). Symptomatic ICH (sICH) was defined as an increase of 4 or more points of NIHSS within 24 hours attributable to ICH. Early neurological improvement as NIHSS score 0 to 1 at 24 hours, or a decrease of 4 or more points in NIHSS score at 24 hours. The primary study outcome was the percentage of patients who achieved a favourable outcome, defined as a mRS score of 0-2 at 90 days. Secondary outcomes included the overall distribution of 90-day mRS (shift analysis), early neurological improvement, any ICH, sICH, and mortality at 90 days.

Statistical Analysis

Quantitative variables are expressed as the mean (SD) for normally distributed parameters or median [interquartile range (IQR)] otherwise. Categorical variables are expressed as numbers (percentage). The patients were divided into two groups according to successful reperfusion or not (mTICI 2b-3 versus mTICI 0-2a). Baseline characteristics were compared between these two groups using the Student's t-test for Gaussian continuous variables, Mann-Whitney U-test for non-Gaussian continuous variables, or χ^2 test (or Fisher's exact test when the expected cell frequency was < 5) for categorical variables, as appropriate. The effect of recanalization on outcomes was further assessed with mixed logistic regression models with center as random affect adjusted for age and NIHSS. Effects are presented as odds ratios (OR) with 95% confidence intervals (CI). The common odds ratio for 1-point improvement in mRS was calculated with a mixed ordinal logistic model adjusted for age, NIHSS and time from symptom onset to puncture. Statistical analyses were conducted at a 2-tailed α level of 0.05. The data were analyzed using STATA ver. 17.

Results

Three hundred twelve patients had a pretreatment ASPECTS 0-5 stroke due to a tandem occlusion treated with MT during the study period. Of these, 50 patients were excluded from the present analysis for the following reasons: age <18 years (n=1) recanalization status unknown (n=6), 90-day mRS unknown (n=28), and MT not performed (n=15; **Figure 1**). Of the 262 included patients with ASPECTS 0-5 and tandem occlusion, 203 (77.5%) achieved a successful reperfusion after a median time from symptom onset of 329 minutes (interquartile range IQR, 138). As shown in **Table 1**, there was no significant difference in baseline characteristics between patients with and without successful reperfusion. Overall, 239 (91.6%) patients had a pretreatment MRI, and median ASPECTS was 4 (IQR, 2). 231 (88.2%) patients had a median ASPECTS 3-5. 123 (47.1%) patients were treated with intravenous thrombolysis. 49 patients were treated with balloon-angioplasty and 63 with stenting for the cervical carotid steno-occlusive disease. On univariate analysis, the successful reperfusion group had higher odds of mRS 0-3 at 90 days (OR 3.48, 95%CI 1.72-7.06; $P<0.001$) that persisted after adjustment for center, age, NIHSS, time from symptom onset to puncture (aOR 7.03, 95%CI 2.60-19.01; $P<0.001$) (**Table 2**). Successful reperfusion group had higher odds of 90-day mRS 0-2 after adjustment (aOR 3.85, 95%CI 1.39-10.68; $P=0.009$). Patients with a successful reperfusion presented also a decreased rate of sICH (26.8% versus 17.4%). However, these differences were not statistically significant after adjustment ($P=0.096$) (**Table 2**). As shown in **Figure 2**, patients with successful reperfusion had a lower mRS score at 90 days after MT than the patients without successful reperfusion (common odds ratio for 1-point improvement in mRS, 1.57; 95%CI 1.22-2.03; $P<0.001$).

Overall study population division into 2 groups according to the ASPECTS (0-2 and 3-5) showed that successful reperfusion remained associated with an increased rate of mRS 0-3 and mRS 0-2 at 90 days in the ASPECTS 3-5 subgroup (**Table 3**). A similar finding was found in shift analysis with a shift analysis of 1.57 (95%CI 1.18-2.08; $P=0.002$) in the ASPECTS 3-5 subgroup (**Figure I** in the online-only Data Supplement). Of note, the impact of successful reperfusion on 90-day mRS 0-2 did not reach the significance level in patients with ASPECTS 3-5 (**Table 3**). Mortality, any ICH, parenchymal hematoma and sICH remained also decreased in reperfused compared with non-reperfused patients in the 2 ASPECTS subgroups. In patients with a ASPECTS of 0 to 2, the favorable outcome was low in those both with and without successful reperfusion (25% versus 0%) with a high mortality rate (33.3% versus 71.4%).

Patients with ASPECTS 0-5 due to a tandem occlusion or a non-tandem occlusion (intracranial internal carotid artery or M1 segment of the middle cerebral artery) had a similar probability to achieve a 90-day mRS 0-2 (aOR 0.77 [0.48-1.22]; $P=0.26$) but a higher probability to achieve a 90-day mRS 0-3 (aOR 1.51 [1.01-2.26]; $P=0.042$) (**Table 4**). The rate of symptomatic intracranial hemorrhage (aOR 1.15 , $P=0.615$) and 90-day mortality ($P=0.925$) did not differed between the two groups.

Discussion

In this study, we assessed the impact of endovascular reperfusion on the safety and functional outcome of large core (ASPECTS 0-5) LVO-AIS patients complicating a tandem occlusion in current clinical practice. Our results demonstrate that the achievement of successful endovascular reperfusion was highly feasible and associated with a 25% increased rate of favorable outcome without safety concern

since endovascular reperfusion tends also to be associated with lower rates of sICH. Those rates were similar to the rates observed among large core LVO-AIS complicating an isolated proximal intracranial occlusion. Successful reperfusion was not associated with ICH whatever the ASPECTS subgroup.

Beyond the question about the benefit and safety of MT for large core, the optimal management of the cervical steno-occlusive lesion is not known to date. Several studies evaluating the impact of emergent carotid artery stenting in the acute phase of stroke reported a favorable signal compared to no stenting,^{6,7} even after intravenous thrombolysis.⁸ However, most of the patients had a favorable imaging profile with a small ischemic core and/or large mismatch, as the two ongoing RCTs. In TITAN (NCT03978988) trial, patients with ASPECTS 5-10 within 8 hours or with the DAWN/DEFUSE3 trials criteria could be included.⁹ In EASI-TOC (NCT04261478), no precise volume cut off is mandatory, except that acute imaging judged by the treating physician must demonstrate salvageable brain tissue. In our study, 25 (%) patients were treated with carotid stenting with or without balloon dilatation, and 61 (%) received aspirin during MT. Emergent stenting often requires additional antithrombotic treatment to prevent stent thrombosis. Stent thrombosis remains frequent (20%) but various additional antithrombotic treatment may also increase the rate of hemorrhagic transformation.¹⁰

Several ongoing RCTs are evaluating the benefit and safety of MT versus the medical therapy alone for large core LVO-AIS, such as Large Stroke Therapy Evaluation (LASTE, NCT03811769), efficacy and safety of Thrombectomy in Stroke with extended leSION and extended time window: a randomized, controlled trial (TENSION, NCT03094715), and A Randomized Controlled Trial to Optimize Patient's Selection for Endovascular Treatment in Acute Ischemic Stroke (SELECT2,

NCT03876457). All RCTs except the LASTE trial are enrolling patients with moderate core volume (ASPECTS 3-5) on either non-contrast CT or diffusion-weighted imaging. Contrariwise to several ongoing RCTs the recently published RESCUE-Japan LIMIT trial did enroll patients with tandem occlusion.² In this RCT, MT was associated with a 20% increased rate of mRS 0-3 at 3 months by comparison with the best medical treatment (31% vs 12.7%; P=0.002). However, the result of a recent RESCUE-JAPAN substudy suggested that the benefit of MT was mostly observed in patients with a moderate extent of the ischemic region (ASPECTS 4-5) lesion outlined for most of the patients by DWI.¹¹ In the RESCUE-Japan LIMIT, 20% of the subjects had a tandem occlusion and the overall patient management differ from our registry. Hence, by comparison with our study group, only 27% of patients in each group received alteplase (at a 0.6 mg/kg dose) versus 60% in our study. The rate of functional recovery (90-day mRS 0-2) was 14% in the endovascular group versus 29.2% in our cohort. Therefore, our results suggest that patients with a tandem occlusion may be included in RCT investigating the benefit of MT for the treatment of large core LVO-AIS.

This study has several limitations, especially due to its retrospective and non-randomized design. In fact, only patients treated with MT were included in the ETIS registry, there should be bias by the surgeons whether to perform mechanical thrombectomy or not. Moreover, even though DWI-ASPECTS is simple and frequently used in clinical setting, we lack volumetric assessment of ischemic lesions as well as perfusion imaging. In fact, each DWI-ASPECTS point corresponds to a wide range of volumes.¹² Retrospective study reported that even in patients with large core a strong benefit of MT could be observed in cases of core perfusion mismatch.¹³ In addition, diffusion-weighted imaging-ASPECTS typically

underestimate ASPECTS score by comparison with non-contrast CT that is used in several countries as well as selection criteria of several ongoing RCTs testing MT for the treatment of large core-LVO-AIS. In addition, the type of adjuvant mechanical and chemical treatment of cervical lesion may also influence the prognosis and was not standardized across the participating centers.

PERSPECTIVE

As previously mentioned by our group, the absence of salvageable ischemic tissue on pretreatment imaging as well as the occurrence of an hemorrhagic transformation are critical factors associated with poor outcome in LVO-AIS patients undergoing a successful MT.^{14,15} By comparison with the best medical treatment, MT was associated with an increased rate of hemorrhagic transformation. This rate increases with infarct volume and may be also influenced by the antithrombotic treatment used during the procedure to maintain stent patency. Recently, Seners et al. demonstrated in a comparative cohort of patients with a large core LVO-AIS receiving either MT or best medical management, that the increased hemorrhagic transformation risk associated with MT was independent of the presence of salvageable ischemic tissue on pretreatment imaging while MT was associated with a higher rate of functional recovery only in patients with substantial penumbra on pretreatment imaging.¹⁶ Interestingly, even in patients scanned within 3 hours after onset, substantial penumbra was detected only among 50% of the patients enrolled.¹⁷ Therefore, in a population of large core LVO-AIS patients, penumbral imaging might play a critical role identifying those who are more likely to benefit from the endovascular reperfusion of tandem occlusion. In addition, new targets in antiplatelet management might in the future improve the benefit/risk ratio of the adjuvant molecules, especially

in this high-risk population of patients requiring additional antiplatelet treatment after emergent carotid stenting.

Conclusions

In our study, endovascular successful reperfusion of large core LVO-AIS with a tandem occlusion is associated with improved functional outcome and without increasing the hemorrhagic transformation risk compared to the reperfusion of isolated intracranial occlusion. Therefore, patients with tandem occlusion may not be excluded from randomized trials testing the safety and benefit of MT for large core LVO-AIS.

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Disclosures None

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Figures.

Figure 1. Patient flow chart.

Figure 2. Distribution of modified Rankin Scale (mRS) score according to successful reperfusion status in overall study sample. Common odds ratio (OR) for 1-point improvement in mRS calculated using ordinal logistic regression model is reported. CI indicates confidence interval.

Tables.

Table 1. Baseline Characteristics According to the Successful Reperfusion Status.

Table 2. Outcomes According to the Successful Reperfusion Status in Overall Study Sample.

Table 3. Impact of the Successful Reperfusion Status according to the ASPECTS Subgroup.

Table 4. Outcomes for Successfully Reperused Patients in Tandem and Non-Tandem Occlusions.

Table 1. Baseline Characteristics According to the Successful Reperfusion Status.

	Successful Reperfusion Status		Total	P Value
	mTICI 2b-3	mTICI 0-2a		
Number of patients	96 (77.4)	28 (22.6)	124 (100.0)	
Age, mean \pm SD, y	62 (15)	62 (13)	62 (15)	0.826
Women	22 (22.9)	7 (25.0)	29 (23.4)	0.819
Medical history				
Hypertention	47 (50.0)	13 (48.1)	60 (49.6)	0.865
Hypercholesterolemia	26 (28.0)	6 (22.2)	32 (26.7)	0.553
Smoking	23 (24.7)	6 (25.0)	29 (24.8)	0.978
Diabetes mellitus	12 (13.0)	5 (19.2)	17 (14.4)	0.428
Prestroke Rankin 0-2	91 (97.8)	27 (96.4)	118 (97.5)	0.672
Prior antiplatelet therapy	21 (22.3)	4 (15.4)	25 (20.8)	0.440
Systolic BP, mean \pm SD, mmHg	149 (25)	144 (25)	147 (25)	0.374
Diastolic BP, mean \pm SD, mmHg	84 (16)	88 (17)	85 (16)	0.345
Blood Glucose, median (IQR), mmol/L	6 (2)	7 (2)	6 (2)	0.278
NIHSS score, median (IQR)	18 (5)	20 (8)	18 (7)	0.365
Imaging				
MRI	90 (93.8)	26 (92.9)	116 (93.5)	
CT	6 (6.2)	2 (7.1)	8 (6.5)	0.866
ASPECTS, median (IQR)	4 (2)	5 (2)	4 (2)	0.654
ASPECTS 0-2	12 (12.5)	4 (14.3)	16 (12.9)	
ASPECTS 3-5	84 (87.5)	24 (85.7)	108 (87.1)	0.804
Intracranial occlusion site				
MCA-M1	39 (62.9)	12 (75.0)	51 (65.4)	
MCA-M2	7 (11.3)	0 (0.0)	7 (9.0)	
ICA	14 (22.6)	1 (6.2)	15 (19.2)	
Others	2 (3.2)	3 (18.8)	5 (6.4)	0.035
Procedural Characteristics				
Prior use of IV thrombolysis	59 (62.1)	18 (64.3)	77 (62.6)	0.834
Use of general anesthesia	23 (24.2)	8 (28.6)	31 (25.2)	0.640
Adjuvant aspirin administration	43 (44.8)	18 (64.3)	61 (49.2)	0.069
Adjuvant mechanical treatment				
Angioplasty	20 (47.6)	4 (57.1)	24 (49.0)	
Stenting	22 (52.4)	3 (42.9)	25 (51.0)	0.641
Onset to imaging, median (IQR), min	108 (72)	119 (76)	110 (68)	0.366
Onset to puncture, median (IQR), min	260 (116)	250 (158)	254 (116)	0.949
Number of passes \leq 2	29 (46.0)	6 (31.6)	35 (42.7)	0.264
Complications*	14 (16.1)	8 (30.8)	22 (19.5)	0.097

Values expressed as numbers (percentage) unless otherwise indicated.

ASPECTS indicates Alberta Stroke Program Early CT score; BP, blood pressure; ICA, internal carotid artery; IQR, interquartile range; IV, intravenous; MCA, middle cerebral artery; NIHSS, National Institutes of Health Stroke Scale; SD, standard deviation; and mTICI, modified Thrombolysis in Cerebral Infarction perfusion scale grade.

*Embolus to a new territory, arterial perforation carotid dissection.

Table 2. Outcomes According to the Successful Reperfusion Status in Overall Study Sample.

	Successful Reperfusion Status		Univariate			Multivariate*		
	mTICI 2b-3 (n=96)	mTICI 0-2a (n=28)	Odds Ratio	95%CI	P value	Odds Ratio	95%CI	P value
Early Neurological Improvement	33 (34.4)	5 (17.9)	2.35	0.80-6.89	0.12	2.39	0.68-8.41	0.176
mRS 0-3 at 90 days	49 (56.3)	3 (11.5)	9.88	2.76-35.36	< 0.001	25.80	3.24-205.75	0.002
mRS 0-2 at 90 days	30 (34.5)	3 (11.5)	4.03	1.12-14.54	0.032	3.84	0.88-16.77	0.073
mRS 0-1 at 90 days	16 (18.4)	2 (7.7)	2.70	0.58-12.63	0.205	3.20	0.36-28.59	0.297
Any ICH	42 (51.9)	15 (60.0)	0.72	0.29-1.78	0.474	0.51	0.18-1.51	0.226
Mortality at 90 days	23 (26.4)	12 (46.2)	0.42	0.17-1.04	0.06	0.78	0.29-2.10	0.627
Parenchymal hematoma	13 (16.7)	7 (29.2)	0.52	0.17-1.57	0.245	0.62	0.18-2.08	0.437
Symptomatic ICH	12 (15.0)	8 (32.0)	0.38	0.13-1.06	0.064	0.55	0.17-1.78	0.319

Values expressed as numbers (percentage).

Early Neurological Improvement was defined as NIHSS score 0 to 1 at 24 hours or a decrease of 4 or more points in NIHSS score at 24 hours, sICH as an increase of 4 or more points of NIHSS within 24 hours attributable to intracranial hemorrhage.

CI indicates confidence interval; NIHSS, National Institutes of Health Stroke Scale; mRS, modified Rankin Scale score; ICH, intracranial hemorrhage; mTICI, modified Thrombolysis In Cerebral Infarction.

*Adjusted with a mixed model with center as random effect for age, NIHSS, time from symptom onset to puncture.

Table 3. Impact of the Successful Reperfusion on Outcomes according to the ASPECTS Subgroup.

ASPECTS 0-2	Successful Reperfusion Status		Odds Ratio	Univariate 95%CI	P value
	mTICI 2b-3	mTICI 0-2a			
	(n=12)	(n=4)			
Early Neurological Improvement	3 (25.0)	0 (0.0)	1.00	-	-
mRS 0-3 at 90 days	3 (33.3)	0 (0.0)	1.00	-	-
mRS 0-2 at 90 days	2 (22.2)	0 (0.0)	1.00	-	-
mRS 0-1 at 90 days	1 (11.1)	0 (0.0)	1.00	-	-
Any ICH	6 (85.7)	3 (100.0)	1.00	-	
Mortality at 90 days	4 (44.4)	2 (66.7)	0.38	0.00-64.39	0.714
Parenchymal hematoma	2 (28.6)	1 (33.3)	0.80	0.04-14.64	0.88
Symptomatic ICH	2 (28.6)	2 (66.7)	0.20	0.01-3.66	0.277

ASPECTS 3-5	Successful Reperfusion Status					Multivariate*		
	mTICI 2b-3	mTICI 0-2a	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
	(n=84)	(n=24)						
Early Neurological Improvement	30 (35.7)	5 (20.8)	2.04	0.67-6.21	0.208	2.16	0.57-8.23	0.257
mRS 0-3 at 90 days	46 (59.0)	3 (13.0)	9.58	2.63-34.98	<0.001	8.89	2.30-34.34	0.001
mRS 0-2 at 90 days	28 (35.9)	3 (13.0)	3.73	1.02-13.68	0.046	3.98	0.89-17.77	0.069
mRS 0-1 at 90 days	15 (19.2)	2 (8.7)	2.50	0.53-11.85	0.248	2.37	0.41-13.67	0.334
Mortality at 90 days	19 (24.4)	10 (43.5)	0.42	0.16-1.11	0.079	0.40	0.12-1.30	0.129
Any ICH	36 (48.6)	12 (54.5)	0.79	0.30-2.05	0.627	0.76	0.28-2.11	0.601
Parenchymal hematoma	11 (15.5)	6 (28.6)	0.49	0.15-1.60	0.234	0.48	0.13-1.72	0.259
Symptomatic ICH	10 (13.7)	6 (27.3)	0.42	0.13-1.34	0.143	0.51	0.15-1.79	0.296

*Adjusted with a mixed model with center as random effect for age/NIHSS/time from symptom onset to puncture

Table 4. Outcomes for Successfully Reperfused Patients in Tandem and Non-Tandem Occlusions.

	Successful Reperfusion Status		Univariate			Multivariate*		
	Tandem occlusion (n=65)	Non-tandem occlusion (N=550)	Odds Ratio	95% CI	P value	Odds Ratio	95% CI	P value
Early Neurological Improvement	22 (33.8)	252 (45.8)	0.61	0.36-1.06	0.08	0.51	0.28-0.91	0.023
mRS 0-3 at 90 days	35 (56.5)	218 (43.7)	1.79	1.03-3.11	0.038	1.69	0.95-2.99	0.074
mRS 0-2 at 90 days	22 (35.5)	152 (30.5)	1.26	0.72-2.19	0.42	0.95	0.52-1.74	0.863
mRS 0-1 at 90 days	13 (21.0)	86 (17.2)	1.28	0.66-2.48	0.463	1.00	0.50-2.04	0.99
Mortality at 90 days	15 (24.2)	160 (32.1)	0.59	0.31-1.12	0.108	0.90	0.45-1.80	0.768
Any ICH	31 (54.4)	273 (57.5)	0.77	0.43-1.37	0.369	0.77	0.42-1.41	0.403
Parenchymal hematoma	13 (24.1)	96 (20.9)	1.12	0.57-2.20	0.744	1.11	0.54-2.26	0.782
Symptomatic ICH	8 (14.3)	56 (11.9)	1.20	0.54-2.71	0.653	1.41	0.61-3.24	0.423

*Adjusted with a mixed model with center as random effect for age/NIHSS/time from symptom onset to puncture

Figure 1.

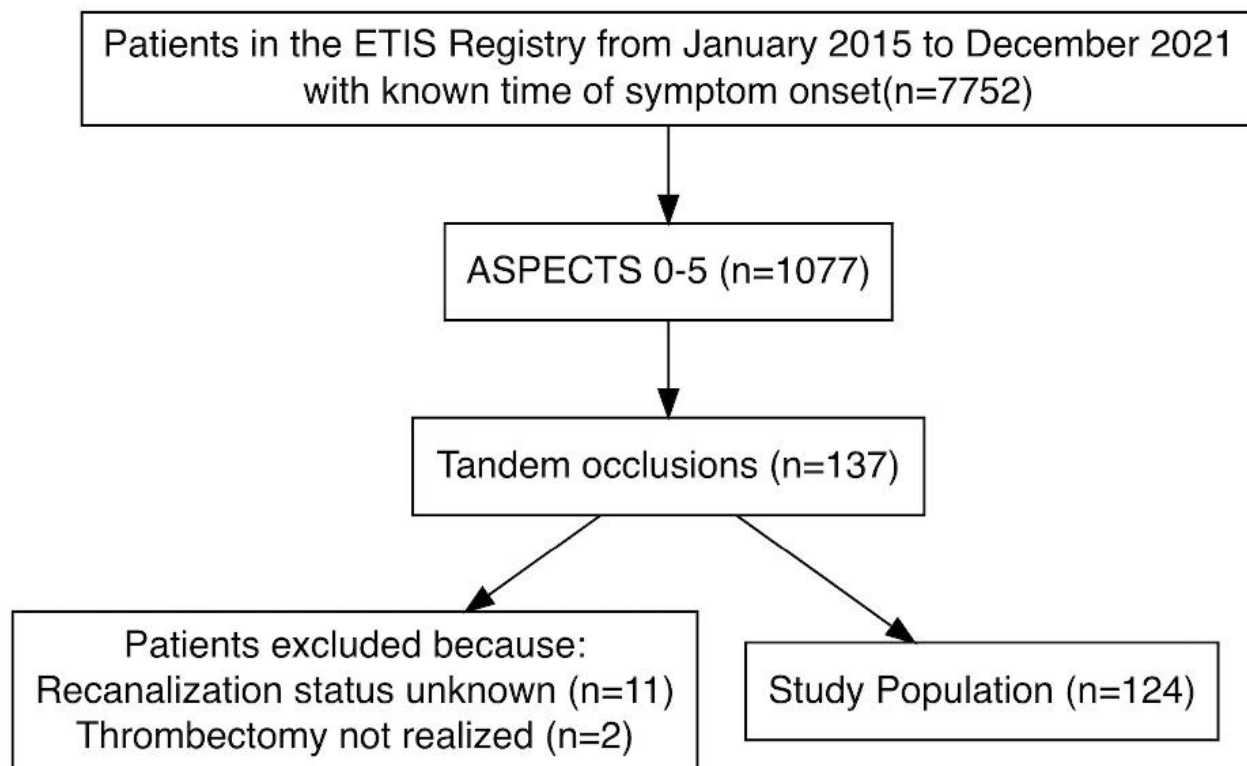


Figure 2.

