Impact of recanalisation by mechanical thrombectomy in mild acute ischemic stroke with large anterior vessel occlusion

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Research Article

Impact of recanalization by mechanical thrombectomy in mild acute ischemic stroke with large anterior vessel occlusion.

Short Title: Mechanical thrombectomy for mild strokes of anterior circulation

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Abstract

Background: The net clinical benefit of mechanical thrombectomy (MT) in patients presenting acute anterior circulation ischemic stroke with large-vessel occlusion (AIS-LVO) and mild neurological deficit is uncertain.

Aims: To investigate efficacy and safety of MT in patients with acute AIS-LVO and mild neurological deficit by evaluating *i*) the influence of recanalization on three-month outcome and *ii*) mortality, symptomatic intracerebral hemorrhage (sICH) and procedural complications.

Methods: We included consecutive patients with acute AIS-LVO and National Institutes of Stroke Scale (NIHSS) score<8, treated by MT at Lille University Hospital. Recanalization was graded according to modified Thrombolysis in Cerebral Infarction (mTICI) score, mTICI 2b/2c/3 being considered successful. We recorded procedural complications and classified intra-cerebral hemorrhages (ICH) and sICH according with European Cooperative Acute Stroke Study (ECASS) and ECASS2 criteria. Three-month outcome was evaluated by modified Rankin scale (mRS). Excellent and favorable outcomes were respectively defined as mRS 0-1 and 0-2 (or similar to pre-stroke).

Results: We included 95 patients. At three months, 56 patients (59. 0%) achieved an excellent outcome and 69 (72, 6%) a favorable outcome, both being more frequent in patients with successful recanalization than in patients without (excellent outcome 71, 1% versus 10, 5%, $p<0.001$ and favorable outcome 82.9% versus 31.6%, $p<0.001$). The difference remained unchanged after adjustment for age and pre-MT infarct volume. Similar results were observed in patients with pre-MT NIHSS≤5. Death occurred in five patients (5.3%), procedural complications in 12 (12.6%), any ICH in 38 (40.0%), including 3 (3.2%) sICH.

Conclusions: Achieving successful recanalization appears beneficial and safe in acute AIS-LVO patients with NIHSS<8 before MT.

1. Introduction

Mechanical thrombectomy (MT) is the standard of care for patients presenting anterior circulation acute ischemic stroke with large-vessel occlusion (AIS-LVO). Nevertheless, efficacy and safety of MT in patients with AIS-LVO and minor-to-mild neurological deficit remain uncertain. Indeed, patients with low National Institutes of Stroke Scale (NIHSS) score were excluded from landmark randomized clinical trials in which the results were geared toward clinically severe stroke. Consistently, the metanalysis performed by Goyal et al. did not show a statistically significant benefit in patients with NIHSS ≤10, limiting firm conclusions about the net clinical benefit of MT in these patients [1]. Moreover, patients with a NIHSS score < 8 were not included in the SWIFT-PRIME trial and were lightly represented in the other randomized trials, limiting firm conclusions in this specific subgroup of patients. In patients with minor (NIHSS ≤ 5) to mild (NIHSS < 8) neurological deficit, intravenous thrombolysis (IVT) is safe and improves outcome, suggesting a positive effect of recanalization [2]. However, the rate of successful recanalization after IVT in large vessel occlusion is low [3] and observational studies suggested that MT, in addition to best medical treatment (BMT), could be safe and effective in patients with AIS-LVO and mild neurological deficit [4–7].

The aim of our study was to evaluate efficacy and safety of MT in AIS-LVO patients with mild neurological deficit before MT by evaluating *i*) the influence of successful recanalization after MT on vital and functional outcome at month-3 and *ii*) the rate of sICH and procedural complications.

2. Methods

2.1. *Setting*

We included patients from the Lille reperfusion registry, which is an ongoing observational registry of consecutive patients from the 16 hospitals included in the North-of-France stroke network treated by MT. The organization of stroke care in the 16 hospitals of the network has been previously described [8].

2.2. *Inclusion and exclusion criteria*

We included all consecutive patients (no upper age limit) between January 1st 2015 and July 31st 2018, with acute AIS-LVO, presenting with NIHSS<8 immediately before MT and persistent LVO on pre-treatment digital subtraction angiography (DSA). We decided to exclude patients recanalized (spontaneously or after intravenous thrombolysis (IVT)) on pre-therapeutic imaging in order to evaluate the risk/benefit profile of recanalization obtained by MT. Patients were either directly admitted to the Lille University Hospital where the MT center is located, according to the mothership model, or referred from another hospital, according to the drip and ship model [8].

2.3. *Baseline clinical data and eligibility criteria acute treatments*

We prospectively collected the following demographic characteristics and vascular risk factors, as previously defined [8,9]: age, gender, arterial hypertension, diabetes mellitus, hypercholesterolemia, smoking (previous or current), excessive alcohol consumption, history of myocardial infarction (MI) and stroke or transient ischemic attack (TIA), previous or current atrial fibrillation (AF), antithrombotic medication prior to stroke, pre-stroke modified Rankin Scale score (mRS). We recorded whether patients were directly admitted or referred from remote hospitals. We assessed NIHSS immediately before MT and 24 hours later. Patients eligible for IVT were treated according to the European Stroke Organisation recommendations [10]. Eligibility criteria for MT were evidence of AIS-LVO on magnetic resonance imaging (MRI) angiography sequences at baseline (or on computed tomographic angiography (CTA) in case of contra-indication for MRI) and possibility to start MT within eight hours after stroke recognition. After the publications of the results of the DEFUSE 3 and DAWN trials, we extended the time-window up to 24 hours from last known normal and selected the patients according to trial criteria [11,12]. MT was initiated as soon as possible after the end of imaging and performed by a trained neuroradiologist, under conscious sedation, by trans-femoral approach. We recorded: *i*) time from symptom recognition to puncture; *ii*) time from symptom recognition to first imaging (last slice); *iii*) time from first imaging to puncture; *iv*) time from symptom recognition to recanalization for patients with successful recanalization after MT; *v*) time from groin puncture to recanalization. Stroke etiology was classified according to TOAST criteria.

2.4. *Baseline radiological assessment*

All patients underwent MRI at admission (with fluid attenuation inversion recovery [FLAIR] and gradient echo T2* sequences, b1000 diffusion weighed imaging (DWI) with apparent diffusion coefficient (ADC) mapping, and time-of-flight magnetic resonance angiography [MRA]). Those with a contra-indication for MRI underwent a CT-scan. All patients underwent another MRI (or CT)-scan 22 to 36 hours after treatment, or earlier in case of clinical worsening. A senior neuroradiologist analyzed all images (MRI, CT, DSA), blinded to clinical data. Infarct volumes were assessed using a semi-automated software (OLEA sphere 3.0) on the last brain imaging performed before MT. Site of occlusion was determined on pre-treatment DSA: M1 middle cerebral artery (MCA) occlusion, M2 MCA occlusion, terminal internal carotid artery (ICA) and tandem occlusion. We defined successful recanalization as mTICI score 2b, 2c or 3.

2.5. *Outcome assessment*

Outcome at month-3 was evaluated using the mRS score. An excellent outcome was defined as an mRS score 0-1 or similar to the pre-stroke mRS, a favorable outcome as an mRS score 0-2 or similar to the pre-stroke mRS. Procedural complications were collected, including device-related complications (subarachnoidal hemorrhage, carotido-cavernous fistula), puncture-site problems (hematoma or occlusion), and embolization in other arterial territories.

Intra-cerebral hemorrhages (ICHs) were classified on imaging performed at 22-36 hours using the European Cooperative Acute Stroke Study (ECASS) criteria [13] as hemorrhagic infarction (HI) and parenchymal hematoma (PH). Symptomatic ICH (sICH) was defined according to ECASS 2 criteria [14].

All-cause mortality rate was evaluated at three months.

2.6. *Statistical analysis*

Quantitative variables are expressed medians (interquartile range, IQR). Categorical variables are expressed as numbers (percentage). Normality of distributions was assessed using histograms and Shapiro-Wilk test. Patients were divided in two groups according to successful recanalization. Baseline characteristics were described according to study groups and importance of imbalances was assessed by calculating the absolute standardized differences (ASDs); ASD>20% were interpreted as meaningful imbalance. Comparison in binary outcomes between the two study groups were performed using chi-square test or Fisher's exact test and comparison in overall distribution of the month-3 mRS was performed using Mann-Whitney U test. Difference in binary outcomes were expressed as odds ratio (OR) calculated by penalized-likelihood logistic regression (to account for the small sample size) and the difference in month-3 mRS was expressed as common OR for 1-point improvement (after pooled together 5 and 6) [15]. Two sensitivity analyses for comparisons in functional outcomes were done, firstly in the subgroups of patients with MCA-M1 occlusion, and secondly, in the subgroup of patients with pre-treatment NIHSS score≤5. Main comparisons were further adjusted for pre-specified confounders (age and pre-treatment volume) using multivariable penalized-likelihood logistic regression models. Among patients with successful recanalization, we assessed the association of functional outcomes with both recanalization grades (mTICI 3 vs. 2b/2c) and time from groin puncture to successful recanalization (treated as a continuous variable and an ordinal variable according to the tertiles), using univariable penalized-likelihood logistic regression models. Statistical testing was conducted at the two-tailed α-level of 0. 05. Data were analyzed using the SAS software version 9.4 (SAS Institute, Cary, NC).

3. Results

From January 1st 2015, to July 31st 2018, 922 consecutive patients with AIS-LVO were treated by MT. Among them, 106 had a NIHSS<8 at the first neurological examination of whom 33 patients had a neurological deterioration before thrombectomy (31%, see supplemental table for outcome description in this subgroup) and 73 had a pre-treatment NIHSS<8. From the 816 with a NIHSS≥8 at the first neurological examination, only 22 patients had neurological improvement before thrombectomy (Fig. 1). Thus, 95 with pre-treatment NIHSS<8 were eligible and included in the present study–(flow chart in Fig. 1). Patient characteristics are described in Table 1. Seventy-six patients out of 95 (80%) achieved successful recanalization (n=36 with mTICI 2b/2c, n=40 with mTICI 3), with a median time of 293 minutes (IQR, 234 to 360) from symptom recognition to recanalization and of 26 minutes (IQR, 18 to 43 minutes) after groin puncture.

3.1. *Outcomes and Successful Recanalization*

Overall, 56 (59.0%) patients achieved an excellent outcome and 69 (72.6%) a favorable outcome. Figure 2 shows the distribution of month-3 mRS scores according to recanalization status. Patients with successful recanalization were more likely to have both excellent and favorable outcome than patients without (Table 2). After adjustment for age and infarct volume, we found that successful recanalization remained significantly associated with both favorable and excellent outcome (Table 2). The positive associations persisted in the two sensitivity analyses restricted to: *i*) patients with M1 MCA occlusion and *ii*) patients with pre-treatment NIHSS≤ 5 (Fig. 3).

Regarding safety outcomes, ICH occurred in 38 patients (40.0%), including eight PHs and three sICHs. Procedural complications occurred in 12 (12.6%) patients. The rate of complications in the group of patients with M2 occlusion was 11.5% (3/26). Details are reported in Table 1s (supplemental material). Five patients died (5.3%). Regarding safety outcome, there was no significant difference between patients with and without successful recanalization.

3.2. *Outcomes according to grade and delays of recanalization*

Although the difference did not reach statistical significance, patients with mTICI 3 score presented better functional outcomes than those with mTICI 2b (Fig. 4). We also observed a non-significant trend toward lower excellent and favorable outcomes rates with increasing time from groin puncture to recanalization (Fig. 4).

4. Discussion

Our study has shown that among patients with mild neurological deficit treated with MT for AIS-LVO, about three-quarters had a favorable outcome and more than half had an excellent outcome at three months. The likelihood of achieving month-3 favorable/excellent outcome was strongly influenced by recanalization success: in case of recanalization failure, only one patient out of 10 had an excellent outcome and less than one-third had a favorable outcome. The benefit of recanalization on functional outcome was also observed in the subgroup of patients with the least severe clinical deficit (NIHSS≤5). MT appeared to be safe with only 3% sICH and a three-month mortality rate of 5%.

Our study has several strengths. Data were prospectively collected, with a pre-specified data collection protocol focusing on functional outcome and no exclusion due to missing data. The neuroradiological assessment was systematically performed on the last neuroimaging performed before MT. We only included patients with persistent occlusion on pre-treatment DSA to assess the impact of recanalization obtained by MT in patients with low NIHSS, in which clinicians have to balance the therapeutic decision of performing MT against bringing the additional risk of procedural complications. Baseline characteristics and mortality rates in our study were consistent with previous reports, re-ensuring about the generalizability of the results [16].

There are also several limitations. We analyzed data from a single-center cohort in a tertiary university hospital [8]. Moreover, we did not collect data on patients for whom we decided not to perform MT, enabling us only to compare patients with a successful recanalization after MT to patients with recanalization failure, but not MT treated patients with patients treated with BMT alone. Other limitations include the retrospective design and the relatively small sample size. Last, we did not evaluate either collaterality or perfusion, which could be of interest in patients with mild stroke and LVO [17].

Inconsistently with our results, previous observational studies [18–21], suggested that patients with acute AIS-LVO with minor-to-mild neurological deficit treated by MT had similar outcome compared with patients treated by BMT, including IVT. Nevertheless, in these studies, the two groups of patients (MT vs. BMT) were substantially different, with higher proportion of proximal LVO (ICA or M1) in the group treated with MT and higher proportion of distal occlusion [19] (M2 to M4 and anterior cerebral artery) in the group treated with BMT [18]. Importantly, distal occlusions are per se associated with better outcome and higher chances to obtain a successful recanalization after IVT [18], with potential impact on results. Moreover, MT patients were treated later [20], with potential impact on outcome. In our study, despite differences at baseline on NIHSS and occlusion site between patients with recanalization versus without, sensitivity analysis and comparisons in functional outcomes allowed to confirm our results on the benefit of MT-obtained recanalisation on outcome in patients with MCA-M1 occlusion and with pre-treatment NIHSS score≤5. Other observational studies [4–6] and a recent meta-analysis [22] showed, accordingly with our results, that patients with AIS-LVO and minor/mild neurological deficit, treated with MT, achieved better functional outcomes compared to those treated with BMT.

We observed a strong influence of successful recanalization on outcome in acute AIS-LVO patients with minor/mild neurological deficit treated by MT, the best clinical benefit being achieved in case of complete recanalization. In our study, rates of excellent/favorable outcome were low (10% and 31%) in case of recanalization failure, and they were significantly higher in case of successful recanalization (71% and 83%, respectively). This is consistent with other reports showing similar rates of favorable/excellent outcome in patients with successful recanalization [21]. These results strongly suggest that the association between recanalization and outcome, clearly demonstrated in patients with severe deficit, also exists in patients with low NIHSS scores.

In line with our findings, previous observational studies [23,24] and a recent meta-analysis [25] found good safety profiles in patients with minor/mild neurological deficit treated with MT and similar rate of sICH compared to literature [23]. However, our procedural complication rate appeared higher than previously reported [24], likely because of the exhaustive definition we decided to use in this population of patients with minor/mild neurological deficit. Although there was no significant difference in safety outcomes in patients with and without successful recanalization, there was a numerical difference between the two groups for procedural complications and symptomatic ICH. Indeed, in the subgroup of patients with recanalization failure, the MT procedure had to be aborted because of procedural complication in three cases versus no case in case of successful recanalization, which might have influenced the month-3 outcome. It is however impossible to determine whether procedural complications led to recanalization failure or recanalization failure led to more procedural complications. In accordance with a previous report [22], three-month mortality was very low.

5. Conclusions

Awaiting the results of on-going trials (IN EXTREMIS/MOSTE and ENDOLOW study), in MT treated patients with AIS-LVO and mild neurological deficit, recanalization could be safe and effective.

6. Acknowledgements

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7. Statement of Ethics

The institutional review board (Comité de protection des personnes Nord Ouest IV) classified the study as observational on March 9, 2010 and approved the study by December 21, 2010 (n° 10. 677). Patients and their relatives gave their informed consent to participate.

8. Disclosure statement

Arnaud Karam, Julien Labreuche and Nicolas Bricout report no disclosures.

Barbara Casolla, Marc Ferrigno and Hilde Henon served as investigators for clinical trials (Astra-Zeneca, Boehringer-Ingelheim, Daiichi-Sankyo, Pfizer). All fees were paid to ADRINORD or the Lille University Hospital research account, no personal funding.

Charlotte Cordonnier served on advisory boards (Bayer, Medtronics, Daiichi-Sankyo) and as investigator for clinical trials (Astra-Zeneca, Boehringer-Ingelheim, Daiichi-Sankyo, Pfizer). All fees were paid to ADRINORD or the Lille University Hospital research account, no personal funding.

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10. Author contributions

Arnaud Karam designed analyzed and interpreted all data and drafted the manuscript.

Barbara Casolla and Marc Ferrigno contributed to data collection, analyzed all data and revised the manuscript.

Julien Labreuche performed the statistical analyses.

Charlotte Cordonnier and Nicolas Bricout conceptualized and designed the study, interpreted study data, and revised the manuscript.

Hilde Hénon designed and conceptualized the study, analyzed and interpreted all data, and revised the manuscript.

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12. **Figure Legends**

Figure 1. Flow chart of the study

Figure 2. Distribution of modified Rankin Score (mRS) at 90 days, according to successful recanalization after mechanical thrombectomy.

NIHSS=National Institutes of Health Stroke Scale, mRS=modified Rankin Score.

Figure 3. Comparison in functional outcomes according to successful recanalization in sensitivity analyses restricted to patients with M1 middle cerebral artery occlusion or to patients with pre-treatment NIHSS≤5. CI=confidence interval, NIHSS=National Institutes of Health Stroke Scale, MCA=middle cerebral artery, mRS=modified Rankin Score, mTICI=modified Thrombolysis in Cerebral Infarction scale, OR=odds ratio.

Figure 4. Excellent and favorable outcome according to delays and grade of recanalization. CI=confidence interval, mRS=modified Rankin Score, mTICI=modified treatment in cerebral infarction score, OR=odds ratio. OR calculated per 15 minutes increase in groin puncture to successful recanalization time (treated as continuous variable).

13. Tables

Table 1. Baseline characteristics of the study population, overall and according to successful recanalization after mechanical thrombectomy.

	Overall (n=95)	**No** (mTICI 0-2a) **(n=19)**	**Yes** (mTICI2b/3) **(n=76)**	**ASD, %**
Demographic characteristics				
Age, years	69~~.0~~ (59~~.0~~ to 78~~.0~~)	68~~.0~~ (61~~.0~~ to 80~~.0~~)	~~69.5~~70 (58~~.5~~ to 7~~6.57~~)	10.4
Male gender	45 (47. 4)	7 (36. 8)	38 (50. 0)	26.8
Medical history				
Hypertension	61 (64. 2)	17 (89. 5)	44 (57. 9)	76.8
Diabetes mellitus	16 (16. 8)	3 (15. 8)	13 (17. 1)	3.6
Hypercholesterolemia	43 (45. 3)	6 (31. 6)	37 (48. 7)	35.4
Smoking (previous or current)	39 (41. 1)	6 (31. 6)	33 (43. 4)	24.7
Excessive alcohol consumption	13 (13. 7)	1 (5. 3)	12 (15. 8)	34.8
Previous MI	12 (12. 6)	3 (15. 8)	9 (11. 8)	11.5
Previous stroke or TIA	15 (15. 8)	6 (31. 6)	9 (11. 8)	49.3
Previous or current AF	30 (31. 6)	7 (36. 8)	23 (30. 3)	14.0
Antithrombotic medication prior to stroke	42 (44. 2)	10 (52. 6)	32 (42. 1)	21.2
Anticoagulant use	19 (20. 0)	4 (21. 1)	15 (19. 7)	3.3
Antiplatelet use	27 (28. 4)	6 (31. 6)	21 (27. 6)	8.7
Stroke characteristics				
Pre-stroke mRs > 0	21 (22. 1)	6 (31. 6)	15 (19. 7)	27.4
NIHSS before MT	5 (3 to 6)	6 (4 to 6)	5 (3 to 6)	32.7
Direct admission	25 (26. 3)	6 (31. 6)	19 (25. 0)	14.7
M1 MCA	48 (50. 5)	14 (73. 7)	34 (44. 7)	89.1
M2 MCA	26 (27. 4)	1 (5. 3)	25 (32. 9)	
Intracranial ICA	4 (4. 2)	0 (0. 0)	4 (5. 3)	
Tandem	17 (17. 9)	4 (21. 1)	13 (17. 1)	
Volume, ml [1]	5~~.0~~ (2~~.0~~ to 11~~.0~~)	5~~.0~~ (2~~.0~~ to 7~~.0~~)	5~~.0~~ (2~~1.6~~ to 11~~.0~~)	11.3
Wake-up stroke	22 (23. 2)	5 (26. 3)	17 (22. 4)	9.2
Suspected stroke cause				
Large artery atherosclerosis	17 (17. 9)	3 (15. 8)	14 (18. 4)	20.4
Cardioembolic	39 (41. 1)	9 (47. 4)	30 (39. 5)	
Other	8 (8. 4)	1 (5. 3)	7 (9. 2)	
Unknown	31 (32. 6)	6 (31. 6)	25 (32. 9)	
Treatments characteristics				
IVT	66 (69. 5)	9 (47. 4)	57 (75. 0)	59.1
General anesthesia	1 (1. 1)	0 (0. 0)	1 (1. 3)	16.3
Time symptom recognition to puncture, min	262 (210 to 320)	266 (204 to 355)	261 (212 to 318)	5.5
Time symptom recognition to first imaging, min	126 (93 to 167)	119 (102 to 153)	126 (89 to 170)	9.3
Time first imaging to puncture, min	92 (43 to 142)	51 (42 to 120)	95 (44 to 143)	25.9

Values are expressed as number (%) or median (Interquartile range). AF=atrial fibrillation; ASD=absolute standardized difference; ICA=internal carotid artery, IVT=intravenous thrombolysis, NIHSS=National Institutes of Health Stroke Scale, MCA=middle cerebral artery, MI=myocardial infarction, MT=mechanical thrombectomy; mRS=modified Rankin Score, TIA=transient ischemic attack, mTICI=modified Thrombolysis in Cerebral Infarction scale. [1]Three missing values.

Table 2. Outcomes according to successful recanalization after mechanical thrombectomy.

	Successful Recanalization			Unadjusted	Adjusted[2]
	No (mTICI 0-2a)	**Yes** (mTICI 2b/3)	p-value	OR (95%CI)	OR (95%CI)
Excellent outcome	2 (10. 5)	54 (71. 1)	<0. 001	16. 96 (3. 99 to 72. 04)	37. 41 (5.17 to 270. 48)
Favorable outcome[1]	6 (31. 6)	63 (82. 9)	<0. 001	9. 77 (3. 16 to 30. 16)	9. 87 (2. 92 to 33. 30)
90-day mRs, median	3 (2 to 4)	1 (0 to 2)	<0. 001	9. 96 (3. 66 to 27. 13)[3]	12. 21 (4.17 to 35. 68)[3]
Procedural complications	5 (27. 8)	8 (10. 5)	0. 12	0. 31 (0. 08 to 1. 06)	0. 33 (0. 08 to 1. 27)
Any ICH	9 (47. 4)	29 (38. 2)	0. 47	0. 69 (0. 24 to 1. 89)	0. 90 (0. 29 to 2. 71)
Parenchymal hematoma	1 (5. 3)	7 (9. 2)	Not done	Not done	Not done
Symptomatic ICH	2 (10. 5)	1 (1. 3)	Not done	Not done	Not done
90-day mortality	1 (5. 3)	4 (5. 3)	Not done	Not done	Not done

Values expressed as number (%) or median (Interquartile range). ICH=intracerebral hemorrhage, mRS=modified Rankin Score, OR=odds ratio. [1]pre-specified as primary outcome measure. [2]adjusted for pre-specified confounding factors (age and pre-treatment volume) and and pre-treatment NIHSS. [3]common OR for 1-point improvement in mRS (after pooled together 5 and 6) calculated using ordinal logistic regression model.

Supplemental material

Table 1s. Procedural complications according to successful recanalization after mechanical thrombectomy

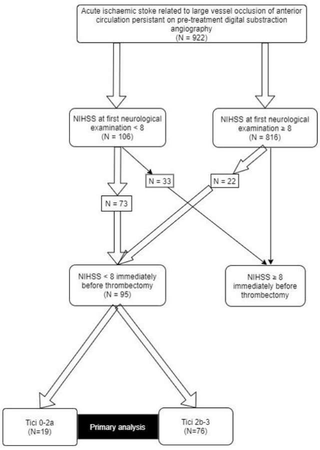
	Successful recanalization	
	Yes (mTICI 2b/3) **(n=76)**	**No** (mTICI 0-2a) **(n=19)**
Subarachnoidal hemorrhage	0	3
Carotido-cavernous fistula	0	1
Hematoma at puncture site	4	2
Occlusion at puncture site	1*	0
Embolization in other arterial territories	1*	1*

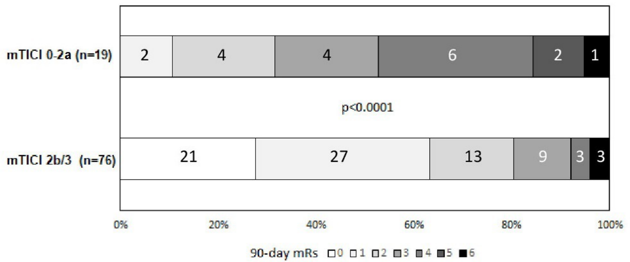
Values are expressed as number.
*Complications of a mechanical thrombectomy performed for an MCA M2 occlusion.

Table 2s. Univariate analysis comparing outcomes in patients with NIHSS < 8 at first neurological examination and with early neurological deterioration before treatment to patients with NIHSS < 8 immediately before MT.

	Patients with early neurological deterioration (N=33)	Patients with NIHSS<8 before MT (N=95)	P value
Successful recanalization	28 (84.8)	76 (80)	0.539
Excellent outcome	13 (39.4)	56 (58.9)	0.052
Favorable outcome[1]	18 (54.5)	69 (72.6)	0.055
90-day mRs, median	2 (1 to 5)	1 (1 to 5)	0.077
Procedural complications	1 (3.0)	12 (12.6))	n/a
Any ICH	11 (34.4)	38 (40)	0.572
Parenchymal hematoma	1 (3.1)	8 (8.4)	n/a
Symptomatic ICH	1 (3.1)	3 (3.2)	n/a
90-day mortality	4 (12.1)	5 (5.3)	0.068

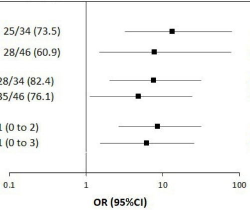
Values expressed as number (%) or median (Interquartile range). ICH=intracerebral hemorrhage, mRS=modified Rankin Score.


Acute ischaemic stoke related to large vessel occlusion of anterior circulation persistant on pre-treatment digital substraction angiography (N = 922)
NIHSS at first neurological examination < 8 (N = 106)
NIHSS at first neurological examination ≥ 8 (N = 816)
N = 33
N = 22
N = 73
NIHSS < 8 immediately before thrombectomy (N = 95)
NIHSS ≥ 8 immediately before thrombectomy
Tici 0-2a (N=19)
Primary analysis
Tici 2b-3 (N=76)



mTICI 0-2a (n=19)
2
4
4
6
2
1
p<0.0001
mTICI 2b/3 (n=76)
21
27
13
9
3
3
0%
20%
40%
60%
80%
100%
90-day mRs 0 1 2 3 4 5 6

		Recanalization			
Outcomes	**Subgroups**	**mTICI (0-2a)**	**mTICI (2b/3)**	**P**	**OR (95%CI)**
Excellent outcome	MCA-M1 occlusion	2/14 (14.3)	25/34 (73.5)	<0.001	13.42 (3.24 to 79.22)
	Pre-treatment NIHSS 0-5	1/8 (12.5)	28/46 (60.9)	0.019	7.70 (1.50 to 77.45)
Favorable outcome	MCA-M1 occlusion	5/14 (35.7)	28/34 (82.4)	0.004	7.57 (2.04 to 31.59)
	Pre-treatment NIHSS 0-5	3/8 (37.5)	35/46 (76.1)	0.041	4.85 (1.11 to 23.99)
90-day mRs	MCA-M1 occlusion	3 (2 to 4)	1 (0 to 2)	<0.001	8.57 (2.67 to 31.52)
	Pre-treatment NIHSS 0-5	3 (2 to 4)	1 (0 to 3)	0.010	6.22 (1.51 to 25.51)



Outcomes	Recanalization		n(%)	OR (95%CI)	P
Excellent outcome	Grade				
		mTICI 2b (n=36)	22 (61.1)	1.00 (ref.)	-
		mTICI 3 (n=40)	32 (80.0)	2.46 (0.89 to 6.81)	0.082
	Time, minutes			*0.75 (0.50 to 1.12)* [1]	*0.15*
		< 23 (n=27)	23 (85.2)	1.00 (ref.)	-
		23-36 (n=24)	16 (66.7)	0.37 (0.09 to 1.41)	0.14
		>36 (n=25)	15 (60.0)	0.28 (0.07 to 1.04)	0.057
Favorable outcome	Grade				
		mTICI 2c (n=36)	27 (75.0)	1.00 (ref.)	-
		mTICI 3 (n=40)	36 (90.0	2.80 (0.80 to 9.70)	0.10
	Time, minutes			*0.66 (0.42 to 1.04)* [1]	*0.070*
		< 23 (n=27)	24 (88.9	1.00 (ref.)	-
		23-36 (n=24)	21 (87.5)	0.88 (0.17 to 4.45)	0.87
		>36 (n=25)	18 (72.0)	0.35 (0.08 to 1.48)	0.15