Mechanical Thrombectomy in Patients With Milder Strokes and Large Vessel Occlusions

A Multicenter Matched Analysis

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Background and Purpose—We aimed to describe the safety and efficacy of immediate mechanical thrombectomy (MT) in patients with large vessel occlusions and low National Institutes of Health Stroke Scale (NIHSS) versus best medical management.

Methods—Patients from prospectively collected databases of 6 international comprehensive stroke centers with large vessel occlusions (distal intracranial internal carotid, middle cerebral artery-M1 and M2 segments, or basilar artery with or without tandem occlusions) and NIHSS 0 to 5 were identified and divided into 2 groups for analysis: immediate MT or initial best medical management which included rescue MT after neurological deterioration (best medical management-MT). Uni- and multivariate analyses and patient-level matching for age, baseline NIHSS, and occlusion site were performed to compare baseline and outcome variables across the 2 groups. The primary outcome was defined as good outcome (modified Rankin Scale score, 0–2) at day 90. Safety outcome was symptomatic intracranial hemorrhage as defined by the ECASS (European Cooperative Acute Stroke Study) II and mortality at day 90.

Results—Compared with best medical management-MT (n=220), patients with immediate MT (n=80) were younger (65.3±13.5 versus 69.5±14.1; *P*=0.021), had more often atrial fibrillation (44.8% versus 28.2%; *P*=0.012), higher baseline NIHSS (4, 0–5 versus 3, 0–5; *P*=0.005), higher Alberta Stroke Program Early CT Score (10, 7–10 versus 10, 5–10; *P*=0.023), more middle cerebral artery-M1, and less middle cerebral artery-M2 (41.3% versus 21.9% and 28.8% versus 49.3%; *P*=0.016) occlusions. The adjusted odds ratio for good outcome was 3.1 (95% CI, 1.4–6.9) favoring immediate MT. In the matched analysis, there was a 14.4% absolute difference in good outcome (84.4% versus 70.1%; *P*=0.03) at day 90 favoring immediate MT. There were no safety concerns.

Conclusions—Our retrospective, pilot analysis suggests that immediate thrombectomy in large vessel occlusions patients with low NIHSS on presentation may be safe and has the potential to result in improved outcomes. Randomized clinical trials are warranted to establish the optimal management for this patient population. **(*Stroke*. 2018;49:2391-2397. DOI: 10.1161/STROKEAHA.118.021106.)**

Key Words: atrial fibrillation ■ intracranial hemorrhages ■ stroke ■ thrombectomy ■ tomography, X-ray computed

Currently, the vast majority of these patients with mild strokes does not receive an immediate vessel imaging with either computed tomographic or magnetic resonance angiography. However, acute ischemic stroke patients with low National Institutes of Health Stroke Scale (NIHSS) who harbor a large vessel occlusion (LVO) decline at a 20% to 40% rate[1,2] and have underappreciated impairments related to their relatively mild strokes.[3] Similarly, LVO patients presenting with a transient ischemic attack are under increased risk of clinical deterioration.[4,5] Experience with mechanical thrombectomy (MT) in the LVO mild stroke target population is limited. Among the recent endovascular trials demonstrating efficacy, baseline stroke severity did not modify treatment effect.[6] However, only 14 of 1766 patients in the recent randomized controlled trials[7–13] had a low baseline NIHSS (0–5). Only few nonrandomized studies comparing immediate MT (IMT) with initial best medical management (BMM) have been published so far with data indicating no benefit of IMT,[14,15] all the way up to 23% to 43% difference in good outcome favoring IMT.[1,16,17] Hence, the efficacy and

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safety of IMT versus BMM (including intravenous recombinant tissue-type plasminogen activator if applicable and rescue MT in case of clinical deterioration) for patients with low NIHSS and LVOs have not been established. Here, we present a large retrospective multicenter analysis of prospectively collected data on patients with mild stroke harboring an LVO from 6 international comprehensive stroke centers.

Methods

The data that support the findings of this study are available from the corresponding author on reasonable request. Prospectively run local acute ischemic stroke databases (Heidelberg University Hospital, Munich University Hospital, Osnabrück Hospital, Massachusetts General Hospital, University of California San Francisco Hospital, and Grady Memorial Hospital) were searched for patients with (1) baseline NIHSS 0 to 5, (2) proven (by computed tomographic angiography or magnetic resonance angiography) LVO including intracranial internal carotid, middle cerebral artery (MCA)-M1, and MCA-M2 with or without tandem occlusions or anterior cerebral artery or basilar occlusion, and (3) available 3-month outcome data. Data were retrieved from routine clinical documentation. However, in contrast to what is typically done in prospective clinical trials, no formal audits or site monitoring was performed. Patients with isolated cervical intracranial internal carotid occlusions (and patent intracranial vessels) were excluded from analysis. The data collection period differed across the different centers but included all consecutive patients fulfilling the above criteria with the following distribution: Heidelberg University Hospital: 66 of 2391 (2.8%) patients from 2005 to 2016, Munich University Hospital: 16 of 346 (4.6%) patients from 2015 to 2016, Osnabrück Hospital: 75 of 1040 (7.2%) patients from 2012 to 2016, STOPStroke Registry (Massachusetts General Hospital/University of California San Francisco Hospital): 88 of 741 (11.9%) patients from 2003 to 2005, and Grady Memorial Hospital: 55 of 450 (12.2%) patients from 2014 to 2016. In all centers, treatment decisions were made by the treating physician.

We retrieved relevant clinical baseline characteristics, radiological findings, as well procedural aspects and outcome data. Recanalization was assessed with the modified Thrombolysis in Cerebral Infarction scale, and successful recanalization was defined as modified Thrombolysis in Cerebral Infarction ≥2b. The primary outcome was the rate of good functional outcomes as defined as modified Rankin Scale (mRS) 0 to 2 at 90 days and was obtained through outpatient assessments or a standardized interview by an unblinded investigator and, if those were not possible, through detailed rehabilitation reports containing a full description of the clinical deficit, Barthel-Index, and social medicine data at discharge (5% of patients, ie, 15 of 300, all German patients).

Secondary outcomes were the rates of excellent outcome (mRS, 0–1) at day 90 and a mRS shift analysis at day 90. Exploratory analyzes were performed to assess treatment benefit using alternative mRS shift analysis methods (method B: 0–2, 3, 4, 5–6; method C: 0–1, 2, 3, 4, 5–6; method D: 0–1, 2, 3, 4–6). Safety outcome was symptomatic intracranial hemorrhage (sICH) as defined by the ECASS (European Cooperative Acute Stroke Study) II[18] and mortality at day 90.

Patients were divided into 2 groups: patients who received IMT or initial BMM including intravenous thrombolysis if applicable and rescue MT after neurological deterioration (BMM-MT) as determined by the local clinical team. For all procedures, local standard operating procedures and local guidelines were followed. All patients were treated either on local stroke units or neurocritical care units. In all MT procedures, an approved stent retriever and aspiration catheter were used.

Local ethics approval was obtained from each participating center for the local databases, and only pseudonymized data without personal information were entered in the combined database for analysis. The local ethics boards waived the need for patient consent for the purposes of this retrospective analysis.

Matching Methodology

Patients were first categorized into 6 categories according to occlusion site: intracranial internal carotid artery, MCA-M1, MCA-M2, anterior cerebral artery, tandem, and basilar artery. For each group, a matching method based on weighted Euclidean distances was used to obtain a pair of subjects considered to be the nearest neighbors in a bidimensional space of age and baseline NIHSS score, as previously described.[19] Because of collinearity of NIHSS and Alberta Stroke Program Early CT Score (ASPECTS) and the aim to avoid overmatching, we decided for NIHSS and not ASPECTS to be included in the matching procedure. Moreover, the difference between groups in NIHSS was greater in the overall cohort than for ASPECTS. The distance between each IMT-BMM-MT pair was computed using the %FIND_NEIGHBORS Macro in SAS University Edition (SAS Institute, Cary, NC). Each IMT patient was matched with nearest BMM-MT patient (having the smallest Euclidian distance). After matching, the distribution of Euclidian distances was studied to identify outliers, and a threshold was determined as follows: threshold=Q 75+1.5*(Q75−Q25), where Q25 and Q75 are, respectively, the 25th and 75th percentiles. Pairs with distances greater than the threshold were considered extreme values at the tail of the distribution and eliminated from further consideration.

Statistical Analysis

Nominal variables are presented as frequencies, ordinal values as medians with min–max distribution, and continuous variables as mean±SD. For the whole cohort, all comparative analyses were done with the Fisher exact-test, the χ^2, Mann-Whitney, or Kruskal-Wallis resp. *T* test where appropriate and a $P<0.05$ was considered as significant. To identify independent predictors of good outcome, we used a stepwise forward logistic regression model including all variables with $P\leq0.1$ after univariate analysis (age, baseline mRS, hypertension, history of smoking, recombinant tissue-type plasminogen activator use, onset to treatment time, and IMT). Odds ratios (OR) are presented with 95% CIs. For the matched cohort analysis, mRS shift analysis and modifications of it were performed by Van Elteren test and ordinal regression for OR. Statistical analysis was performed using IBM SPSS Statistics 23 (IBM-Armonk, NY) and SAS University Edition (SAS Institute).

Results

Overall Cohort

A total of 300 patients were included. Mean age was 68.3±14 years, and 53.7% of patients were men. Except for Massachusetts General Hospital/University of California San Francisco Hospital (STOPStroke Registry dataset), all other centers contributed IMT patients to this analysis within a range of 19% to 49% of all contributed patients. Patients had a typical distribution of cardiovascular risk factors (Table 1). Twenty (6.7%) patients with a preexisting baseline disability (mRS>2) were included. As compared with BMM-MT patients (n=220), IMT patients (n=80) were younger (65.3%±13.5 versus 69.5±14.1; $P=0.021$), more often had atrial fibrillation (44.8% versus 28.2%; $P=0.012$), and had higher baseline NIHSS (4, 0–5 versus 3, 0–5; $P=0.005$), as well as more MCA-M1 (41.3% versus 21.9%) and less MCA-M2 (28.8% versus 49.3%; $P=0.016$) occlusions, and had higher baseline ASPECTS scores (10, 7–10 versus 10, 5–10; $P=0.023$). The frequency of intravenous recombinant tissue-type plasminogen activator use was similar in both groups (47.5% versus 51.8%; $P=0.39$). Twenty-five (11.3%) patients in the BMM-MT group received rescue MT. The most prominent MT maneuver was stent retrievers on first pass in both groups (IMT 86% versus

Table 1. Univariate Analysis and Distribution of Patient Characteristics, Lab Values, Procedure Times, and Imaging Data in Patients With Favorable and Unfavorable Outcomes

Patient Characteristics		All Patients (n=300)	IMT (n=80)	BMM-MT (n=220)	*P* Value
Baseline clinical characteristics					
Age, y, mean±SD		68.3±14	65.3±13.5	69.5±14.1	0.02*†
Male, n (%)		161 (53.7)	44 (55)	117 (53.2)	0.79‡
Hypertension, n (%)		215 (71.7)	56 (70)	159 (72.3)	0.77‡
Diabetes mellitus, n (%)		49 (16.3)	13 (16.3)	36 (16.4%)	1.0‡
Atrial fibrillation, n (%)		97 (32.3)	35 (43.8)	62 (28.2)	0.012†‡
Hypercholesterolemia, n (%)		111 (37)	29 (36.3)	82 (37.3)	0.89‡
History of smoking, n (%)		66 (22)	16 (20)	50 (22.7)	0.75‡
Oral anticoagulation, n (%)		42 (17.9)	9 (13)	33 (20)	0.26‡
Baseline mRS, median (min–max)		0 (0–4)	0 (0–4)	0 (0–4)	0.88§
Baseline mRS >2 (%)		20 (6.6)	4 (5)	16 (7.3)	NA
Baseline NIHSS, median (min–max)		3 (0–5)	4 (0–5)	3 (0–5)	0.008†§
MAP on admission in mm Hg, mean±SD		114±19	114±19	114±19	0.82*
Radiological findings, procedural aspects, and outcome measures					
ASPECTS, median (min–max)		10 (5–10)	10 (7–10)	10 (5–10)	0.023†§
Occlusion site	Distal ICA/carotid T, n (%)	27 (9)	7 (8.8)	22 (9.1)	0.016†‖
	Tandem occlusion, n (%)	36 (12)	10 (12.5)	26 (11.9)	
	M1, n (%)	81 (27.1%)	33 (41.3)	48 (21.9)	
	M2, n (%)	131 (43.8)	23 (28.8)	108 (49.3)	
	ACA, n (%)	3 (1)	1 (1.3)	2 (0.9)	
	Basilar artery, (%)	21 (7)	6 (7.5)	15 (6.8)	
Treatment year, median (min–max)		2012 (02–16)	2015 (12–16)	2010 (02–16)	0.001†§
Intravenous rt-PA, n (%)		152 (50.7)	38 (47.5)	114 (51.8)	0.51‡
Rescue MT, n (%)		NA	NA	25/220 (11.3)	NA
Onset to treatment time, min, mean±SD		403±520	319±391	433±557	0.01*
Door to needle time, min, mean±SD		46±33	37±23	47±35	0.15*
Door to groin puncture time, min, mean±SD		169±232	93±75	409±367	0.001*†
Recanalization (TICI 2b–3), (%)		93/105 (88.6)	70 (87.5)	23/25 (92)	0.72‡
sICH, n (%)		7 (2.3)	4 (5)	3 (1.4)	0.08‡
Excellent outcome (mRS, 0–1), n (%)		173 (57.7)	49 (61.3)	124 (56.4)	0.51‡
Good outcome (mRS, 0–2), n (%)		222 (74)	68 (85)	154 (70)	0.011†‡
Good outcome including back to baseline mRS, n (%)		233 (77.7)	69 (86.3)	164 (74.5)	0.041†‡
Mortality, n (%)		23 (7.7)	3 (3.8)	20 (9.1)	0.14‡

Onset to treatment time: treatment is defined as start rt-PA or groin puncture or best medical management if no recanalization therapy was offered. ACA indicates anterior cerebral artery; ASPECTS, Alberta Stroke Program Early CT Score; BMM, best medical management; ICA, intracranial internal carotid; IMT, immediate mechanical thrombectomy; MAP, mean arterial pressure; mRS, modified Rankin Scale; MT, mechanical thrombectomy; NA, not applicable; NIHSS, National Institutes of Health Stroke Scale; rt-PA, recombinant tissue-type plasminogen activator; sICH, symptomatic intracranial hemorrhage; and TICI, Thrombolysis in Cerebral Infarction.

*Unpaired *t* test.

†Statistically significant ($P<0.05$)

‡Fisher exact test.

§Mann-Whitney test.

‖Pearson χ^2 test.

rescue MT 88%), and the rest of the patients was treated with aspiration catheters on first pass or throughout the procedure. Reperfusion rates were similarly high in IMT versus rescue-MT patients (87.5% versus 92%; *P*=0.72). The MT procedure was performed in general anesthesia in around half the cases in both groups (IMT 55% versus rescue MT 48%), and the rest of the patients were treated in conscious sedation or monitored anesthesia care. Onset to treatment time and door to needle time showed a trend towards being shorter in IMT patients, and door to arterial puncture time was per definition much shorter in IMT than rescue MT patients (89±72 versus 322±340 minutes; *P*<0.001). Rates of sICH were low in both groups but were numerically lower in BMM-MT patients (5% versus 1.4%; *P*=0.26). Rates of good outcomes as well as the chances of returning to baseline mRS were significantly higher in IMT patients (85% versus 70%, *P*=0.011 and 86.3% versus 74.5%, *P*=0.041). There were trends, but no significant differences in the rates of 90-day excellent outcome (61.3% versus 56.5%; *P*=0.18) or mortality (3.2% versus 8.3%; *P*=0.15) in IMT versus BMM-MT patients. Analyzing only patients who received intravenous thrombolysis (n=152), the difference in rates of good outcomes was numerically greater than in the whole cohort (IMT 81.6% versus BMM-MT 64.9%; *P*=0.068), but because of the lower sample size, this was not statistically significant. After excluding patients with basilar artery occlusion from the analysis, we found the difference in the primary end point remained significant (90-day mRS 0–2: IMT 83.8% versus BMM 70.1%; *P*=0.021). Younger age (66.4±13.7 versus 73.8±13.2; *P*<0.001), lower baseline mRS (0, 0–2 versus 0, 0–4; *P*<0.001), IMT (84.6% versus 69.4%; *P*=0.011), and absence of hypertension (68.5% versus 80.8%; *P*=0.041) were the only factors significantly associated with good outcome on univariate analysis in the whole cohort. However, only IMT (OR, 3.1; 95% CI [1.4–6.9]) and baseline mRS (OR, 0.31; 95% CI [0.21–0.44]) were identified as independent predictors of good outcome on multivariate analysis. Notably, separating the BMM-MT group into those with pure medical management (n=195) and those with rescue MT (n=25), we found that patients with rescue MT had the lowest rates of good outcome (54.5% for rescue-MT versus 71.7% for BMM alone versus 85% for IMT; *P*=0.007)

Matched Cohort

The matching algorithm generated 77 pairs of IMT-BMM-MT patients, of which 2 had an Euclidian distance higher than the preset threshold and thus were excluded from further consideration. Baseline characteristics were well balanced between groups except for higher rates of atrial fibrillation in the IMT group (45.5% versus 28.6%; *P*=0.03; Table 2) and baseline ASPECTS (10 versus 9; *P*=0.002; Table 2). However, this imbalance in ASPECTS between groups was not reflected in an association of ASPECTS with good outcome (10 [9–10] versus 10 [9–10]; *P*=0.09).

IMT patients had significantly higher rates of good outcomes (84.4% versus 70.1%; *P*=0.03; Figure). Excellent outcome was not significantly different (61% versus 53.2%; *P*=0.33). Rates of sICH were numerically higher in IMT (5.2% versus 2.6%; *P*=0.37) but were not significantly different. Mortality was low in both groups (3.9% versus 5.2%; *P*=0.83).

Table 3 displays different options of 90-day mRS shift analyses. There was a significant shift favoring the IMT group when scores 0, 1, and 2 as well as 5 and 6 were aggregated (option B, OR, 2.29; 95% CI [1.05–4.98]; *P*=0.03). Two other modified analysis showed a trend in mRS shift favoring IMT (options C and D). The classic shift analysis, however, did not show a significant shift favoring the IMT group (option A, OR, 1.34; 95% CI [0.76–2.35]; *P*=0.32).

Table 2. Matched Analysis for Both Cohorts

Patient Characteristics	IMT (n=77)	BMM-MT (n=77)	*P* Value
Age, y* (median [IQR])	68.5 [58–75]	69.5 [63–77]	0.68†
Baseline NIHSS* (median [IQR])	3.5 [3–5]	4 [4–5]	0.74†
Gender (male), n (%)	42 (54.5)	45 (58.4)	0.63‡
Hypertension, n (%)	54 (70.1)	55 (71.4)	0.86‡
Dyslipidemia, n (%)	28 (36.4)	30 (39.0)	0.74‡
Diabetes mellitus, n (%)	12 (15.6)	13 (16.9)	0.83‡
Atrial fibrillation, n (%)	35 (45.5)	22 (28.6)	0.03‡§
Smoking, n (%)	14 (18.2)	23 (20.8)	0.69‡
Baseline mRS			0.77†
0	65 (84.4)	58 (84.1)	
1	7 (9.1)	9 (13)	
2	5 (6.5)	2 (2.9)	
Occlusion site*			1.00‡
ICA-T	7 (9.1)	7 (9.1)	
Tandem	9 (11.7)	9 (11.7)	
M1	32 (41.6)	32 (41.6)	
M2	23 (29.9)	23 (29.9)	
Basilar	6 (7.8)	6 (7.8)	
ASPECTS, median[IQR]	10 [9–10]	9 [8.5–10]	0.002†§
MAP, mm Hg median [IQR]	115[108–128]	118[104–146]	0.35†
IV t-PA, n (%)	36 (46.8)	42 (54.5)	0.33‡
sICH, n (%)	4 (5.2)	2 (2.6)	0.41‖
Excellent outcome (mRS, 0–1), n (%)	47 (61.0)	41 (53.2)	0.33‡
Good outcome (mRS, 0–2), n (%)	65 (84.4)	54 (70.1)	0.03‡§
Mortality, n (%)	3 (3.9)	4 (5.2)	0.73‡

ASPECTS indicates Alberta Stroke Program Early CT Score; BMM, best medical management; ICA, intracranial internal carotid; IMT, immediate mechanical thrombectomy; IQR, interquartile range; IV-tPA, intravenous tissue-type plasminogen activator; MAP, mean arterial pressure; mRS, modified Rankin Scale; MT, mechanical thrombectomy; NIHSS, National Institutes of Health Stroke Scale; and sICH, symptomatic intracranial hemorrhage.

*The 2 groups were matched for these variables.

†Mann-Whitney test.

‡Pearson χ^2 test.

§Statistically significant (*P*<0.05)

‖Fisher exact test.

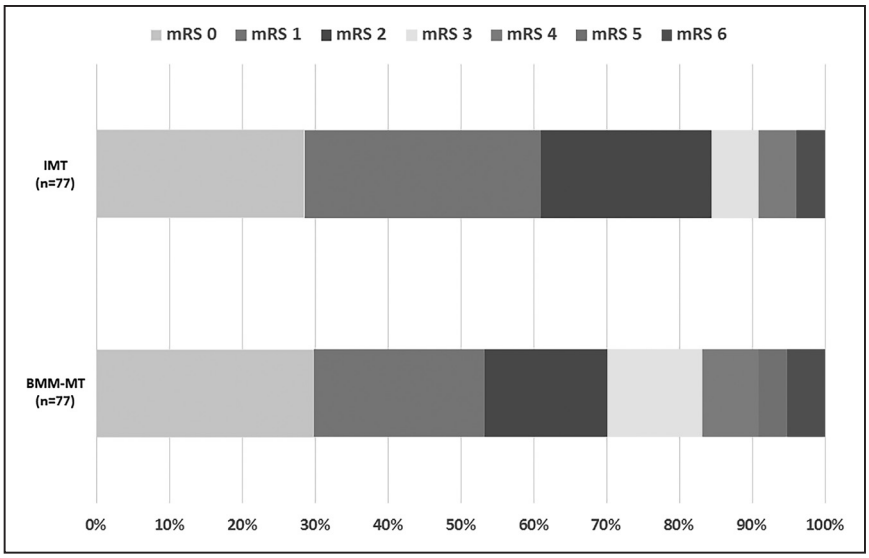

Figure. Ninety-day modified Rankin Scale (mRS) distribution based on the matched cohort. BMM indicates best medical management; IMT, immediate mechanical thrombectomy; and MT, mechanical thrombectomy.

Discussion

In this large multicentric study of patients with versus without IMT, we observed that IMT was an independent predictor of good outcome (OR, 3.1; 95% CI [1.4–6.9]) with an absolute difference of 15%, suggesting that successful early MT improves functional independence. This finding was further corroborated by our matched analysis adjusting for age, baseline NIHSS, and occlusion site (absolute difference in good outcome: 14.4%; 84.4% versus 70.1%; *P*=0.03). In addition, we could show in an exploratory analysis that a modified shift analyses on the mRS within the matched cohort also significantly favored IMT.

Previous studies of smaller single-center and multicenter cohorts reported ambiguous findings in regards to MT in LVO patients with low NIHSS on presentation. Pfaff et al[20] have shown that MT in LVO patients (n=33) with NIHSS ≤8 can be performed safely (sICH, 6%) and with reasonable rates of good outcome (90-day mRS, 0–2; 63.6%) even in longer time windows (median onset to arterial puncture of 320 minutes). Another German single-center report including 41 patients with M1 occlusions and NIHSS 0 to 5 described 4.8% sICH and a 75% rate of good outcome after 3 months.[21] If minor stroke patients deteriorate and rescue MT is performed later (68% >8 hours from onset), MT (n=28) seemed to be associated with better outcome (adjusted OR: 10.9; 95% CI [3–38]) compared with those without MT (n=181).[22] However, rescue MT may be inferior to IMT in these patients. Haussen et al[1] prospectively compared the impact of IMT (n=10) versus initial medical treatment (n=22, including rescue thrombectomy if clinical deterioration) on NIHSS difference from admission to discharge. They found that patients with IMT had higher NIHSS improvement (−2.5 versus 0; *P*<0.01) and a nonsignificantly better clinical outcome at 90 days (mRS 0–2: 100% versus 77%; *P*=0.15).[1] A follow-up study from the same group with a larger sample size corroborated the aforementioned findings and but also demonstrated improved rates of independence at follow-up.[17] Messer et al[16] showed the same trend favoring IMT; good outcomes (mRS, 0–2) were higher in patients with IMT (75%; n=8) as compared with patients with rescue MT (33%; n=6). Notably, patients from these cohorts were included in the current analysis. Conversely, Dargazanil et al[14] demonstrated that patients (n=301) with LVO and NIHSS <8 achieved comparable excellent outcomes (mRS 0–1, 64.5%) but better perfect outcomes (mRS 0, 39.4% versus 27.5%; *P*=0.03) with IMT versus BMM, including rescue MT.[23] In another analysis on 138 patients (NIHSS ≤8) who underwent MT, the reperfusion grade was significantly associated with an increase in excellent outcome; the OR (95% CI) was 3.09 (1.06–9.03) for Thrombolysis in Cerebral Infarction 2B and 6.66 (2.27–19.48) for Thrombolysis in Cerebral Infarction 3.[24] A study on 78 patients from Spain found no benefit for MT within 6 hours after onset over BMM but an increased risk for sICH after MT (11.8% versus 0%; *P*=0.033).[15] In our analysis, as well as in all other above-mentioned series, no significant increase in sICH was observed, with low rates in both groups (5% versus 1.4%; *P*=0.08).

The healthcare impact of this condition is likely considerable. Minor neurological deficits (NIHSS, 0–5) are very common representing approximately half of all strokes.[25] The LVO rates for patients with acute ischemic stroke vary according to clinical severity but are estimated to represent ≈20% of all strokes, and up to 10% of all LVOs may occur with mild symptoms.[26–28] In specialized centers with a high volume endovascular service, LVOs can be detected in up to 30% in selected minor stroke patients.[16] Moreover, a population-based study suggests that there are as many patients with transient ischemic attack as patients with low NIHSS strokes[29] and that their LVO rates are likely to be comparable.[4] However, because current guidelines only recommend MT in patients with NIHSS ≥6,[30] acute vessel imaging in patients with milder symptoms is not routinely performed and hence many of these cases are missed.[31] Therefore, the absolute rates of patients meeting the inclusion criteria for this analysis were low (2.1%–12.2%) in the contributing databases, but this is most likely because of the fact that only a minority of low NIHSS patients received acute vessel imaging.

Our study has significant limitations, most of which are inherent to its retrospective nature and noncontrolled design, including the potential for selection bias, as well as the heterogeneous treatment approach across the different centers over

Table 3. Different Shift Analysis Combinations Based on the Matched Analysis Cohort

	IMT (n=77)	BMM-MT (n=77)	*P* Value	OR	95% CI
90-d mRS (A)*			0.32	1.34	0.76–2.35
0	22 (28.6)	23 (29.9)			
1	25 (32.5)	18 (23.4)			
2	18 (23.4)	13 (16.9)			
3	5 (6.5)	10 (13.0)			
4	4 (5.2)	6 (7.8)			
5	0 (0)	3 (3.9)			
6	3 (3.9)	4 (5.2)			
90-d mRS (B)*			0.03†	2.29	1.05–4.98
0, 1, and 2	65 (84.4)	54 (70.1)			
3	5 (6.5)	10 (13.0)			
4	4 (5.2)	6 (7.8)			
5 and 6	3 (3.9)	7 (9.1)			
90-d mRS (C)*			0.14	1.58	0.86–2.93
0 and 1	47 (61.0)	41 (53.2)			
2	18 (23.4)	13 (16.9)			
3	5 (6.5)	10 (13.0)			
4	4 (5.2)	6 (7.8)			
5 and 6	3 (3.9)	7 (9.1)			
90-d mRS (D)*			0.15	1.57	0.85–2.91
0 and 1	47 (61.0)	41 (53.2)			
2	18 (23.4)	13 (16.9)			
3	5 (6.5)	10 (13.0)			
4, 5, and 6	7 (9.1)	13 (16.9)			

BMM indicates best medical management; IMT, immediate mechanical thrombectomy; mRS, modified Rankin Scale; MT, mechanical thrombectomy; and OR, odds ratio.

*Shift analysis by Van Elteren test/ordinal regression for OR.

†Statistically significant ($P<0.05$).

time. As such, although we have done our best to adjust for potential confounders, our results should be interpreted with caution and viewed as exploratory and hypothesis generating. Only a prospective, randomized controlled trial can appropriately address the critical question on optimal initial management for LVO patients presenting with low clinical severity.

Conclusions

Our retrospective, pilot analysis suggests that immediate thrombectomy in LVO patients with low NIHSS on presentation may be safe and has the potential to result in improved outcomes. Randomized clinical trials are warranted to establish the optimal management approach for this patient population.

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