The influence factors on good outcome and mortality within 3 months after mechanical thrombectomy in patients with acute large vessel occlusion stroke

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Summary

Objective: The influence factors associated with mechanical thrombectomy for patients with acute large vessel occlusion stroke remain to be elucidated. This study aimed to investigate clinical and procedural factors influence on good outcome and mortality after mechanical thrombectomy in a cohort of patients stroke. *Subject and method:* We analyzed clinical; procedural data and results of 123 patients with acute large vessel occlusion stroke, who had treated mechanical thrombectomy. A good outcome was defined as a modified Rankin Scale (mRS) of 0 to 2 at 3 months. The associations between clinical, imaging, procedural factors and good outcome, mortality, respectively, were evaluated using logistic regression analysis. *Result*: Using logistic regression analysis, a deviation of the eyes and head (odds ratio {OR}, 1.17; 95% confidence interval {CI}, 1.01 - 1.34, p=0.03); baseline NIHSS score (OR, 1.17; 95% CI: 1.01 - 1.34; p=0.03) and CTA-based collateral flow assessment (OR, 3.35; 95%CI: 0.12 - 0.72; p=0.007) were independent predictors of good outcome. Seizures, Glasgow score < 8, baseline NIHSS score > 15 and ASPECTS < 7 had associated mortality with p<0.01. Revascularization time, reperfusion of cerebral artery (TICI > 2b, 3), ventilation, tracheostomy, craniotomy, reocclusion, symptomatic intracerebral hemorrhage (sICH) after thrombectomy and complication in treated duration were associated with good outcome and mortality. *Conclusion:* The deviation of the eyes and head, baseline NIHSS score and CTA-based collateral flow were independent predictors of good outcome. Seizures, Glasgow < 8, NIHSS > 15 and ASPECTS < 7 had associated mortality. Revascularization time, reperfusion with TICI > 2a, ventilation, tracheostomy, craniotomy, reocclusion, sICH after thrombectomy and complication were associated with both good outcome and mortality.

Keywords: Acute ischemic stroke, mechanical thrombectomy, prognosis, mortality, outcome.

1. Background

Mechanical thrombectomy has been approved as standard treatment for acute anterior circulation stroke due to occlusions of the internal carotid artery (ICA) or the M1 segment of the middle cerebral artery (MCA) [8] and improvement of functional independence compared with standard medical care. After its acceptance as an effective treatment option, the next steps will be to further establish patient selection criteria and to generalize mechanical thrombectomy to a broader class of stroke patients with acute large vessel occlusions. To further broaden treatment indications for mechanical thrombectomy, understanding the prognostic factors related to clinical outcomes could be essential. Although there exist a few studies that have investigated prognostic factors that predict outcomes after mechanical thrombectomy in patients with acute anterior circulation stroke, these studies are limited by small sample size and the inclusion of patients

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with posterior circulation stroke [9]. Thus, this study aimed to investigate clinical, imaging, and procedural factors predictive of good outcome and mortality after mechanical thrombectomy in a cohort of patients with acute ischemic stroke.

2. Subject and method

2.1. Subject

From July 2016 to December 2017, a total of 123 consecutive patients presenting with acute ischemic stroke due to ICA, MCA, basilar artery (BA) occlusions were treated with mechanical thrombectomy at 108 Military Central Hospital. Patients were followed after 90 days. The institutional ethics committee approved this retrospective analysis and waived informed consent based on the study design. We prospectively collected the following clinical, imaging, and procedural treatment data of these 123 patients.

The inclusion criteria for mechanical thrombectomy were as follows: (1) Age ≥ 18 years, (2) A deficit on the National Institutes of Health Stroke Scale (NIHSS) of ≥ 6 points or any persistent neurologic deficit that is potentially disabling, (3) occlusion of ICA, MCA or BA, (4) no intracranial hemorrhage detected on the cranial CT.

The exclusion criteria were as follows: (1) hemorrhage in the CT; (2) patients who had contraindications on CT; (3) history of severe head trauma, myocardial infarction in the last 3 months; high bleeding risk: platelet count < 100,000/mm^3.

2.2. Evaluation criteria

Multimodal factors were reviewed, including patient age, sex, underlying disease, location of occluded vessel, procedural treatment and complications. All patients underwent clinical assessment with NIHSS at baseline, ASPECTS score, collateral flow score and modified Rankin Scale (mRS) score at 90 days by the review of medical records. Good clinical outcomes were defined as 0-2 mRS at 90 days and mortality were defined as mRS 6. Differences were analyzed in multiple time intervals: Time from symptom onset to groin puncture time, procedure time (from groin puncture to reperfusion time), and time from onset to reperfusion. Radiologic results were evaluated by the number of stent passages, thrombolysis in cerebral infarction (TICI) score and successful recanalization, which was defined as a TICI score of 2b to 3. Safety variables and complications were analyzed regarding distal emboli, symptomatic hemorrhage, and mortality within 90 days.

2.3. Statistical analysis

Continuous variables are presented as medians and interquartile ranges (IQR). Discrete variables are presented as counts (n) and percentages (%). The variables tested in the multivariate logistic regression models were those with $p<0.05$ in the univariate analysis. A multivariate logistic regression analysis was performed to identify independent predictors for mortality at 3 months. Variables with a p value of $p<0.05$ in the univariate analysis on mortality were included in a multivariate logistic regression analysis. All statistical analyses were performed with SPSS software (version 22.0). A p value <0.05 was considered significant.

3. Result

3.1. Baseline characteristics

Table 1. Clinical, image characteristics and results

		Patients (n = 123)	Rate %
Age	($\overline{X} \pm$ SD)	64.8 ± 12.5	
	Max/Min	84/32	

Sex	Male	76	61.7
	Female	47	38.3
History	Hypertension	71	57.7
	Atrial fibrillation	40	32.5

Table 1. Clinical, image characteristics and results *(Next)*

Characteristics		Patients (n = 123)	Rate %
Glasgow score ($\bar{X} \pm SD$)		11.5 ± 2.6	
NIHSS	($\bar{X} \pm SD$)	17.6 ± 6.1	
	Max/Min	42/6	
ASPECTS (n = 103)	($\bar{X} \pm SD$)	7.9 ± 1.8	
Occlusion sites	MCA	59	48.0
	ICA	44	35.8
	BA	20	16.2
CTA collateral (n = 103)	Good	10	9.7
	Modarate	41	39.8
	Poor	54	50.5
Endovascular revascularization	TICI 0, 1, 2a	10	8.2
	TICI 2b	19	15.4
	TICI 3	94	76.4
Reocclusion	TICI 2b, 3 but MORI 0, 1	13	11.4
Outcome 3 months (mRS)	mRS 0-2	77	62.6
	mRS 3-5	24	19.5
	mRS 6 (Mortality)	22	17.9
	Futile recanalization	38	30.9
Time intervention (minutes)	≥ 30	79	64.2
	< 30	44	35.8
Intra cerebral hemorrhage (ICH)	Nonsymptomatic	20	17.4
	Symptomatic	10	8.7
Procedural treatment	Ventilation	28	22.8
	Tracheostomy	19	15.4
	Craniotomy	7	5.7

The average age was 64.8 ± 12.5. Male was 61.7%. Patients with hypertension (57.7%), atrial fibrillation (32.5%). Glasgow scores (11.5), NIHSS score (17.6).

ASPECTS score mean 7.9 ± 1.8. Locations of occlusion: MCA (48%), ICA (35.8%), BA (16.2%). CTA collateral with good level 9.7%, poor level 50.5%.

Endovascular revascularization was successful (TICI 2b, 3) 91.8%. Futile recanalization was 30.9% and good neurological function (mRS ≤ 2) of 62.5%.

Mortality within 90 days was 17.9%.

Time intervention more than 30 miniutes was 64.2% and less than 30 minutes 35.8%.

Intracerebral hemorrhage (ICH) after intervention was 30/123 = 24.4%, with symptomatic ICH was 8.7%.

Some procedural treatment were ventilation (22.8%), tracheostomy (15.4%) and craniotomy (5.7%).

3.2. Relationship between good neurological outcome with clinical characteristics, time, images and procedural treatment

Table 2. Logistic regression analysis of predictors of good outcome

Factors	Odds ratio (OR)	Confidence interval (CI) 95%	p
Age	1.017	0.97 - 1.06	0.43
Time from onset to door (minutes)	1	0.99 - 1.01	0.3
Time intervention	1.01	1.0 - 1.02	0.024
Deviation of eyes and head	2.79	0.14 - 0.95	0.04
Glasgow score	0.9	0.73 - 1.30	0.82
NIHSS score	1.17	1.01 - 1.34	0.03
ASPECTS score	0.97	0.71 - 1.32	0.84
CTA collateral	3.35	0.12 - 0.72	0.007
DSA collateral	0.62	0.27 - 1.35	0.22
TICI score	0.3	0.14 - 0.57	0.001
Ventilation	0.065	0.017 - 0.245	0.06
Tracheostomy	0.03	0.003 - 0.31	0.001
Craniotomy	2.16	0.15 - 31.1	0.57
Reocclusion	0.12	0.03 - 0.47	0.002
Symptomatic ICH	2.54	1.47 - 4.39	0.001

In multivariate analysis, there are 3 factors of patients which was independently associated with good outcome: Deviation of eyes and head sign (OR = 2.79; CI 95%: 0.14 - 0.95; p=0.04); NIHSS score (OR = 1.17; CI 95%: 1.01 - 1.34; p=0.03) and CTA collateral (OR = 3.35; CI 95%: 0.12 - 0.72, p=0.007).

The relevant factors to procedural treatment and complications which was independently associated with good outcome: TICI score (OR = 0.3; CI 95%: 0.14 - 0.57; p=0.001); Tracheostomy (OR = 0.03; CI 95%: 0.003 - 0.31; p=0.001); Reocclusion (OR = 0.12; CI 95%: 0.03 - 0.47; p=0.002); Symptomatic ICH (OR = 2.54; CI 95%: 1.47 - 4.39; p=0.001); Time intervention (OR = 1.01; CI 95%: 1.0 - 1.02; p=0.024).

3.3. Relationship between mortality with clinical characteristics, time, images and procedural treatment

Table 3. Logistic regression analysis of predictors of mortality

Factors	Odds ratio (OR)	Confidence interval (CI) 95%	p
Age	0.9	0.9 - 1.0	0.85
Time from onset to door (minutes)	1.1	0.2 - 6.1	0.35
Time intervention	4.2	1.1 - 16.4	0.04
Deviation of eyes and head	1.7	0.3 - 7.8	0.13
Glasgow score	0.9	0.4 - 0.9	0.012
NIHSS score	1.1	0.9 - 1.3	0.28
ASPECTS score	0,9	0.7 - 1.4	0.16
CTA collateral	0.4	0.1 - 1.1	0.29
DSA collateral	1.55	0.8 - 2.98	0.19

Table 3. Logistic regression analysis of predictors of mortality *(Next)*

Factors	Odds ratio (OR)	Confidence interval (CI) 95%	p
TICI score	0.36	0.19 - 0.67	0.001
Ventilation	0.14	0.05 - 0.43	0.001
Tracheostomy	0.24	0.07 - 0.83	0.024
Craniotomy	1.32	0.15 - 11.6	0.8
Reocclusion	1.93	0.23 - 16.03	0.54
Symptomatic ICH	2.43	1.46 - 3.89	0.001
Malignant brain infarcts	0.06	0.02 - 0.18	0.001

There is a factor of patients which was independently associated with mortality: Glasgow score (OR = 0.9, CI 95%: 0.4 - 0.9, p=0.012).

The relevant factors to procedural treatment and complications which was associated with mortality: TICI score (OR = 0.36, CI 95%: 0.19 - 0.67, p=0.001); Ventilation (OR = 0.14; CI 95%: 0.05 - 0.43, p=0.001). Tracheostomy (OR = 0.24, CI 95%: 0.07 - 0.83, p=0.024); Symptomatic ICH (OR = 2.43, CI 95%: 1.46 - 3.89; p=0.001). Malignant brain infarcts (OR = 0.06, CI 95%: 0.02 - 0.18, p=0.001).

4. Discussion

4.1. Baseline characteristics

Baseline characteristics of all patients are given in Table 1, it has shower mean age was 64.8 ± 12.5 years and there were 47 women (38.3%). Main medical history included hypertension (57.7%), atrial fibrillation (32.5%) and target lesions were in the anterior circulation for 103 (83.7%) patients and the posterior circulation for 20 (16.3%) patients. The level of occlusion was: MCA (48%); ICA (35.8%), and vertebrobasilar arteries (16.2%). Patients presented with an admitting median NIHSS score of 17 (IQR 12 - 25) and mean ASPECTS score was 7.9 ± 1.8. Data from our study was quite same data from Behme D et al in Germany [4]. Our study had median NIHSS score of 17 higher than Behme study and we have used ASPECTS score for evaluation patients before intervention. The most study about acute ischemic stroke used similar baseline characteristics, includes such reputed trials as SWIFT trial, TREVO trial [8].

Technical success: Pre-procedure, patients had mTICI scores of 0 or 1 in all cases. Post-procedure, the overall revascularization rate of

the Penumbra system to TICI 2b-3 was 91.8% therein TICI 3 was 76.4%, but reocclusion was 11.4%. Our all data were higher than result of Behme D et al [4], Saver JL et al in SWIFT trial [8], Zaidat OO et al in NASA registry [8], but similar result of Mokin M et al, 2013 with Solitaire stent (revasculation rate of 88%) [8].

About complications: After the intervention, 24.4% of patients were ICH, in this only 8.7% of patients had sICH. Our result was similar experience of Behme D et al [4] and result of SWIFT trial [8].

At discharge, 62.6% of patients had a favorable neurological outcome, defined as mRS 0 - 2 at 90 days. Death from any cause at hospital was 22/123 patients (17.9%). The result was as similar as result of TREVO study [8]. Our result has shower death from any cause at hospital was 16/101 patients (15.8%) and mortality at 90 days was 21/101 (20.8%), which was lower than Behme D et al in Germany [4] with 32%, but higher than Saver JL et al with 16% or 17% [8]. Good function outcome at 90 days (mRS 0 - 2) was 61.3% (49/80) was higher than Behme D et al [4] of 43%, but similar SWIFT prime with 60% and SWIFT with 58% [8].

4.2. Relationship between good neurological outcome with clinical characteristics, time, images and procedural treatment

In Table 2, we had used multivariate analysis, there are 3 factors of patients which was independently associated with good outcome: Deviation of eyes and head sign (OR = 2.79; CI 95%: 0.14 - 0.95; p=0.04); NIHSS score (OR = 1.17; CI 95%: 1.01 - 1.34; p=0.03) and CTA collateral (OR = 3.35 CI 95%: 0.12 - 0.72, p=0.007). Deviation of eyes and head sign was a famous clinical symptoms, also known as Prevost signs, what were reported widely as signs prognosis of AIS [5]. Particularly, NIHSS scores at admission have been assessed by many authors as the important outcome predictors of AIS patients [2]. When comparison of CTA- and DSA-based collateral flow assessment in patients with anterior circulation stroke, Jansen IGH. et al had concluded that CTA-based collateral flow assessment was significantly associated with mRS at 90 days, whereas DSA was not [6]. Previously, the statistics from the IMS III study, collateral flow assessment by multiple CTA, it was confirmed that collateral flow was the best way to select patients for intervention [7].

The relevant factors to procedural treatment and complications which was independently associated with good outcome: TICI score (OR = 0.3; CI 95%: 0.14 - 0.57; p=0.001); Tracheostomy (OR = 0.03; CI 95%: 0.003 - 0.31; p=0.001); Reocclusion (OR = 0.12; CI 95%: 0.03 - 0.47; p=0.002); Symptomatic ICH (OR = 2.54; CI 95%: 1.47 - 4.39; p=0.001); Time intervention (OR = 1.01; CI 95%: 1.0 - 1.02; p=0.024). With time intervention, Alawieh A. et al at the University of South Carolina School of Medicine in 2018, apply the A direct aspiration first pass technique (ADAPT) to treated AIS patients. With 197 patients, who underwent ADAPT thrombectomy for large vessel occlusions, which had time intervention mean 36.9 ± 34.2 minutes. Recanalization was achieved with 17.8 ± 8.8 in 'early recan' min compared with 70 ± 39.8 min in 'late recan' patients. The likelihood of achieving a good outcome was higher in the 'early recan' group (65.2%) than in the 'late recan' group (38.2%; p<0.001). Besides, patients in the 'late recan' group had a higher likelihood of postprocedural hemorrhage, specifically parenchymal hematoma type 2, than those in the 'early recan' group. Logistic regression analysis showed that baseline NIHSS, recanalization time, and atrial fibrillation had a significant impact on 90 day outcomes [3]. In 2016, Truong Le Tuan Anh, at the Nhan Dan 115 Hospital, had used analysis and multiple logistic regression, there were 4 independent predictors of good outcome (mRS 0 - 2) at 3 month: Less than 70 years old, NHISS scores less than 15, no reocclusion and recanalization with solitaire stent [1]. In 2017, in

Korea, the authors have proved thet age (OR = 0.965; 95% CI: 0.944 - 0.986; p=0.001), successful revascularization (OR = 4.658; 95% CI: 2.240 - 9.689; p<0.001), parenchymal hemorrhage (OR = 0.150; 95% CI: 0.049 - 0.460; p=0.001), and baseline NIHSS score (OR = 0.908; 95% CI: 0.855 - 0.965; p=0.002) were independent predictors of good outcome [9].

4.3. Relationship between mortality with clinical characteristics, time, images and procedural treatment

There is a factor of patients which was independently associated with mortality: Glasgow score (OR = 0.9; CI 95%: 0.4 - 0.9; p=0.012). Our result was similar to report in study of Truong Le Tuan Anh [1]. The relevant factors to procedural treatment and complications which was associated with mortality: TICI score (OR = 0.36; CI 95%: 0.19 - 0.67; p=0.001); Ventilation (OR = 0.14; CI 95%: 0.05 - 0.43; p=0.001); Tracheostomy (OR = 0.24; CI 95%: 0.07 - 0.83; p=0.024); Symptomatic ICH (OR = 2.43; CI 95%: 1.46 - 3.89; p=0.001); Malignant brain infarcts (OR = 0.06; CI 95%: 0.02 - 0.18; p=0.001). The results implemented the previous conclusions of the Yoon W et al, the independent predictors of mortality were age (OR = 1.043; 95% CI: 1.002 - 1.086; p=0.041), successful revascularization (OR = 0.171; 95% CI: 0.079 - 0.370; p<0.001), parenchymal hemorrhage (OR = 2.961; 95% CI: 1.059 - 8.276; p=0.038), and a history of previous stroke/TIA (OR = 3.124; 95% CI: 1.340 - 7.281; p=0.008) [9].

5. Conclusion

The results from 123 acute ischemic stroke patients after mechanical thrombectomy at 108 Military Central Hospital showed that: The factors have effected good outcome, what were no deviation of eyes and head sign, low NIHSS score, good CTA collateral and time intervention below 30 minutes. Signs of seizures, low Glasgow scores, NIHSS scores more than 15 and ASPECTS below 7 were predictors of mortality. TICI score 0 - 2a, ventilation, tracheostomy, craniotomy, reocclusion, symptomatic intracerebral hemorrhage were associated with good outcome recovery and mortality at 3-month.

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