Predictive Factors Associated Clinical Outcome and Mortality in Post Mechanical Thrombectomy in Large Vessel Occlusion in Prasat Neurological Institute

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Abstract

Background: Clinical outcome after large vessel occlusive strokes depends on admitting clinical condition, successful recanalization, and collateral circulation. Some of variables may be adjustable for the better outcome. This study tried to find out the modifiable prognostic factors of acute large vessel occlusion when treated with mechanical thrombectomy.

Methods: This is a retrospective single-center analysis of 60 patients with large vessel occlusion treated with mechanical thrombectomy. Data of patient demographics, laboratory investigation, neuroimaging, procedural characteristics, and clinical outcomes were recorded and analyzed. Primary outcome was set for functional independence at 90 days after stroke onset (modified Rankin Scale score of 0-2). Secondary outcome were death during hospitalization, neurological complications and systemic complications.

Results: The patients with mTICI reperfusion grade 3 have significantly good functional outcome when compared to the mTICI0-2b (odds ratio [OR] 8.532; 95% confidence interval [CI] 1.843-39.501). While the successful recanalization (mTICI2b or 3) did not show significantly different between group of good clinical outcome (mRS 0-2 at 90 days after onset) and group of poor clinical outcome (mRS ≥ 3 at 90 days after onset) (93.8% vs. 75.0%; P = 0.69). In addition, patients with hypertension and diabetic mellitus had poorer clinical outcomes in comparison with patients without these risk factors (78.6% vs. 37.5%; P = 0.02 and 39.3% vs. 6.2%; P = 0.04, respectively). And high baseline NIHSS (>25) score showed higher rate of death at

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discharge (NIHSS 16-25; 80% vs. 53.8% and NIHSS > 25; 20% vs. 0%; P = 0.011).

Conclusions: mTICI3 reperfusion is associated with superior outcome and independent function at 90 days after stroke onset than mTICI2b patients. As reperfusion quality is the most important modifiable predictor of patient outcome, the endovascular treatment approaching to mTICI3 may be considered. Furthermore the patients with high baseline NIHSS > 25 may be associate with higher rate of death. And patients with risk of intracranial atherosclerosis (hypertension and diabetic mellitus) could bring about poorer clinical outcome.

Keywords: Mechanical thrombectomy, Large vessel occlusion, Outcome, Endovascular thrombectomy, Quality of life

Introduction

Acute ischemic stroke is a common medical condition with high burden of disability and death. In Thailand, mortality rate from acute ischemic stroke has been rising since 2014, And now ischemic stroke is the second most common cause of death. According to many evidences, intravenous alteplase is recommended for patient who can be treat within 4.5 hours after stroke onset if no contraindication because of its benefit of significant reduction in morbidity and mortality.[1,2] In acute ischemic stroke patient who have large vessel occlusion and come to the hospital between 4.5 to 6 hours after stroke onset, mechanical thrombectomy is recommended.[1] Meta-analysis of fives randomized controlled trials (RCTs); MR CLEAN, ESCAPE, REVASCAT, SWIFT PRIME and EXTEND IA; have strong evidences that mechanical thrombectomy is superior to intravenous thrombolytic agent in large vessel occlusion (LVO) patients.[3]

Recanalization by endovascular thrombectomy significantly improved functional outcome (mRS of 0-2) at 90 days after stroke onset.[3,4] And in selected patients with LVO between 6-16 hours[5] and 6-24 hours[6] after stroke onset who meet the illegible clinical-imaging mismatch criteria, mechanical thrombectomy is also recommended. Therefore, mechanical thrombectomy is reasonable for reduce morbidity and mortality and improve quality of life. However there are many factors affect the outcome of mechanical thrombectomy treatment such as age, sex, previous medical history, blood sugar level, history of smoking, site of occlusion, the severity of symptom of ischemic stroke and time to treatment.[7-11] According to multiple predictors influence the outcome after endovascular treatment, it is important to consider other modifiable variables that might improve functional outcomes in patients with large vessel occlusion who are candidate for endovascular treatment.

Method

Clinical Assessment

Data was collected from patients with large vessel occlusion who underwent mechanical thrombectomy in Prasat Neurological Institute, a comprehensive stroke center in Thailand, from January 2015 to June 2019. Baseline characteristics including demographics, vascular risk factors, baseline National Institutes of Health Stroke Scale (NIHSS) score, site of arterial occlusion, baseline Alberta Stroke Program Early Computed Tomography Score (ASPECTS), admission serum glucose, systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels and status of intravenous

alteplase treatment were recorded. ASPECTS score and multiphase CTA collateral grading by American Society of interventional and therapeutic neuroradiology society of interventional radiology (ASITN/SIR) were calculated independently by interventional neurologist and neuro-radiologist who were blinded to subject identity/disease severity and treatment regimen. The ASPECTS scale is a 10-point scoring system to quantify early ischemic changes in the middle-cerebral-artery territory, with a score of 10 indicating normal and 1 point subtracted for each abnormal region. The collateral grading for anterior circulation was reported in 5 grades (grade 0,grade 1, grade 2, grade 3, grade 4). Collateral grade 0 means the worst collateral vessels supply and grade 4 for the best one. In case of discrepancy scores from two reviewers, a consensus review was performed by the third neuroradiologist.

Successful recanalization at the end of endovascular procedure was defined by original Thrombolysis in Cerebral Infarction (TICI) score or modified Thrombolysis in Cerebral Infarction (mTICI) scores of 2b or 3. TICI or mTICI scores were obtained from the reports of endovascular specialists.

Symptomatic intracranial hemorrhage (sICH) was defined as presence of a parenchymal hematoma type 2 on brain CT. Neurologic deterioration with an increase in NIHSS score of 4 points within 36 hours from treatment. Functional outcome was evaluated at 90 days using the modified Rankin Scale (mRS) score. The mRS scores, which ranges from 0 (no symptoms) to 6 (death) were recorded in out patient clinic document when patients came to hospital visit or were evaluated by telephone follow-up.

Outcome Measurement

Primary outcome included functional independence at 90 days after onset. Good outcome (functional independence) in our study was defined as an mRS score of 0-2 and a poor outcome was defined as an mRS score of 3-6. While deaths during hospitalization, neurological complications (neurologic deterioration, hemorrhagic transformation, symptomatic intracranial hemorrhage, brain edema, subarachnoid hemorrhage, intraventricular hemorrhage) and systemic complications (infection and extracranial bleeding) represented secondary outcomes.

Moreover, at 3 months after treatment, all patients were interrogated quality of life (Qol) question by using the EQ5D-5L health status questionnaire by EuroQol group.

Statistical analyses

Continuous variables are presented as mean ± SD (normal distribution) and as median with IQR (skewed distribution). Categorical variables are presented as percentages with their corresponding 95% CIs. Statistical comparisons between two groups were performed using the χ^2 test or, in case of small expected frequencies, the Fisher' exact test. Continuous variables were compared by the use of the unpaired t test or Mann-Whitney U test, as indicated. For exploring the factors associated with 90-day outcomes, the baseline variables showing possible associations with the outcomes in the univariate logistic analysis ($P < 0.10$) were entered in the multivariate logistic regression model by using the backward stepwise (likelihood ratio) method to calculate the odds ratio (OR) with its 95% confidence interval (CI). Statistical significance was achieved in multivariate logistic

regression models with a two-tailed value of $p<0.05$. The Statistical Package for Social Science (SPSS) V.22.0 for Windows was used for statistical analyses.

Results

Baseline characteristics of the patients

Sixty-seven patients were enrolled to our study. Seven patients were excluded due to incomplete data or no shown follow up information. The remaining study population consisted of 60 acute ischemic stroke patients with large vessel occlusion who underwent mechanical thrombectomy procedure. Baseline characteristics of the study population are presented in Table 1. Mean age was 62.0 (±15) years; 34 (56.7%) were male. Thirty-four cases (56.7%) received intravenous thrombolytic agents. The median symptom onset to groin puncture time was 334 minutes (interquartile range [IQR], 267-417 minutes), the mean from successful groin puncture to revascularization time was 93.3 ± 49.9 minutes and the median from symptom onset to revascularization time was 429.5 minutes (IQR, 363.5-513.75 minutes). Mean NIHSS score on admission was 15.82 ± 5.9. Sixteen patients had internal carotid artery occlusion (26.7%), 30 patients had proximal (M1) middle cerebral artery (MCA) occlusion (50%), 3 patients had M2 MCA occlusion (5%), and the remaining 11 patients had posterior circulation; basilar artery occlusions in 10 patients (16.7%) and posterior cerebral artery in 1 patient (1.67%). Successful recanalization (mTICI 2b or 3) was achieved in 51 patients (85%).

Table 1 Baseline characteristics of the study population

Variable	
Age, y, mean±SD	62.0 ± 15
Male sex, n (%)	34 (56.7)
Hypertension, n (%)	34 (56.7)
Diabetes mellitus, n (%)	13 (21.7)
Atrial fibrillation, n (%)	10 (16.7)
Chronic renal failure, n (%)	3 (5)
Smoking, n (%)	24 (40)
Mean±SD baseline NIHSS score, points	15.82 ± 5.9
IV thrombolytic treated, n (%)	34 (56.7)
Median (IQR) symptom onset to groin puncture, min	334 (267 - 417)
Median (IQR) symptom onset to recanalization, min	429.5 (363.5 - 513.75)
Mean±SD procedure time, min	93.3 ± 49.9
Successful recanalization achieved (mTICI 2b or 3), n (%)	51 (85)
Site of vessel occlusion, n (%)	
Internal carotid artery	16 (26.7)
Middle cerebral artery	
First segment	30 (50.0)
Second segment	3 (5.0)
Posterior arterial circulation	
Basilar artery	10 (16.7)
Posterior cerebral artery	1 (1.67)

Main Results

From sixty patients, there were 32 cases (53%) who had good clinical outcome (mRS 0-2 at 90 days after stroke onset). Six patients were dead (10%) at discharge. Cause of death were symptomatic intracerebral hemorrhage with brain edema (4 cases), brain edema (1 case) and subarachnoid hemorrhage (1 case).

As shown in Tables 2, patients with hypertension and diabetic mellitus had poor clinical outcomes when compared to good clinical outcome group (78.6% vs. 37.5%; *P = 0.02* and 39.3% vs. 6.2%; *P = 0.04*, respectively). Patients with good clinical outcome had lower admission serum glucose (113.5 [IQR], 93.75 - 132.50 vs. 138.0 [IQR], 113.5 - 200.0; *P = 0.01*). The patients with functional independence had lower admission NIHSS score (NIHSS = 6-15) than the patients with dependent group (NIHSS 6-15 = 56.7% vs. 25% and NIHSS >16 = 43.8% vs. 75%, *P = 0.14*).

As shown in Tables 3, patients with good baseline ASPECTS score, ASPECTS score = 9 to 10, had better clinical outcome when compared to the poor outcome group (44.5% vs. 9.1%; *P = 0.046*). Patients with good clinical outcome frequently had good collateral grading (grade 3-4 on ASITN/SIR) than those with poor clinical outcome at 90 days after thrombectomy (71.41 vs. 36.8; *P = 0.028*).

The surrogate outcome of successful recanalization (mTICI 2b/3) had no effect on good and poor clinical outcome groups (93.8% vs. 75.0%; *P = 0.69*). But the rate of good clinical outcome in patients who had final mTICI3 after revascularization was significant higher than the poor clinical outcome group (75.0% vs. 35.7%; *P = 0.002*).

After intervention, patients who developed brain edema had poorer clinical outcome significantly (72.7% vs. 25.0%; *P = 0.034*) . However patients with brain edema had no significant different when compared between group of death at discharged and group of clinical improved at discharge. (100.0% vs. 50.0%; *P = 0.059*). As shown in Tables 5, the patients with high baseline NIHSS score at admit had higher rate of death at discharge (NIHSS 16-25; 83.3% vs. 53.8% and NIHSS > 25; 16.7% vs. 0% ; *P = 0.011*).

Factors Associated with Good Clinical Outcome

In multivariate analysis, the only one factor was found to be associated with good clinical outcome (Table 4): mTICI score after revascularization grade 3 (mTICI3 vs. mTICI0-2b; OR=8.532, *P = 0.006* ; 95%CI, 1.843-39.501). While other factors such as risk of atherosclerosis (hypertension and diabetic mellitus), baseline NIHSS score and successful revascularization (final mTICI 2b or 3) had no significantly associated with functional independent at 90 days after stroke onset.

Table 2 The characteristics of patients with functional independent and dependent at 90 days

Variable	Good neurological outcome* (n=32)	Poor neurological outcome** (n=28)	*P* value
Age, y, median (IQR)	61.0 (42.25 - 69.25)	64.5 (57.0 - 80.5)	.011
Male sex, n (%)	20 (62.5)	15 (50.0)	.330
Hypertension, n (%)	12 (37.5)	22 (78.6)	.002
Diabetes mellitus, n (%)	2 (6.2)	11 (39.3)	.004
Atrial fibrillation, n (%)	6 (18.7)	4 (14.2)	.734
Chronic renal failure, n (%)	1 (3.1)	2 (7.1)	.594
Previous stroke (score of 0 or 1 on mRS), n (%)	4 (12.9)	11.1	1.000
Smoking, n (%)	14 (43.8)	10 (35.7)	.526
Baseline NIHSS score, n (%)			.014
6-15	18 (56.7)	7 (25.0)	
>16	14 (43.8)	21 (75.0)	
Admission systolic blood pressure, mmHg, median (IQR)	147.5 (130.25 - 166.75)	160.0(139.25 - 180.00)	.098
Admission diastolic blood pressure, mmHg, median (IQR)	85.0 (77.0 - 92.25)	89.5 (80.0 - 102.75)	.134
Admission serum glucose, mg/dL, median (IQR)	113.5 (93.75 - 132.50)	138.0 (113.5 - 200.0)	.001
Admission low density lipoprotein, mg/dL, median (IQR)	119.5 (95.5 - 130.75)	100.5 (73.0 - 116.75)	.012
IV thrombolytic treated, n (%)	20 (62.5)	14 (50.0)	.330
Symptom onset to tissue plasminogen activator bolus time, min, median (IQR)	220.00 (150.00 - 260.00)	167.00 (106.50 - 218.50)	.113
Symptom onset to groin puncture, min, median (IQR)	429.50 (351.25 - 509.25)	440.00 (377.25 - 588.50)	.339
Symptom onset to recanalization, min, median (IQR)	434.00 (347.00 - 511.00)	421.00 (373.25-667.00)	.481
Successful recanalization achieved (mTICI 2b or 3), n (%)	30 (93.8)	21 (75.0)	.069
Final score on mTICI after recanalization, n (%)			.002
0 - 2b	8 (25.0)	18 (64.3)	
3	24 (75.0)	10 (35.7)	
Post thrombectomy stenosis, n (%)	10 (32.3)	15 (53.5)	.131
Symptomatic intracranial hemorrhage, n (%)	8 (25.0)	3 (10.7)	.217
Extracranial bleeding, n (%)	8 (25.0)	9 (32.1)	.729
Brain edema, n (%)	8 (25.0)	20 (72.7)	.034
Infection, n (%)	28 (87.5)	20 (72.7)	.426

*good neurological outcome = mRS at 90 days after stroke onset ≤ 2

**poor neurological outcome = mRS at 90 days after stroke onset ≥ 3

Table 3 Factors associated with good neurological outcome in anterior cerebral circulation (mRS score at 90 days ≤ 2)

Factors	Good neurologic outcome (n = 27)	Poor neurologic outcome (n = 22)	*P* value
ASPECTS on baseline CT, n (%)			.046
9-10	12 (44.5)	2 (9.1)	
7-8	11 (40.7)	13 (59.0)	
≤ 6	4 (14.8)	7 (31.8)	
Collateral grading by American Society of interventional and Therapeutic Neuroradiology/Society of Interventional Radiology, n (%)		.028	
0-2	6 (28.6)	12 (63.2)	
3-4	15 (71.4)	7 (36.8)	
Site of intracranial artery occlusion, n (%)			
Internal carotid artery	8 (29.6)	8 (32.0)	.853
M1 segment middle cerebral artery	17 (63.0)	13 (52.0)	.424
M2 segment middle cerebral artery	2 (7.4)	1 (4.0)	1.00

Table 4 Factors associated with good neurological outcome (mRS score at 90 days ≤ 2)

Variable	OR	95% CI	*P* value
No history of hypertension	2.612	.592-11.521	.205
No history of diabetes mellitus	4.517	.679-30.036	.119
Baseline NIHSS score			
6-15	3.031	.675-13.604	.148
Successful recanalization*	1.299	.130-13.015	.824
mTICI score after revascularization			
Grade 3	8.532	1.843-39.501	.006

*Successful recanalization = mTICI score after revascularization = 2b or 3

Secondary Outcomes

There were 6 patients (10%) from total 60 cases who died when discharge. There were multiple sites of vessel occlusion; M1 of MCA occlusion (4 cases), internal carotid artery (1 case) and basilar artery (1 case). Cause of death were symptomatic intracerebral hemorrhage with brain edema (4 cases), brain edema (1 case) and subarachnoid hemorrhage (1 case).

As shown in Tables 5, the patients with high baseline NIHSS scored associated with higher rate of death at discharge (NIHSS 16-25; 83.3% vs. 53.8% and NIHSS > 25; 16.7% vs. 0% ; *P = 0.011*). Mortality at discharge did not differ significantly between the previous antiplatelet or anticoagulant used group and the group of patient who did not have (66.7% vs. 35.2%; *P = 0.70*). The median time from symptom onset to IV thrombolysis, the median time from symptom onset to groin puncture, and the median time from symptom onset to revascularization time in mortality group were 127.0 (IQR, 109.0 - 159.0), 300.0 (IQR, 235.5 - 660.5), 378.0 (IQR, 352.0 - 717.0) respectively and there were no significantly different from improved patients at discharge (*P = 0.085*, 0.471,0.383 respectively).

Table 5 Factors associated with death at discharge

Variable	Death at discharged (n=6)	Improvedat discharged (n=54)	*P* value
Age, y, median (IQR)	67.0 (52.5 - 81.5)	63.0 (50.5 - 71.5)	.414
Previous antiplatelet or anticoagulant used, n (%)	4 (66.7)	19 (35.2)	.070
Baseline NIHSS score, n (%)		.011	
6-15	0 (0.0)	25 (46.2)	
16-25	5 (83.3)	29 (53.8)	
> 25	1 (16.7)	0 (0.0)	
Minutes from onset to tissue plasminogen activator bolus time, min, median (IQR)	127.00 (109.00 - 159.00)	202.50 (145.00 - 249.50)	.085
Minutes from onset to groin puncture, min, median (IQR)	300.00 (235.50 - 660.50)	336.00 (272.00 - 422.00)	.471
Minutes from onset to recanalization, min, median (IQR)	378.00 (352.00 - 717.00)	446.00 (372.50 - 516.50)	.383
Brain edema, n (%)	6 (100.0)	27 (50.0)	.059
Post intervention infection, n (%)	0 (0.0)	45 (83.3)	.042

There were 45 patients (75%) who had complications after endovascular intervention. Nineteen patients from total 45 patients had good functional outcome (mRS = 0-2 at 90 days after onset) and the remaining 26 patients had poor functional outcome (mRS = 3-6 at 90 days after onset). Eight patients had neurological complications (neurologic deterioration, hemorrhagic transformation, symptomatic intracranial hemorrhage, brain edema, subarachnoid hemorrhage, intraventricular hemorrhage). Fourteen patients had systemic complications (infection and extracranial bleeding). And 23 patients had both neurological complications and systemic complications. The 17 patients (from total 23 cases; 74%) with both neurological and systemic complications developed poor functional outcome. In the same way, 62.5% of patients with only neurological complications also had poor functional outcome. But only 4 cases from total 14 cases of patients (28.5%) with systemic complications had poor clinical outcome.

As shown in Tables 6, stent retriever was used as the most common technique in 42 cases (70%). The second most commonly employed technique was the aspiration (12 case; 20%) and the less common was balloon angioplasty (6 case; 10%). The techniques of procedure, the procedure attempts and failed recanalization were not different between the complicate group and no complication).

Prespecified secondary clinical outcomes regarding to mortality at discharge and complication occurred during hospitalization were shown in Table 5 and 6; The proportion of outcomes indicating death at discharged had significantly higher NIHSS score as described above but had no significantly different when analyzed with multivariate analysis. Not only mortality at discharged outcome but complication after intervention outcome also did not differ significantly when analysed with multivariate analysis.

Table 6 Factors associated with complications after intervention

Variable	Complication occurs (n = 45)	No complication occurs (n = 15)	*P* value
Mechanical thrombectomy technique, n (%)		.166	
Stent retriever	32 (72.7)	10 (66.7)	
Aspiration	10 (22.7)	2 (13.3)	
Balloon angioplasty	2 (4.5)	4 (26.7)	
Type of stent retriever, n (%)		.244	
Solitaire	45 (100.0)	14 (93.3)	
Trevo	0 (0.0)	1 (6.7)	
Minutes from onset to groin > 360 minutes, min, median (IQR)	480.00 (412.00 - 844.00)	413.50 (376.75 - 445.50)	.033
Minutes from onset to groin > 360 minutes, n (%)		.089	
with NIHSS baseline 6-15	15 (33.3)	11 (73.3)	
with NIHSS baseline 16-25	30 (66.7)	4 (26.7)	
No. of procedure attemp, n (%)		.712	
1-3	36 (79.5)	13 (86.7)	
>3	9 (20.5)	2 (13.3)	
Failed recanalization, n (%)	4 (8.9)	0 (0.0)	.564

Besides of death and complications, quality of life (Qol) after intervention was assessed. Quality of life at 90 days after stroke onset was set for secondary outcome. The EuroQoL Group 5-Dimension self report Questionaire (EQ5D-5L) was used for the mea-surement of health status. The utility scores range from -0.283 to 1.00, with higher scores indicating better quality of life. Our study data showed the mean utility of EQ5D-5L was 0.42±0.46 and the median utility of patients with good functional outcome group was ≤0.960 (IQR; 0.803-1.00).

Discussion

From our study, we found 32 patients from total 60 patients (53%) had good clinical outcome (mRS 0-2 at 90 days after stroke onset) same as the Highly Effective Reperfusion evaluated in Multiple Endovascular Stroke Trials (HERMES) showed intervention population group achieved mRS score 0-2 at 90 days after underwent the endovascular treatment for 46% (291 cases/total 633 cases). In addition to primary outcome, mortality rate at 90 days from our study was 16.7% and had in accord with HERMES trial that had mortality rate in group of intervention for 15.3%.

As known that hypertension and diabetes mellitus are common causes of atherosclerosis. Tsang ACO et al[12] reported the patient with intracranial atherosclerosis large vessel occlusion had high prevalence of diabetes mellitus and hypertension. Zhang M et al[13] showed diabetes mellitus was independent risk factor for poor prognosis patients with anterior circulation acute ischemic stroke who underwent mechanical thrombectomy. Lee JS et al.[14] also reported intracranial atherosclerotic occlusion had poorer 3-month functional independence compared to embolic occlusion. The results might be attributed to the fact that intracranial atherosclerosis can cause vascular insufficiency.[15] Furthermore Kim YW et al.[16] showed intracranial atherosclerotic disease associated with longer procedure time and poorer clinical outcome. Concordant to multiple studies, our study indicates that hypertension and diabetes mellitus may associate with higher rate of poor functional outcome (mRS ≥ 3 at 90 days after stroke onset) because diabetes mellitus and hypertension could associate with intracranial atherosclerosis and could bring about longer procedure time, reflecting the procedure complexity.

Same as intracranial atherosclerosis, the poor collateral grading may cause poor clinical outcome. Our study found the patients with poor clinical outcome frequently had poor collateral grading (grade 0-2 on ASITN/SIR). Nambiar V, et al[17] reported patients with intermediate or good collaterals who recanalized showed a statistically significant association with good clinical outcome while patients with poor collaterals and achieved recanalization did not have good outcome. Bang OY, et al[18] also demonstrated pretreatment collateral grade determined the recanalization rate after endovascular revascularization therapy. Luo Gang, et al[19] also showed the poor collateral grading status was independent predictor of mortality at 90 days in patients with acute posterior circulation stroke who underwent thrombectomy.

Our study reveals no significant differentiation between group of independent and dependent function at 90 days after stroke onset with successful recanalization (mTICI 2b or 3) achieved. But we have found the patient with good clinical outcome group had higher number of mTICI 3 achievement

significantly. A recent systematic review and meta-analysis of the 14 trials (2379 patients included) demonstrated TICI3 reperfusions are associated with superior outcome and better safety profiles than TICI2b reperfusions.[20] In addition, Dargazanli C, et al[21] published a prospective randomized multicenter trial that revealed patient who underwent mechanical thrombectomy with mTICI grades 2c and TICI3 reperfusion had a higher rate of favorable outcome than patients with mTICI2b. Therefore achieving the mTICI 2C/3 reperfusion grade rather than mTICI 2b should be the goal in endovascular stroke treatment for anterior ischemic stroke with large vessel occlusion.

A recent multicenter trial found a significant relationship between higher baseline NIHSS scores and futile recanalization (futile recanalization; LVO with near complete or complete recanalization TICI grades 2b and 3 with 3 months mRS score 3-6).[22] From our data the higher NIHSS score may result in independent function at 90 days after stroke onset and mortality at discharge. Because the higher NIHSS score indicates more severity of ischemic stroke disease, the core infarction and neuronal death rate become higher and penumbra zone may less be spared.

However we have not found associations between functional independent and other demographics variabilities, admission SBP and DBP levels, pretreatment with IV thrombolytic agents, onset to groin puncture time, onset to recanalization time or successful revascularization at the end of mechanical thrombectomy. Besides of functional independent, our study assessed quality of life (Qol) after intervention at 90 days after stroke onset by using EQ5D-5L score. This study data showed mean utility of EQ5D-5L was 0.42 ± 0.46. MR CLEAN study[23] presented secondary outcome as median EQ5D score at 90 days = 0.69 (0.33 - 0.85) in actual intra-arterial group (mechanical thrombectomy 83.7% and acute cervical carotid stenting 12.9%). From ESCAPE study[24], the data revealed the endovascular treatment patients had better quality of life than control group. The median EQ-5D visual analogue scale score at 90 days in intervention group was 80 (60-90). The EQ-5D visual analogue scale scores range from 0 to 100, with 0 indicating the worst possible quality of life and 100 the best possible quality of life. Similar to ESCAPE study, our study found mean EQ-5D visual analogue scale scores from mechanical thrombectomy was 67.1 ± 32.

Although EQ5D scores in our study seem inferior than other previous studies, but the population's characteristic were quite different. In our study, the participants were included both anterior and posterior circulation stroke, onset to groin puncture extended to 24 hours after onset and did not exclude poor collateral cases (MR CLEAN trial included only anterior cerebral circulation LVO and excluded patients with onset to groin >6 hours / ESCAPE trial also enrolled only anterior circulation stroke, time from onset to groin up to 12 hours and moderate to good collateral circulation). By the way, the median utility of patients with good functional outcome group in our study was 0.960 (IQR; 0.803-1.00) that mean nearly normal life. If there is a good selection for patient with LVO before undergo through mechanical thrombectomy, there will be bring about both independent functional outcome and good patient's quality of life.

Limitation of our study including the small sample size and retrospective analysis in a single center, a technique level limitation and patient se-

lection bias may exist. The individual medical records are vary and may be incompleted in some data. Not every patients obtained CTA, so the collateral grading could not be evaluate in all patients. Moreover there were some patients who did not come to follow up at the hospital visit, the telephone follow up was used for evaluate mRS score and quality of life.

Conclusion

mTICI3 grading reperfusion is associated with superior outcome and independent function at 90 days after stroke onset than mTICI2b patients. As reperfusion quality is the most important modifiable predictor of patient outcome, the endovascular treatment approaching to mTICI3 may be considered for better clinical outcome.

The patients with high baseline NIHSS > 25 reflect to high disease severity and may be associate with higher rate of death. And patients with risk of intracranial atherosclerosis (hypertension and diabetic mellitus) and poor collateral grading could bring about poorer clinical outcome. Preoperative evaluation and case selection before go on mechanical thrombectomy may be benefit for improve clinical prognosis.

Disclosure

The authors declared no conflicts of interest in this study.

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