International Journal of Clinical and Experimental Medicine Research, 2024, 8(4), 522-527
https: //www.hillpublisher.com/journals/ijcemr/
ISSN Online: 2575-7970
ISSN Print: 2575-7989

NIHSS Score Prognostic Effect of Mechanical Thrombectomy in Patients with Acute Mild Ischemic Stroke Complicated with Large Vessel Occlusion

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How to cite this paper: Wei Wei, Jianwei Xiang, Aiping Li, Beibei Chen. (2024) NIHSS Score Prognostic Effect of Mechanical Thrombectomy in Patients with Acute Mild Ischemic Stroke Complicated with Large Vessel Occlusion. *International Journal of Clinical and Experimental Medicine Research*, 8(4), 522-527.
DOI: 10.26855/ijcemr.2024.10.002

Received: July 30, 2024
Accepted: August 28, 2024
Published: September 26, 2024

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Abstract

Objective: To investigate the effectiveness of mechanical thrombectomy for acute mild ischemic stroke (LVO-MIS) complicated with large vessel occlusion. **Methods:** A total of 80 cases of LVO-MIS admitted to three hospitals from February 1, 2023, to January 1, 2024, were divided into 2 groups according to the random number table method. 40 cases of bridge treatment were the control group, and 40 cases of mechanical thrombectomy were the observation group. The prognostic effect of the two groups was compared. **Results:** The improvement of NIHSS score at 14 days after operation was compared between groups, and the observation group was slightly lower than the control group after treatment, with no significant difference ($P > 0.05$). The rate of good prognosis among groups was better than that of the control group ($P < 0.05$), and the rate of vascular revascularization and the incidence of symptomatic cerebral hemorrhage among groups were slightly better than that of the control group, but there was no significant difference ($P < 0.05$). The incidence of hemorrhage conversion in the observation group was lower than that in the control group, and the difference between groups was significant ($P < 0.05$). **Conclusion:** The safety and effectiveness of mechanical thrombectomy in patients with LVO-MIS have been confirmed, and the effect of mechanical thrombectomy is comparable to that of clinical bridging therapy. In addition, mechanical thrombectomy can also reduce the incidence of hemorrhage transformation in patients with LVO-MIS, improve safety and efficacy, and can be applied clinically.

Keywords

Mechanical thrombectomy; Large blood vessel occlusion; Acute mild ischemic stroke; Prognosis; Effectiveness

1. Introduction

Acute ischemic stroke has a certain mortality rate, especially anterior circulation large blood vessel occlusion, which will not only affect the prognosis of patients and reduce their quality of life but also significantly increase the mortality of patients within 12 weeks of onset [1]. Mechanical thrombectomy is currently an effective method to relieve vascular obstruction in clinical practice. Although it can help patients open blood vessels and provide blood oxygen support for ischemic brain tissue, most patients with anterior large vascular occlusion are accompanied by serious damage to the blood-brain barrier and obvious symptoms of cerebral edema, and severe cerebral edema will continue to aggravate the disease and lead to death of patients [2]. However, there have been few reports of cerebral edema after mechanical thrombolysis in patients with anterior large blood vessel occlusion. Some scholars evaluated vascular recanalization in patients with modified thrombolysis in cerebral infarction (mTICI). It was found that mTICI ≤ 2a indicated a poor prognosis 90 days after surgery [3]. Next, this study will investigate the effectiveness of mechanical thrombectomy for LVO-MIS.

2. Materials and methods

2.1 General information

A total of 80 patients with LVO-MIS admitted to three hospitals from February 1, 2023, to January 1, 2024, were divided into 2 groups according to the random number table method.40 cases of bridge treatment were the control group and 40 cases of mechanical thrombectomy were the observation group. There were 28 males and 12 females in the observation group. The average age was (61.80 ± 3.46) years, ranging from 32 to 88 years. Causes of stroke: 26 cases of atherosclerosis, 12 cases of cardiogenic infarction, and other 2 cases. There were 26 males and 14 females in the bridging group. The average age was (61.67 ± 3.38) years, ranging from 30 to 85 years. The causes of stroke were as follows: 25 cases were atherosclerosis type, 10 cases were cardiogenic infarct type, and 5 cases were others. There was no significant difference in the general data between the two groups ($P > 0.05$), which was comparable. This study was reviewed and approved by the Medical Ethics Committee.

2.2 Inclusion and exclusion criteria

Inclusion criteria: The patients met the diagnostic criteria related to ischemic stroke [4] and were diagnosed with acute anterior circulation large vessel occlusion by MRA and CTA. Onset to intravenous administration ≤ 4.5 h; Sign informed consent; Duration of cerebral infarction symptoms ≥ 30 min.

Exclusion criteria: cerebral hemorrhage; Serious insufficiency of vital organs such as liver and kidney; Obvious bleeding tendency or active bleeding; Severe cardiovascular and cerebrovascular diseases; Mental illness.

2.3 Methods

The observation group was treated with direct mechanical thrombectomy: after general anesthesia, the patient was taken to a supine position, the bilateral inguinal area was disinfected, the right femoral artery was punctured, the 8F vascular sheath was inserted, and total cerebral angiography was performed to check the collateral circulation compensation, the occlusion of the diseased blood vessels, and the operation path. After the responsible vessel was identified, 6F intermediate catheter and 8F guiding catheter were inserted, and the microcatheter was passed through the blocked section of the responsible vessel with the cooperation of the microguide wire, and the microguide wire was withdrawn. The length and location of the thrombus were determined by microcatheter angiography, and the Solitaire AB stent was placed and released through the microcatheter. 5 minutes later, the microcatheter, stent, and intermediate catheter were pulled out of the guiding catheter together. When the stent is withdrawn, the fluid in the middle catheter and the guide tube stops dripping, and the two are maintained for continuous negative pressure suction to control blood flow. The thrombus can be removed multiple times if necessary.

The control group was treated with 0.9mg/kg alteplase (Boehringer Ingelheim Pharma GmbH & Co.KG, approval number: S20160055), 10% of the total dose was first injected intravenically, and then the remaining 90% was continuously pumped with a micropump within 1h. CTA+CTP or MRI+DWI+MRA were performed. If the patient was accompanied by intracranial large blood vessel occlusion, mechanical thrombectomy was performed immediately, and cerebral angiography, intravenous thrombolysis, and mechanical thrombectomy could be performed at the same time, without waiting for the effect of intravenous thrombolysis. Mechanical thrombectomy should be terminated if the first intraoperative angiography shows the recanalization of the occlusive great vessel.

2.4 Observation indicators

(1) An angiographic review was conducted immediately after surgery, and the vascular recalculation of the two groups was evaluated using the modified cerebral infarction thrombolysis test (mTICI) scale [5]. No perfusion was grade 0, little or no perfusion, and only a small amount of blood flow through the occlusive segment was grade 1; The downstream ischemic area within 50% of partial perfusion of forward blood flow was grade 2a;

The downstream ischemic area with 50% and above partial perfusion of the anterior blood flow was grade 2b; Complete perfusion of anterior blood flow to the downstream ischemic area is grade 3, and 2b and above indicate vascular recanalization.

(2) The National Institutes of Health Stroke Scale (NIHSS) was used to evaluate the degree of neurological impairment in the two groups before and 14 days after surgery, with a total score of 42 points. The lower the score, the less severe the degree of neurological impairment.

(3) Three months after surgery, the patients' prognosis was evaluated with the modified Rankin Scale (mRS), with a score ranging from 0 to 6, 0 being completely asymptomatic and 6 being dead. An mRS Score of 0 to 2 indicates a good prognosis and a score of 3 to 6 indicates a poor prognosis.

(4) The incidence of symptomatic craniocerebral hemorrhage and hemorrhage transformation was observed in the two groups.

2.5 Statistical methods

Data were analyzed using SPSS21.0 statistical software. The statistical data were expressed as percentages (%) and the χ^2 test was used. Measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and tested by t. $P < 0.05$ was considered statistically significant.

3. Results

3.1 Comparison of neurological impairment between groups

There was no significant difference in NIHSS score between the two groups before surgery, and the improvement of NIHSS score at 14 days after surgery showed a slight decrease in the observation group compared with the control group after treatment, with no significant difference ($P > 0.05$) (see Table 1).

Table 1. Comparison of nerve function deficit scores between groups [n, ($\bar{x} \pm s$)]

Group	n	Before operation	Postoperation 14d
Observation group	40	16.22±1.86	9.69±1.65
Control group	40	16.18±1.91	8.96±1.77
t	/	0.095	1.919
P	/	>0.05	>0.05

3.2 Comparison of vascular revascularization rate and prognosis between groups

The rate of good prognosis among groups was better than that of the control group ($P < 0.05$), and the rate of vascular revascularization and the incidence of symptomatic cerebral hemorrhage among groups were slightly better than that of the control group, but there was no significant difference ($P < 0.05$) (see Table 2).

Table 2. Comparison of vascular revascularization rate and prognosis between groups (n, %)

Group	n	Vascular recanalization		Prognosis	
		recanalization	The vessel is not recanalized	Good prognosis	Poor prognosis
Observation group	40	28（70.00）	12（30.00）	20（50.00）	20（50.00）
Control group	40	32（80.00）	8（20.00）	11（27.50）	29（72.50）
χ^2	/	1.068		4.266	
P	/	>0.05		<0.05	

3.3 Comparison of symptomatic craniocerebral hemorrhage rate and hemorrhage conversion rate between groups

There was no significant difference in the incidence of symptomatic cerebral hemorrhage between groups ($P > 0.05$). The incidence of hemorrhage conversion in the observation group was lower than that in the control group, and the difference between groups was significant ($P < 0.05$) (see Table 3).

Table 3. Comparison of symptomatic craniocerebral hemorrhage rate and hemorrhage conversion rate between groups (n, %)

Group	n	Rate of symptomatic craniocerebral hemorrhage	Incidence of hemorrhage transformation
Observation group	40	6 (15.00)	6 (15.00)
Control group	40	3 (7.50)	14 (35.00)
χ^2	/	0.502	4.268
P	/	>0.05	<0.05

4. Discussion

LVO-MIS has the characteristics of high morbidity, high disability rate, high recurrence rate, high mortality rate, and so on. The key to treatment is to open the occlusive blood vessels as soon as possible, restore the blood supply of ischemic brain tissue, save ischemic penumbra tissue, reduce the infarct size, and improve the prognosis of patients [6]. After the ischemic area is supported by blood oxygen, the midline displacement of brain tissue in the patients with vascular recanalization is significantly reduced, and the severity of brain tissue edema is also significantly reduced, indicating that blood recanalization is a protective factor for brain tissue and has positive significance for the control of postoperative brain edema in the patients. Cerebral edema caused by damage to the blood-brain barrier and increased cerebral vascular permeability will not only affect the effect of blood flow recovery but also continue to aggravate the damage to the blood-brain barrier, forming a vicious cycle and reducing the effect of clinical treatment. Therefore, it is of great clinical significance to analyze the causes of cerebral edema, guide clinical scientific prevention and treatment, promote vascular recanalization, and improve the prognosis of patients.

Bridging therapy is a common method for the treatment of AIS-LVO. Intravenous thrombolysis with alteplase before thrombectomy can rapidly activate a fibrinolytic enzyme in thrombus, dissolve tiny intra-vascular embolus, and obtain blood flow recanalization, which is conducive to early cerebral vascular perfusion recovery and improve prognosis. Early intravenous thrombolysis can better dissolve distal embolism, and the cerebral reperfusion rate is further improved. Promote the benign migration of emboli to the far end, reduce the ischemic area, soften thrombus, facilitate the passage of microcatheter and microguide wire, reduce the number of thrombectomies, shorten the time of thrombectomy, shorten the time of recovery of effective blood perfusion, reduce the degree of nerve function defect, and promote the recovery of patients' disease [7]. In addition, intravenous thrombolysis is performed first in bridging therapy, and the recanalization of occlusive blood vessels is evaluated by imaging means to determine whether to implement intravascular thrombolysis. There is no need to wait for the results of CTA and other examinations after thrombolysis, which can shorten the treatment connection time and provide favorable conditions for early time blood perfusion. However, some scholars believe that bridging therapy will delay intravascular intervention, and the time from onset to vascular recanalization will be prolonged. May limit the early use of other antithrombotic drugs; May increase bleeding conversion rate; It can cause embolus dissolution and fragmentation, secondary embolization of the distal end of the blood vessel, and reduce the therapeutic effect.

Mechanical thrombectomy has been widely used in the real world as a first-line treatment for AIS patients caused by anterior proximal large vessel occlusion. Studies have confirmed that mechanical thrombectomy has good efficacy and safety in patients with acute moderate to severe ischemic stroke (NHISS score ≥ 6) complicated with LVO. However, the possible benefits of mechanical thrombectomy in patients with LVO-MIS do not seem to offset the risks of invasive surgery, so the best treatment for mild stroke is unclear, and there is still a lack of high-quality research evidence to support mechanical thrombectomy in patients with acute LVO-MIS. However, the study found that the successful opening of blood vessel occlusion in patients with mild stroke was extremely important to improve prognosis. When emergency vascular recanalization was not achieved, about 25.8% (223/866) of patients with mild stroke could not walk independently upon discharge, and the clinical prognosis of patients with mild stroke was found to be more prone to neurological deterioration after 90 days of postoperative follow-up. In this study, the operation of direct mechanical thrombectomy is simple, which can quickly and safely remove thrombus, open occluded blood vessels, and alleviate clinical symptoms of patients.

The NIHSS score is a quick and relatively simple measure of stroke severity. The guidelines point out that NIHSS score > 6 is the selection criteria for thrombectomy patients. In addition, the NIHSS score was also a strong predictor of long-term prognosis in AIS patients. However, different conclusions were drawn in this study, and the author believes that the results of AIS are the result of the cumulative influence of multiple factors. The cause and location of arterial occlusion, thrombus load, vascular condition, and thrombectomy choice of patients are equally important to their prognosis as the clinical manifestations upon admission, which may be related to the patient's basic conditions (such as stroke or other medical history). Multivariate logistic regression analysis in some studies showed no statistical difference. However, the NIHSS score at admission was an independent influencing factor for death at 90 days after EMT surgery, which may be attributed to the fact that some patients had higher NHISS scores at admission and faster deterioration of their conditions, thus leading to higher mortality. Most of the patients in this study did not show obvious low density in head CT examination upon admission, so there was no statistical significance in ASPECT score between the group with a good prognosis and the group with a poor prognosis. The higher the NIHSS score on admission, the more serious the impairment of brain tissue and brain nerve function of the patient, which is likely to cause extensive involvement of vascular endothelial function, so the swelling symptoms of brain tissue caused by mechanical thrombectomy are more obvious. After the onset of the disease, the longer the time from thrombolytic therapy, the worse the treatment effect, and the higher the risk of cerebral edema after thrombolysis. When blood pressure continues to rise, the damage to vascular endothelium will be more serious, and it will also lead to hyalinous changes in small blood vessels, aggravating the degree of atherosclerosis. Once ischemic stroke is induced at this time, cerebrovascular damage will inevitably be further aggravated, resulting in the deterioration of postoperative cerebral edema symptoms.

A meta-analysis by Saver et al. showed that the benefit of thrombectomy was not obvious when the disease occurred to the time of puncture > 438 min. According to the guidelines for AIS intravascular intervention, thrombectomy time should be within 6h of onset [8]. In this study, due to the small difference in thrombectomy time and strict time control (all patients were punctured within 6h after the onset of symptoms), there was no statistically significant difference in the time from onset to recanalization between the group with good prognosis and the group with poor prognosis. Good collateral circulation can improve the reperfusion rate of brain tissue and the rate of vascular revascularization, delay or prevent nerve cell death, protect ischemic penumbra, reduce the volume of cerebral infarction, reduce the risk of postoperative hemorrhage transformation, and ultimately improve the clinical outcome of patients after vascular revascularization. The results of this study showed that there were no significant differences in NIHSS score, vascular revascularization rate, good prognosis rate, and incidence of symptomatic craniohemorrhage between the two groups. The incidence of bleeding transformation in the direct thrombectomy group was lower than that in the bridging group, suggesting that direct mechanical thrombectomy could reduce the occurrence of bleeding transformation and was safer than bridging therapy. The thrombosis caused by the loss of cardiogenic plaque or carotid atherosclerotic plaque is not completely removed, and the degree of blood flow patency is also low. Residual thrombosis or damaged vascular intima may lead to platelet aggregation and re-stenosis of blood vessels. In addition, in the process of thrombectomy, whether the use of intermediate catheter contact aspiration or stent thrombectomy may lead to thrombectomy, and this study found that contact negative pressure aspiration could not prevent thrombectomy. Solitaire AB stent is a self-expanding nickel-titanium stent with good flexibility, complete recovery, and easy release and recovery. After the thrombus segment is placed, the stent is deployed according to the length of the thrombus segment and completely covers the thrombus, and the thrombus is compressed to the vascular wall with radial support force. After a few minutes of stay, the thrombus is slowly recovered, and the thrombus can be completely removed and the blood flow in the occluded segment can be restored to the maximum extent. The risk of intraoperative bleeding transformation can be reduced and prognosis can be improved by shortening the vascular recanalization time and eliminating the use of thrombolytic drugs.

5. Conclusion

In summary, the safety and effectiveness of mechanical thrombectomy for LVO-MIS patients have been confirmed, and the effect of mechanical thrombectomy is comparable to that of clinical bridging therapy. In addition, mechanical thrombectomy can also reduce the incidence of hemorrhage transformation in LVO-MIS patients, improve safety and efficacy, and can be applied clinically.

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