Int J Clin Exp Med 2020;13(2):830-835
www.ijcem.com /ISSN:1940-5901/IJCEM0104430

Original Article

Influence of mechanical thrombectomy on the prognosis of stroke induced by intracranial large vessel occlusion

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Received November 4, 2019; Accepted December 13, 2019; Epub February 15, 2020; Published February 28, 2020

Abstract: Objective: To investigate the influence of mechanical thrombectomy on the prognosis of stroke caused by intracranial large vessel occlusion. Methods: A single-center, prospective, randomized, double-blind controlled trial was conducted in 98 patients with acute ischemic stroke. These patients were randomly divided into the control group and the experimental group. For the control group, patients received intravenous thrombolytic therapy. According to the causes of vascular occlusion, patients in the experimental group were treated with appropriate mechanical thrombectomy. Therapeutic effects, hospitalization time, treatment costs, vessel recanalization rates, and complications were compared between the two groups. Results: The therapeutic effect, vessel recanalization rate, and treatment cost in the experimental group were significantly higher than those in the control group (all $P<0.05$). However, hospitalization time and National Institute of Health stroke scale (NIHSS) score in the experimental group were significantly decreased compared with the control group (all $P<0.05$). What's more, there was no significant difference concerning complications between the two groups ($P>0.05$). Conclusion: Compared with intravascular thrombolytic therapy, the treatment based on the causes of vascular occlusion is accurate, and does not increase the incidence of complications, which is worth promoting in clinical practice.

Keywords: Acute ischemic stroke, intravenous thrombolysis, mechanical thrombectomy, causes of vascular occlusion, therapeutic effects

Introduction

Stroke is a life-threatening disease commonly observed in human beings. Mild stroke can cause disabilities, while a severe one can cause death. It is reported that acute ischemic stroke accounts for about 85% of all strokes [1]. Acute ischemic stroke is mainly caused by intravascular thrombosis or vascular occlusion, which results in brain hypoxia-ischemia and even dysfunction [2]. Current treatment criteria for acute ischemic stroke are: completing the progressive prevention of acute ischemic stroke actively; promoting the recovery of neurological function in patients with acute ischemic stroke actively while reducing complications [3].

At present, intravenous thrombolysis is the essential treatment for acute stroke. Recombinant tissue plasminogen activator (rt-PA), which is activated by fibrin, can convert plasminogen into plasmin. As a result, blood clots are dissolved [4, 5]. It is reported that the optimal time window of intravenous thrombolysis is 4.5 hours, and the earlier, the better. Due to various reasons, few patients receive treatment within the optimal time window. Moreover, the therapeutic effect of intravenous thrombolysis needs to be improved [6]. It is reported that intravenous thrombolytic therapy can reduce patients' mortality rate. Nevertheless, it can't improve the prognosis of patients complicated with physical disability [7]. Researchers are exploring new treatment for acute ischemic stroke induced by intracranial large vessel occlusion. After years of clinical trials, mechanical thrombectomy, an endovascular treatment, can increase the vessel recanalization rates by nearly 50%. As a result, both therapeutic effect and prognosis are improved [8]. However, these

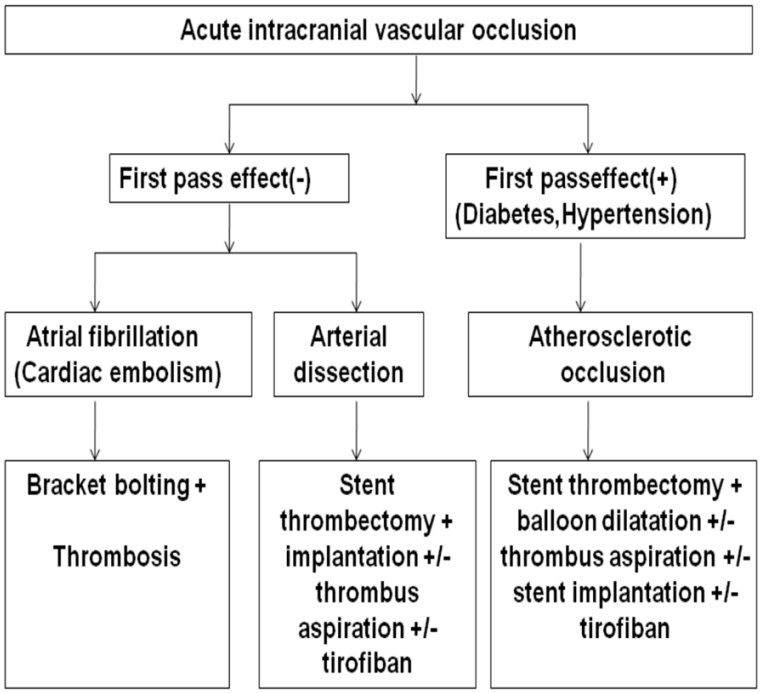

Figure 1. Diagnosis and treatment flow chart for patients with acute stroke.

studies do not perform a binary analysis for the causes of vascular occlusion.

The cause of intracranial vascular occlusion is evaluated by patients' medical history, such as hypertension, diabetes, coronary heart disease, atrial fibrillation, etc. In Asian countries, acute ischemic stroke induced by acute intracranial atherosclerotic stenosis (ICAS) accounts for 33%-50% of all strokes. The diagnosis of this disease depends merely on medical history and imaging. An effective and real-time method for the accurate assessment of cerebral blood flow is not available, resulting in a limited practicality for diagnostics.

The first-pass effect refers to the process of a micro-catheter passing through the acute intracranial artery occlusion segment with the support of a micro-guide wire. The micro-guide wire is held at the distal end, and then pulled from the micro-catheter. With the help of a guiding catheter, angiography is completed. There is a first-pass effect when blood flows anteriorly in the responsible artery [9, 10]. Therefore, the first-pass effect can be used to analyze the causes of acute ischemic stroke and choose an appropriate treatment. It means that a more systematic treatment can be achieved in this way. In order to provide more effective treatments and medical evidence for clinical practice, we studied the influence of mechanical thrombectomy on patients' prognosis.

Materials and methods

General information

This is a single-center, prospective, randomized, double-blind controlled trial. In total, 98 patients diagnosed with acute ischemic stroke in The First Affiliated Hospital of USTC, Anhui Provincial Hospital from January 2017 to December 2018 were enrolled. Based on a random number table, patients were divided into the control group and the experimental group (49 patients for each group).

Inclusion criteria: patients aged below 75 years old; patients' diagnosis of acute ischemic stroke was based on the criteria for diagnosis and treatment of acute ischemic stroke in China (2010), and patients' acute cerebral infarction was confirmed by brain CT and MRI. In addition, patients' cerebral hemorrhage was not observed [11]; patients had their first cerebrovascular accident or slight luminal infarction but without sequelae; patients displayed obvious symptoms of neurological deficit during the treatment.

Exclusion criteria: patients with impaired kidney and liver function; patients who lost consciousness during the treatment, and couldn't perform the trial; patients with poor expected prognosis; patients with a medical history of cerebrovascular diseases.

Informed consent was signed by all enrolled patients. This study was approved by the Ethics Committee of the hospital.

Methods

Based on the results of first-pass effect, different treatment was carried out (**Figure 1**).

Siemens 3.0 TMR and the large C-arm X-ray machine (Siemens, Germany) were used per-

Table 1. Comparison of basic data

Group	Experimental group (n=49)	Control group (n=49)	χ^2 value	*P* value
Age (years)	75.1±12.8	74.5±11.7	0.242	0.809
Gender (n)			0.832	0.413
Male	19	22		
Female	30	27		
Smoking history	9	12	0.938	0.568
Diabetes	13	16	0.808	0.456
Hypertension	24	22	0.053	0.828
Coronary heart disease	5	7	0.355	0.551
Body Mass Index	24.5±4.3	25.0±4.6	0.556	0.580
Hyperlipidemia	15	18	0.183	0.669
Hypertensive course (years)	8.7±2.3	9.0±2.1	0.674	0.502

Table 2. Comparison of vessel recanalization rates

Group	Vessel recanalization	Vessel unreachable
Experimental group (n=49)	34 (69.39%)	15 (30.61%)
Control group (n=49)	23 (46.94%)	26 (53.06%)
χ^2 value	4.193	
P value	0.041	

form intravascular surgery for patients in the experimental group.

Evaluation

Evaluation indicators: In this study, the observation time started at the first day after admission and ended the day before discharge. Comparisons were conducted between the two groups on therapeutic effects, hospitalization time, treatment costs, vessel recanalization rates, intracranial hemorrhage or cerebral hematoma (complication was confirmed by brain CT within 72 hours after both treatments). Angiography was performed three months after discharge. The incidence of 50% vascular occlusion was identified as restenosis.

Evaluation of therapeutic effects: Criteria for the evaluation of therapeutic effects [12]: rehabilitated: National Institute of Health stroke scale (NIHSS) score decreased more than 90.0%; significant: NIHSS score decreased by 46.0%-90.0%; effective: NIHSS score decreased by 18.0%-45.0%; invalid: NIHSS score decreased less than 18.0% or increased, and when patients couldn't take care of themselves. In clinical practice, the first three were counted as effective.

Statistical methods

All data were analyzed using SPSS statistical software version 22.0. The measurement data were calculated as mean ± standard deviation (χ ± SD); paired t test was applied for before-after comparison within the same group, and independent sample t test was used for comparison between the two groups. The enumeration data were calculated as number/percentage (n/%); comparison was conducted using chi-square test. The difference was statistically significant when the *P* value was less than 0.05.

Results

Basic data

As shown in **Table 1**, there were no significant differences concerning age, gender, smoking history, diabetes, hypertension and so on between the two groups (all P>0.05).

Comparison of vessel recanalization rates

As displayed in **Table 2**, the vessel recanalization rate in the experimental group was significantly higher than that in the control group (69.39% vs 46.94%, P<0.05).

Comparison of hospitalization time

The hospitalization time in the experimental group was significantly shorter than that in the control group (P<0.05, **Figure 2**).

Comparison of treatment costs

As illustrated in **Figure 3**, the treatment cost in the experimental group was significantly higher than that in the control group (P<0.05).

Comparison of NIHSS scores and therapeutic effects

There was no significant difference concerning NIHSS scores between the two groups (P>0.05); NIHSS scores were significantly

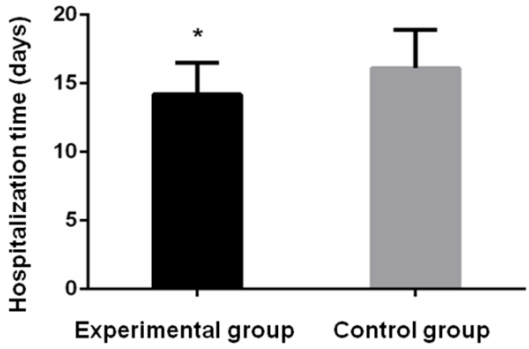

Figure 2. Comparison of hospitalization time. Compared with the control group, *P<0.05.

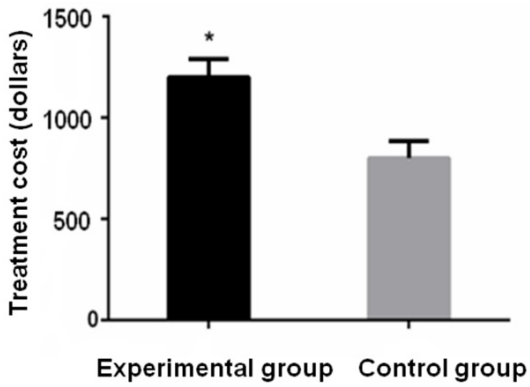

Figure 3. Comparison of hospitalization costs. Compared with the control group, *P<0.05.

decreased in both groups after treatment when compared with those before treatment (all P<0.05); NIHSS score in the experimental group after treatment was significantly lower than that in the control group (P<0.05). The therapeutic effect in the experimental group was better than that in the control group (P<0.05). Details were shown in **Table 3**.

Comparison of complications

As displayed in **Table 4**, there was no significant difference concerning complications between the two groups (P>0.05).

Discussion

Acute ischemic stroke can cause permanent neurological and physical disability, and even death [12, 13]. At present, intravenous thrombolysis and endovascular thrombectomy are the major treatments. However, the development of intravenous thrombolytic therapy is constrained by the time window and uncertainty of potential long-term efficacy. Endovascular thrombectomy is a more popular treatment. Nevertheless, the causes of cerebral infarction are different. As a result, current standard endovascular thrombectomy cannot perform a satisfied therapeutic effect. The first-pass effect can achieve a 90% diagnostic sensitivity when used to analyze acute ischemic stroke induced by ICAS, and help to classify acute ischemic stroke. The effective rate of acute ischemic stroke can be improved by about 20%, which contributes to the improvement of patients' prognosis [14, 15].

To choose an appropriate treatment based on the first-pass effect and patients' underlying diseases helps to achieve accurate treatment and improve the vessel recanalization rate. In this study, the results showed that the vessel recanalization rate in the experimental group was significantly higher than that in the control group, indicating that the therapeutic effect of mechanical thrombectomy based on the causes of vascular occlusion is better than intravenous thrombolysis. In addition, it is reported that the vessel recanalization rate in the endovascular intervention group can reach more than 90%, which is much higher than that in the intravenous thrombolysis group. This study provides further evidence for the previous opinion that mechanical thrombectomy can improve vessel recanalization rate [16, 17].

As a standardized neurological examination, the NIHSS can accurately reflect the neurological deficits of patients with acute ischemic stroke. Therefore, it is a reliable indicator for therapeutic effect. In this study, NIHSS score and rate of decline in the experimental group after treatment was significantly lower than that in the control group. These results indicate that the mechanical thrombectomy based on the causes of vascular occlusion can promote vessel recanalization rate, and relieve brain hypoxia-ischemia in a timely and effective manner. Cerebral vascular blood flow is then restored, resulting in the elimination of potential cell damage caused by hypoxia-ischemia. The recovery of nervous system function and NIHSS score are ultimately improved. Li J et al reported that endovascular intervention can significantly improve NIHSS score and effective rate. What's more, the effective rate of endo-

Table 3. Comparison of NIHSS scores and therapeutic effects

Group	Control group (n=49)	Experimental group (n=49)	χ^2 value	*P* value
NIHSS socre				
Before treatment	11.34±1.25	12.01±1.07	0.069	0.746
After treatment	8.34±1.37###	5.47±1.08###	8.380	<0.001
Therapeutic effects			6.498	0.011
Significant	12	18		
Effective	6	12		
Rehabilitated	13	12		
Invalid	18	7		

Note: compared with the same group before treatment, ###P<0.001.

Table 4. Comparison of adverse reactions between the two groups

Group	Experimental group (n=49)	Control group (n=49)	χ^2 value	*P* value
Complications			0.855	0.355
Bleeding	1	1		
Brain hematoma	2	4		
Restenosis	1	3		
In total	4 (8.16%)	8 (16.33%)		

vascular intervention can reach 50%, which is much higher than that in the control group (about 30%) [18].

Hospitalization time is the main evaluation method of patients' recovery process, and can also reflect the timeliness of treatment. After taking mechanical thrombectomy based on the causes of vascular occlusion, blood supplied to the brain tissue is restored in a short time. It can not only avoid wasted medical resources, but also shorten the recovery period of patients. As a result, the hospitalization time is reduced. In this study, patients in the experimental group were treated with targeted dichotomous therapy. Our results showed that the hospitalization time in the experimental group was significantly shorter than that in the control group, which is consistent with the conclusion that mechanical thrombectomy can shorten the recovery period [19]. However, there were additional costs, such as cost of stents, surgery, and so on. Therefore, the treatment cost in the experimental group was significantly higher than that in the control group. This is an important factor constraining the further application of mechanical thrombectomy in clinical practice. Subsequent studies should concentrate on the solution of this problem.

Both the surgery of intravenous thrombolysis and endovascular thrombectomy can cause hemorrhage spontaneously. Injury induced by ischemia-reperfusion can lead to the occurrence of potential brain edema and restenosis after treatment [20]. Therefore, the above indicator can effectively evaluate the surgical safety of both treatments. In this study, there was no significant difference between the two treatments, indicating that both the treatments are relatively safe. This result is a corroboration of previous reports similar to this [21].

In summary, treatment based on the causes of vascular occlusion can increase the vessel recanalization rate, improve the therapeutic effects, shorten the hospitalization time, minimize the recovery period, and improve patients' safety, which is worthy of clinical promotion.

However, our study is from a single-center, and insufficient in sample size. A multi-center and larger sample size study should be conducted to further confirm our conclusion. At the same time, relevant indications and contraindications for mechanical thrombectomy also need to be studied and improved in subsequent research.

Disclosure of conflict of interest

None.

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