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Original Article

Clinical efficacy of intravenous thrombolysis with alteplase in treatment of elderly patients with minor stroke and its effect on prognosis

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Abstract: Objective: This study aims to explore the clinical efficacy of intravenous thrombolysis with alteplase in the treatment of elderly patients with minor acute ischemic stroke (AIS) and its effect on prognosis. Methods: One hundred and twenty elderly patients with AIS, older than 75 years old, were retrospectively analyzed, who were divided into an observation group and a control group (both n=60). Patients in the control group were conventionally treated, and patients in the observation group were treated with intravenous thrombolysis with alteplase for injection (0.6 mg/kg) on the basis of conventional treatment. Patients in the two groups were treated for 3 consecutive months. The National Institutes of Health Stroke Scale (NIHSS) score 24 hours after admission and 90 days after treatment was used to evaluate the neurological impairment, and the modified Rankin Scale (mRS) score 90 days after treatment was used to evaluate the prognosis. Factors affecting the prognosis of thrombolytic therapy were analyzed, and changes of N-terminal-pro-brain natriuretic peptide (NT-pro-BNP) expression were observed 24 hours after admission and 14 days after treatment. The clinical efficacy, NIHSS and mRS scores before and after treatment, and thrombolytic therapy-related complications were compared between the two groups. The receiver operating characteristic (ROC) curve was plotted according to the multivariate analysis of significant indicators, to analyze the impact of the indicators on the efficacy. Results: In the observation and control groups, the NIHSS score and NT-pro-BNP expression after treatment were significantly lower than those before treatment ($P<0.001$). The two indicators in the observation group were significantly lower than those in the control group ($P<0.001$), and for the both indicators, the difference during treatment was significantly greater in the observation group than that in the control group ($P<0.001$). There was no statistically significant difference in adverse reactions between the two groups ($P>0.05$). Compared with the control group, patients in the observation group had significantly better clinical efficacy ($P<0.05$), and prognosis ($P<0.05$). According to multivariate logistic regression analysis, the NIHSS score 24 hours after admission, NT-pro-BNP expression 24 hours after admission and time from onset to hospital admission were independent prognostic factors for the prognosis. According to ROC curve, the area under curve of the NIHSS score 24 hours after admission was 0.686, that of NT-pro-BNP expression 24 hours after admission was 0.965, and that of time from onset to hospital admission was 0.832. Conclusion: In conclusion, the high NT-pro-BNP expression and NIHSS score indicate a severe condition and poor prognosis. The NIHSS score 24 hours after admission, NT-pro-BNP expression 24 hours after admission and time from onset to hospital admission are independent risk factors for the poor prognosis of elderly patients with AIS.

Keywords: Alteplase, minor stroke in the elderly, brain natriuretic peptide, neurological function, prognosis

Introduction

Acute ischemic stroke (AIS) is the most common cerebrovascular disease in clinical practice. Atherosclerosis, local thrombosis and small artery occlusion cause insufficiency of cerebral blood supply, and then local ischemia and hypoxia, eventually leading to irreversible brain damage [1, 2]. Data show that AIS, more common among the middle-aged and elderly, has high incidence, disability and mortality rates [3]. According to a study, the annual number of cases is between 6 million and 7 million, of which more than 2 million are new cases, and approximately 1.5 million patients die from AIS every year [4]. According to the National Institutes of Health Stroke Scale (NIHSS), stroke is divided into minor, moderate and heavy

stroke, of which moderate and heavy AIS account for the largest proportion [5]. However, in recent studies, minor AIS is an important precursor of unstable or high-risk stroke, so it has been increasingly valued by clinicians [6].

Also known as mild AIS, minor AIS with mild clinical symptoms is common in elderly patients and usually not valued by patients and doctors. However, the disease deteriorates rapidly if it is not controlled at the early stage, which significantly increases the disability and fatality rates [7]. Therefore, it is necessary to find a clinical therapeutic regimen in order to improve the current problems. As a recombinant human tissue-type plasminogen activator, alteplase is currently the standard regimen for the treatment of AIS [8]. According to a study, AIS has been significantly improved after treatment with alteplase [9]. Mainly distributed in the heart, spinal cord and brain, N-terminal-pro-brain natriuretic peptide (NT-pro-BNP) relaxes blood vessels, lowers blood pressure and functions as natriuretic and diuretic agent, as well as regulates sympathetic nerves, which is conducive to clinically observing the progression of AIS [10]. However, it remains divergent whether elderly patients with minor AIS should be treated with intravenous thrombolysis. In a study by Yeo et al., intravenous thrombolysis applied to patients with minor stroke does not increase the risk of hemorrhage, but approximately 30% of patients are still disabled [11]. A study by Feng and others has shown that intravenous thrombolysis with alteplase is effective for elderly patients with cerebral infarction and patients younger than 80 years old [12].

Therefore, the clinical efficacy of alteplase in the treatment of elderly patients with minor AIS and its effect on prognosis were explored in this study through a retrospective analysis, in order to provide a reference for clinical treatment.

Materials and methods

General information

One hundred and twenty elderly patients with minor AIS treated and hospitalized in Xingtai People's Hospital from May 2017 to May 2018 were retrospectively analyzed in this study. Patients in the control group were conventionally treated and patients in the observation group were treated with alteplase. The control group consisted of 35 male patients and 25 female patients, and the observation group consisted of 41 male patients and 19 female patients. Whether to carry out intravenous thrombolysis with alteplase depended on the principle of informed consent and patients' wishes. This study was approved by the Medical Ethics Committee of Xingtai People's Hospital.

Inclusion criteria

Patients admitted to the hospital within 4.5 hours of onset; patients ≥75 years old who met the diagnostic criteria for mild cerebral ischemia in the *Chinese Guidelines for the Secondary Prevention of Ischemic Stroke and Transient Ischemic Attack 2010* issued by the Chinese Society of Neurology of Chinese Medical Association in 2010 [13]; patients diagnosed with minor AIS by imaging; patients with a NIHSS score ≤3 points [14]; patients with complete clinical data.

Exclusion criteria

Patients with subarachnoid hemorrhage; patients complicated with acute myocardial infarction; patients with autoimmune deficiencies, severe hepatic and renal insufficiency; patients with AIS within 3 months; patients allergic to drugs used in this experiment; patients with infection at the time of visit; patients complicated with atrial fibrillation; patients with significant hemorrhagic diseases at present or within 6 months; patients who had orally taken anticoagulant drugs; pregnant women.

Sources of drugs

Alteplase (20 mg/box from Boehringer Ingelheim, Germany), aspirin (100 mg/tablet, 24 tablets/box from Original Pharmacy Co., Ltd., Shenyang, China), mannitol (250 mL: 50 g from Guizhou Tiandi Pharmaceutical Co., Ltd., China).

Therapeutic regimens

Patients in the control group were conventionally treated. The patients were given aspirin at 300 mg/d, and one week later, the drug was maintained at 100 mg/d for a long time.

Patients in the observation group were treated with alteplase on the basis of the control group. The patients were intravenously injected with alteplase at 0.6 mg/kg with a maximum dose of 50 mg. First, 5 mg of alteplase was intrave-

Table 1. mRS scores

Scale	Assessment criteria
Grade 0	No symptoms at all
Grade 1	No significant disability despite symptoms; able to carry out all usual duties and activities
Grade 2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
Grade 3	Moderate disability; requiring some help, but able to walk without assistance
Grade 4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
Grade 5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
Grade 6	Dead

Note: mRS, modified Rankin scale.

Table 2. Clinical efficacy evaluation

Effect level	Assessment criteria
Cured	NIHSS score decreased by 91%-100%
Significant effective	NIHSS score decreased by 46%-90%
Effective	NIHSS score decreased by 18%-45%
Ineffective	NIHSS score decreased by 17% or less, or NIHSS score increased

Note: NIHSS, the national institutes of health stroke scale scores.

nously infused within 1-2 min, and then the remaining 45 mg was intravenously dripped (completed within 1 hour). Computed tomography and magnetic resonance imaging were carried out for reexamination within 24 hours after thrombolysis, and aspirin at 100 mg/d was given after there was no hemorrhage. The patients were intravenously dripped with mannitol within 15 min for dehydration therapy. Both groups of patients were treated for 3 months consecutively.

Collection of clinical data

The clinical data of patients were collected from the hospital information system in terms of gender, age, past medical history, history of smoking, history of alcoholism, NIHSS score, the modified Rankin Scale (mRS) score and lab test indexes.

Grouping based on efficacy

According to the mRS score 90 days after treatment, the patients were divided into a good prognosis group (the mRS score was 0-1 point) and a poor prognosis group (the mRS score was 2-6 points). The clinical data of patients were collected for the analysis of risk factors.

Observational indexes

Main observational indexes were as follows: changes of the NIHSS score 24 hours after admission and 90 days after treatment; changes of NT-pro-BNP expression 24 hours after admission and 14 days after treatment; the mRS score 90 days after treatment with a total score of 6 points, and the higher the score was, the poorer the prognosis was. More details are shown in **Table 1**.

Secondary observational indexes were as follows: clinical efficacy after treatment (the method for efficacy evaluation is shown in **Table 2**); adverse reactions during treatment (lower limb venous thrombosis, respiratory and circulatory disorders, muscular atrophy). Risk factors affecting the prognosis were analyzed according to the multivariate logistic regression, and the receiver operating characteristic (ROC) curve was plotted based on the multivariate analysis of significant indicators.

Statistical analysis

In this study, SPSS 20.0 was used to analyze the data, GraphPad Prism 7 to plot figures, and K-S to analyze data distribution. Count data were expressed by number of cases/percentage (n/%), tested by chi-square, and represented by χ^2. Ordered count data were tested by non-parameters and represented by Z, and measurement data were expressed by mean ± standard deviation ($\bar{x} \pm sd$). Data conforming to normal distribution were tested and represented by t, in which paired t test was used for comparison within the groups before and after treatment, independent sample t test for comparison between groups. Data that did not conform to normal distribution were tested by rank sum and represented by Z. Multivariate logistic regression was used to analyze risk factors affecting the prognosis. The ROC curve was

Table 3. Clinical efficacy evaluation

	Control group (n=60)	Observation group (n=60)	t/χ^2	P
Gender (n, %)			1.292	0.256
Male	35 (58.33)	41 (68.33)		
Female	25 (41.67)	19 (31.67)		
Age (year)	79.3±2.1	79.6±2.2	0.732	0.466
Body mass index (kg/m^2)	22.54±1.36	22.79±1.44	0.978	0.330
Past medical history (n, %)				
Hypertension	45 (75.00)	48 (80.00)	0.430	0.512
Heart disease	25 (41.67)	28 (46.67)	0.304	0.581
COPD	7 (11.67)	5 (8.33)	0.370	0.543
Diabetes	16 (26.67)	21 (35.00)	0.977	0.323
Hyperlipidemia	15 (25.00)	18 (30.00)	0.376	0.540
Smoking history (n, %)			0.342	0.559
Yes	39 (65.00)	42 (70.00)		
No	21 (35.00)	18 (30.00)		
Alcoholism history (n, %)			0.324	0.570
Yes	8 (13.33)	6 (10.00)		
No	52 (86.67)	54 (90.00)		
Time from onset to admission (h)	2.93±1.06	2.94±0.97	0.054	0.957
PT (s)	13.88±0.68	13.68±0.75	1.530	0.129
APTT (s)	35.22±4.25	34.71±4.01	0.676	0.500
TC (mmoL/L)	4.90±0.95	4.88±0.87	0.120	0.905
TG (mmoL/L)	1.75±0.80	1.70±0.87	0.328	0.744
LDL (mmoL/L)	3.27±0.84	3.16±0.80	0.735	0.464

Note: COPD, chronic obstructive pulmonary disease; PT, prothrombin time; APTT, activated partial thromboplastin time; TC, total cholesterol; TG, triglyceride; LDL, low density lipoprotein.

plotted according to the multivariate logistic analysis of significant data, with the prognosis as an independent variable (Y) and indicators with differences in univariates as dependent variables (the assignment table is shown in **Table 7**). P<0.05 indicated a statistically significant difference.

Results

Clinical data

There was no statistically significant difference in clinical data between the two groups (P>0.05). More details are shown in **Table 3**.

Changes of NIHSS score and NT-pro-BNP expression before and after treatment

The changes of NT-pro-BNP expression 24 hours before treatment and 14 days after treatment and NIHSS score 24 hours before treatment and 90 days after treatment were detected. Before treatment, there were no significant differences between the observation and control groups in the NIHSS score and NT-pro-BNP expression (both P>0.05), which after treatment were significantly lower than those before treatment in the two groups (P<0.001). The two indicators in the observation group were significantly lower than those in the control group (P<0.001), and for the two indicators, the difference during treatment was significantly greater in the observation group than that in the control group (P<0.001). More details are shown in **Table 4** and **Figure 1**.

Adverse reactions

According to comparison of adverse reactions between the two groups, there were 3 patients with lower limb venous thrombosis, 2 patients with respiratory and circulatory disorders, 1 patient with muscular atrophy and 2 patients with intracranial hemorrhage in the control group; there were 2 patients with lower limb venous thrombosis, 3 patients with respiratory

Table 4. Changes of NIHSS score and NT-pro-BNP expression before and after treatment

	Control group (n=60)	Observation group (n=60)	t/χ^2	P
NIHSS score				
24 h before the treatment	2.43±0.50	2.58±0.49	1.660	0.100
90 d after treatment	2.03±1.16[a]	1.17±0.69[a]	4.936	<0.001
Differences	0.40±0.83	1.42±0.87	6.582	<0.001
NT-pro-BNP (ng/mL)				
24 h after admission	443.11±55.99	437.05±67.22	0.537	0.593
14 d after treatment	232.37±28.45[a]	182.50±20.71[a]	10.977	<0.001
Differences	210.74±58.76	254.55±69.89	13.250	<0.001

Note: NIHSS, the national institutes of health stroke scale scores; NT-pro-BNP, N-terminal pro-brain natriuretic peptide.
[a]P<0.001, compared with before treatment.

Table 5. Adverse reaction (n, %)

	Control group (n=60)	Observation group (n=60)	χ^2	P
Thrombus of lower extremity veins	3 (5.00)	2 (3.33)	0.208	0.648
Respiratory circulatory disorder	2 (3.33)	3 (5.00)	0.208	0.648
Myophagism	1 (1.67)	2 (3.33)	0.342	0.559
Intracranial hemorrhage	2 (3.33)	1 (1.67)	0.342	0.559

Table 6. Clinical efficacy (n, %)

	Control group (n=60)	Observation group (n=60)
Cured	15 (25.00)	26 (43.33)
Marked effective	20 (33.33)	18 (30.00)
Effective	14 (23.33)	13 (21.67)
Ineffective	11 (18.34)	3 (5.00)
Z	-2.444	
P	0.015	

and circulatory disorders, 2 patients with muscular atrophy and 1 patient with intracranial hemorrhage in the observation group. There was no statistically significant difference in adverse reactions between the two groups (P>0.05). More details are shown in **Table 5**.

Comparison of clinical efficacy

According to comparison of clinical efficacy between the two groups, the control group had 15 patients cured, 20 patients with marked effect, 14 patients with effect and 11 patients with invalidation; the observation group had 26 patients cured, 18 patients with marked effect, 13 patients with effect and 3 patients with invalidation. The clinical efficacy in the observation group was significantly better than that in the control group (P<0.05). More details are shown in **Table 6**.

mRS score 90 days after treatment and grouping

According to the analysis of mRS scores 90 days after treatment in the observation and control groups, the control group had 32 patients with good prognosis and 28 patients with poor prognosis, while the observation group had 44 patients with good prognosis and 16 patients with poor prognosis. Based on chi-square analysis, the prognosis in the control group was significantly poorer than that in the observation group (χ^2=5.167, P=0.023). One hundred and twenty patients were divided into the good prognosis group (n=76) and the poor prognosis group (n=44).

Univariate analysis of prognosis

According to the prognosis, 120 patients were divided into the good prognosis group (n=76) and the poor prognosis group (n=44). According to comparison of clinical data and related indicators through univariate analysis, there were no statistically significant differences between the two groups in terms of gender, age, body mass index, past medical history (hypertension, heart disease, chronic obstructive pulmonary disease, diabetes and hyperlipidemia), history of smoking, history of alcoholism, prothrombin time, activated partial thromboplastin time, total cholesterol, triglyceride, low density

Table 7. Multivariate Logistic analysis

	Poor prognosis group (n=44)	Good prognosis group (n=76)	t/χ^2	P
Gender (n, %)			0.116	0.733
Male	27 (61.36)	49 (64.47)		
Female	17 (38.64)	27 (35.53)		
Age (year)	79.2±2.0	79.6±2.2	1.107	0.271
Body mass index (kg/m^2)	22.64±1.42	22.81±1.36	0.670	0.504
Past medical history (n, %)				
Hypertension	33 (75.00)	59 (77.76)	0.108	0.743
Heart disease	18 (40.91)	35 (46.05)	0.299	0.585
COPD	5 (11.36)	7 (9.21)	0.144	0.705
Diabetes	10 (22.73)	27 (35.53)	2.141	0.144
Hyperlipidemia	10 (22.73)	23 (30.26)	0.764	0.373
Smoking history (n, %)			0.865	0.352
Yes	32 (72.73)	49 (64.47)		
No	12 (27.27)	27 (35.53)		
Alcoholism history (n, %)			0.447	0.504
Yes	4 (9.09)	10 (13.16)		
No	40 (90.91)	66 (86.84)		
Time from onset to admission (h)	3.35±0.95	2.22±0.64	7.641	<0.001
PT (s)	13.32±0.82	13.54±0.78	1.506	0.135
APTT (s)	35.16±4.28	35.94±4.39	0.985	0.326
TC (mmoL/L)	4.98±1.00	4.89±0.95	0.505	0.614
TG (mmoL/L)	1.79±0.91	1.75±0.80	0.256	0.799
LDL (mmoL/L)	3.35±0.75	3.28±0.80	0.495	0.622
NIHSS scores 24 h after admission	2.64±0.48	2.27±0.45	4.162	<0.001
NT-pro-BNP 24 h after admission (ng/mL)	474.80±42.03	380.10±40.42	12.060	<0.001
Therapeutic regimen (n, %)			5.167	0.023
Conventional therapy	16 (36.36)	32 (42.11)		
Alteplase therapy	28 (63.64)	44 (57.89)		

Note: COPD, chronic obstructive pulmonary disease; PT, prothrombin time; APTT, activated partial thromboplastin time; TC, total cholesterol; TG, triglyceride; LDL, low density lipoprotein.

lipoprotein (P>0.05), whereas there were significant differences in time from onset to hospital admission, NIHSS score 24 hours after admission, NT-pro-BNP expression 24 hours after admission and therapeutic regimens (P< 0.05). More details are shown in **Table 7**.

Multivariate logistic analysis

Indicators with differences in univariates were included in the assignment table (the assignment table is shown in **Table 8**). According to the multivariate logistic regression analysis, the NIHSS score 24 hours after admission, NT-pro-BNP expression 24 hours after admission and time from onset to hospital admission were independent factors for the prognosis (P<0.05). More details are shown in **Table 9**.

ROC curve

According to the ROC curve based on the multivariate analysis of indicators with differences, the area under curve of NIHSS score 24 hours after admission was 0.686, with 95% confidence interval (CI): 0.587-0.785, that of NT-pro-BNP 24 hours after admission was 0.965, with 95% CI: 0.939-0.991, and that of time from onset to hospital admission was 0.832, with 95% CI: 0.755-0.908. More details are shown in **Table 10** and **Figure 2**.

Discussion

Cerebrovascular disease is one of the three major diseases common in humans, and the incidence rate and the elderly patients are

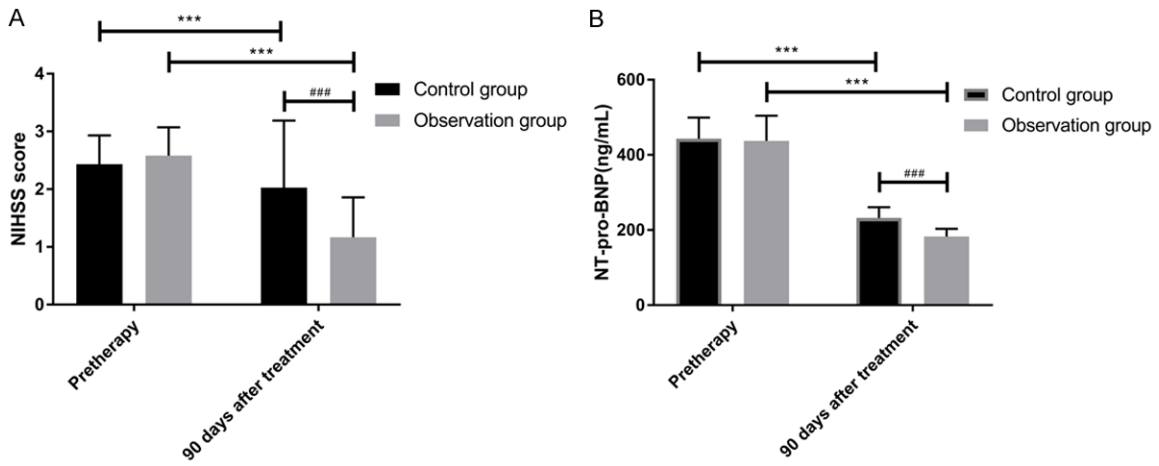

Figure 1. Changes of NIHSS score and NT-pro-BNP expression before and after treatment. A: NIHSS scores; B: NT-pro-BNP. Compared within two groups before and after treatment, ***P<0.001; compared between two groups, ###P<0.001. NIHSS, the national institutes of health stroke scale scores; NT-pro-BNP, N-terminal pro-brain natriuretic peptide.

Table 8. The assignment table

Index	Assessment
Prognosis conditions (Y)	Good prognosis=0, poor prognosis
Time from onset to admission (X)	As the data belongs to continuous variables, the original data is used for analysis
NIHSS scores 24 h after admission (X)	As the data belongs to continuous variables, the original data is used for analysis
NT-pro-BNP 24 h after admission (X)	As the data belongs to continuous variables, the original data is used for analysis
Therapeutic regimen (X)	Alteplase therapy=0; conventional therapy=1

Note: NIHSS, the national institutes of health stroke scale scores; NT-pro-BNP, N-terminal pro-brain natriuretic peptide.

Table 9. Multivariate logistic analysis

	NIHSS scores 24 h after admission	NT-pro-BNP 24 h after admission	Time from onset to admission
β	-6.039	-0.206	-1.980
Standard error	2.210	0.075	0.754
Wals	7.467	7.565	6.904
Sig.	0.006	0.006	0.009
Exp (β)	0.002	0.814	0.138
95% CI of Exp (β)			
Lower limit	0.000	0.703	0.032
Upper limit	0.181	0.942	0.605

Note: β, constant term; Wals, chi-square value; Sig., statistic, namely *P* value; Exp (β), odds ratio; NIHSS, the national institutes of health stroke scale scores; NT-pro-BNP, N-terminal pro-brain natriuretic peptide; CI, confidence interval.

increasing year by year with the aging of the population [15]. Stroke is the most common cerebrovascular disease in clinic, which is divided into ischemic and hemorrhagic stroke according to the pathogenesis. With an incidence rate accounting for 77.8% of cerebrovascular diseases, ischemic stroke is a disease that ischemia-hypoxia caused by several reasons leads to ischemic necrosis or pathological changes in the brain tissue, finally resulting in neurological dysfunction [16, 17].

Ischemic stroke can be divided into minor, moderate and heavy ones based on the NIHSS score, and more than 40% of ischemic cerebrovascular diseases are minor ischemic stroke, according to a study [18]. The treatment of minor ischemic stroke remains controversial in clinical practice. It is clinically believed that the prognosis of patients with minor stroke is better, so the disease is easy to be ignored. However, in a study by Khatri et al., according to the survey of 136 patients with minor stroke who have not received thrombolytic therapy, 29.41% of them have a mRS score >2 points 90 days after tre-

Table 10. ROC data parameter

	NIHSS scores 24 h after admission	NT-pro-BNP 24 h after admission	Time from onset to admission
AUC	0.686	0.965	0.832
95% CI	0.587-0.785	0.939-0.991	0.755-0.908
Specificity	72.73%	82.89%	76.32%
Sensitivity	64.47%	100.00%	100.00%
Youden index	37.20%	82.89%	76.32%
Cut-off	>2.5	441	3.15

Note: ROC, receiver operating characteristic; AUC, area under the curve; CI, confidence interval; cut-off, optimum cut-off point; NIHSS, the national institutes of health stroke scale scores; NT-pro-BNP, N-terminal pro-brain natriuretic peptide.

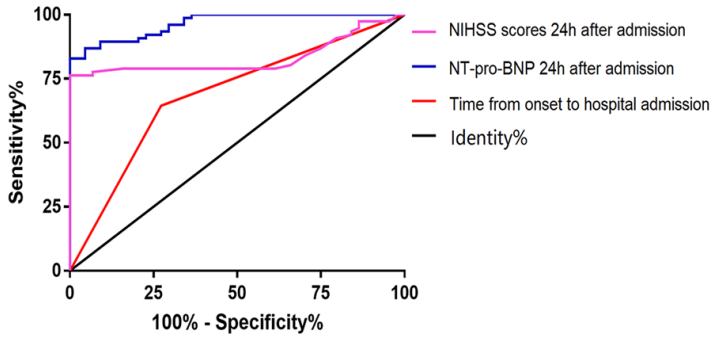

Figure 2. ROC curve analysis. NIHSS, the national institutes of health stroke scale scores; NT-pro-BNP, N-terminal pro-brain natriuretic peptide.

atment [19]. At present, there is little literature on whether timely intervention (thrombolytic therapy) can improve the prognosis of patients. Therefore, to provide references for clinicians, the clinical efficacy and prognosis of intravenous thrombolysis with alteplase in the treatment of elderly patients with minor stroke were compared with conventional treatment in this study.

In this study, intravenous thrombolysis with alteplase was compared with conventional treatment. As a plasminogen activator that has a short half-life, strong thrombolysis effect, low hemorrhage risk and short treatment time, alteplase selectively activates plasminogen, so it causes less impact on the activity of plasmin in patients [20]. The NIHSS score and NT-pro-BNP in the two groups were first compared between before and after treatment. The former is the most important scoring standard for the clinical observation of patients' neurological function, and its table is simple and reliable, which directly reflects patients' stroke severity [21]. The latter is a natriuretic peptide secreted by the heart, the expression of which significantly increases when patients' blood pressure and volume are abnormal [22]. According to Biteker et al., NT-pro-BNP predicts the mortality rate of AIS [23]. According to Bracard et al., the NIHSS score of patients with stroke is significantly reduced after treatment with alteplase [24]. In this study, after treatment, the NIHSS score and NT-pro-BNP in the two groups were significantly improved, and the difference of the two indicators in the observation group was significantly lower than that in the control group. These findings indicate that early thrombolytic therapy can effectively improve the NIHSS score and the NT-pro-BNP expression of patients. There was no statistically significant difference between the two groups in the incidence rate of adverse reactions, and the clinical efficacy in the observation group was significantly better than that in the control group, suggesting that alteplase combined with conventional treatment can improve the clinical efficacy on elderly patients with minor stroke. However, according to the treatment of patients with stroke with alteplase who are over 80 years old in a study by Engelter et al., there was no difference in the clinical efficacy between patients over 80 years old and younger than 80 years old [25]. This may be because the differences in samples between the two groups were large and the NIHSS score of the patients was high.

Subsequently, the mRS score 90 days after treatment was analyzed. mRS score is an important scale for evaluating the prognosis of patients after treatment, which has been proved to be effective [26, 27]. In this study, according to the mRS score 90 days after treatment in the two groups, patients with good prognosis in the observation group were significantly more than those in the control group, well illustrating the efficacy of alteplase. However, it remained unclear which factors affect the prognosis of patients, so 120 patients were

divided into the good and poor prognosis groups based on the mRS score to observe the independent prognostic factors. According to the multivariate analysis, the NIHSS score 24 hours after admission, NT-pro-BNP 24 hours after admission and time from onset to hospital admission were the independent prognostic factors, similar to the results of previous studies [28, 29]. The lower the NIHSS score at the time of admission is and the earlier the admission time is, the better the recovery of patients is. On the contrary, patients with a high NIHSS score and late admission time may miss the best treatment time window. Thus, patients should seek for medical advice in time as soon as having clinical manifestations, which is beneficial to their clinical treatment, prognosis and recovery. Studies have shown that the expression of BNP is closely related to the pathophysiological changes of acute stroke. Therefore, patients should pay close attention to the expression of NT-pro-BNP and be treated in time after admission to avoid poor prognosis.

This study proves the clinical efficacy of alteplase in the treatment of elderly patients with minor stroke and analyzes the risk factors affecting the prognosis. However, there are still limitations in this study. First, as the elderly who are not conducive to long-term follow-up investigation, the patients have not been observed for a long time. Second, there may be deficiencies in sample size because this study is single-centered. At last, the dosage of alteplase in elderly patients is unclear. The commonly used dosage in clinic is 0.9 mg/kg (the maximum dosage is 90 mg), but the exact dosage in elderly patients is unclear although this study refers to the relevant literature for dosage. Therefore, it is hoped that the sample size will be enlarged, and a long-term follow-up will be conducted in future studies to verify the results of this study. Additionally, additional clinical and basic experiments for further determining the dosage of alteplase in elderly patients with minor stroke are also the future research direction.

In summary, the NIHSS score 24 hours after admission, the NT-pro-BNP 24 hours after admission and time from onset to hospital admission are independent prognostic factors for elderly patients with minor stroke. Alteplase can effectively improve the condition of the patients and reduce the NIHSS score and NT-pro-BNP expression. However, the specific dosage of alteplase remains unclear, and whether alteplase should be widely used in clinic needs further exploration.

Disclosure of conflict of interest

None.

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