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*Original Article*

# Comparative study on short-term and long-term prognostic determinants in patients with acute cerebral infarction

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**Abstract:** Background: At present, there are many studies on prognostic determinants in patients with acute cerebral infarction, while studies on short-term and long-term prognostic determinants are less. The purpose of this study was to explore the short-term and long-term association and same and different points of prognostic determinants in patients with acute cerebral infarction for guiding clinical treatment. Methods: 201 patients with acute cerebral infarction were included in the study, whose neurological functions were assessed via National Institute of Health Stroke Scale (NIHSS) within 24 h and computed tomography or magnetic resonance imaging were performed within 48 h of symptom onset. All of the patients were administered with same medication regimen (including medication and rehabilitation). The NIHSS and the modified Rankin Scale were used to assess the extent of disability at 15 d after admission and one year, respectively. Short-term and long-term prognostic determinants and its association were analyzed by single and multivariable logistic regression. Results: Infarct volume correlated with short-term prognosis (OR = 3.543, 95% CI: 1.632~10.212), while it showed no correlation with long-term prognosis; concurrent infection was independent risk factor for short-term prognosis of acute cerebral infarction (OR = 2.532, 95% CI: 1.803~6.886). Baseline NIHSS score independently correlated with short-term and long-term prognosis (odds ratio, respectively: OR = 1.880, 95% CI: 1.462~6.679; OR = 1.761, 95% CI: 1.372~6.758); gender (OR = 0.311, 95% CI: 0.140~0.681) and basal ganglia infarction (OR = 2.263, 95% CI: 1.349~11.662) were independently associated with long-term prognosis, while it showed no significant correlation with short-term prognosis. Short-term prognosis effect was an independent predictor for long-term prognosis (OR = 0.487, 95% CI: 0.141~0.895). Age, hospitalization time, short-term and long-term prognosis of patients showed no significant correlation. Conclusion: There were differences between short-term and long-term prognosis of acute cerebral infarction. Short-term prognosis effect was an independent predictor for long-term prognosis. For controllable factors, active intervene should be taken in order to improve prognosis of patients.

**Keywords:** Acute cerebral infarction, prognosis, influencing factors

## Introduction

Acute cerebral infarction is a disease with higher incidence, morbidity and mortality rates, about 75% of which are left with varying degrees of disability and bring serious burden for society and family. Therefore there is great significance in actively improving the prognosis of cerebral infarction. At present, there are many studies on prognostic determinants in patients with acute cerebral infarction. What are the differences on prognostic determinants of short-term and long-term? What is the long-term prognostic determinants in patients with good short-term prognostic determinants? According to the reports at home and abroad, it is necessary to study and confirm the response to these questions to provide basis for clinical diagnosis and treatment.

## Materials and methods

### *Subjects*

Patients with acute cerebral infarction, who were treated in Department of Neurology,

Xinqiao Hospital, Third Military Medical University, between January 2013 and August 2013 were enrolled in this study.

*Inclusion criteria*

(1) Patients who comply with the Fourth National Cerebrovascular disease Conference on (1995) diagnosis key points and firstly diagnosed with acute cerebral infarction were enrolled in this study; (2) Patients with a NIH stroke scale score between 3 and 25 when admitted to hospital were enrolled in this study; (3) Patients with cerebral infarction two weeks within admission were enrolled in this study; (4) In this study, after approved by the hospital ethical committee, the patient and the family agreed and signed informed consent.

*Exclusion criteria*

(1) Infarct patients with ion who were no less than 90 years old age and older were excluded from this study; (2) Infarct patients with serious disturbance of consciousness and aphasia so as not to properly communicate were excluded from this study; (3) Patients with a history of neurological disorders and left with sequelae or other serious physical illness so they cannot cope with inspections were excluded from this study; (4) Infarct patients with serious merger complications (such as heart and lung, liver and kidney failure, hernia) were excluded from this study; (5) Patients with advanced cancer, pregnancy and lactation were excluded from this study; (6) Patients who diagnosed with cerebral infarction, lost clinical information or miss to follow within one year were excluded from this study; (7) Patients with thrombolytic or endovascular before admission or professional rehabilitation when discharged from hospital were excluded from this study; (8) Patients with brain stem infarction and could not do MRI were excluded from this study.

*Methods*

*Clinical files:* Clinical files included patients' age, gender, admission time, complications during hospitalization, infarction, infarct volume and baseline NIHSS score. NIHSS score were performed for evaluating neurologic impairment within 24 hours admission. 3.0 Tesla magnetic resonance (magnetic resonance imaging, MRI), or 64 layers of X-ray tomography (computed tomography, CT) examination were performed within 48 hours admission. All patients were given the same treatment regimen, at the same time they all underwent rehabilitation therapy (thrombolysis and endovascular stent patients were excluded). The NIHSS and the modified Rankin Scale were performed at 15 d after admission and one year, respectively.

*Volume calculation:* 2006 GE Medical Systems software were used to measure the length, width and height of lesion. Infarct volume were roughly estimated According to Tada formula (Coniglobus formula) (1/2 length × height × width).

*Evaluation and assignment of neurological function:* NHISS score were re-evaluated 15 days after hospitalization. The modified NIHSS score which was greater than or equal to 3 (or discharge NIHSS score of 0) was defined as the effective, while less than three was invalid; the modified Rankin scale which was greater than 2 was defined invalid, while less than or equal to 2 two was defined as effective. Patients with endpoint events (such as death or stroke) were invalid.

*Definition of grouping and assignment:* (1) Age According to the young stroke the age is defined as less than 45 years old, They were divided into two groups according to age (unit: years old): 0: ≤ 45, 1: > 45; (2) Gender they were divided into two groups according to sex: 0 = male, 1 = female; (3) Infarction site According to CT or MRI, the infarction site were divided into five parts: 0 = brainstem, 1 = cerebellum, 2 = basal ganglia, 3 = brain lobe, 4 = multi-site co-exist; (4) Infarct volume Zaidi et al [3] studies have shown that average infarct volume was 40 ml in patients with a good prognosis. In this article they were divided into two groups according to infarct volume (unit: ml): 0 = ≤ 40, 1 ≥ 40; (5) Admission time Admission time is defined as from onset to the time of admission, treatment. They were divided into two groups (units: days): 0 = ≤ 1, 1 ≥ 1; (6) Baseline NIHSS scale score According to the NIHSS score scale, they were divided into two groups: 0 = ≤ 5, 1 ≥ 5; (7) Complications Observed complications included: post-stroke depression and infections.

*Follow-up:* Clinic or telephone follow-up were the main methods for follow-up. 15 days of follow-up included: whether the patient is alive,

with or without complications, the disability rehabilitation and daily living conditions in order to assess the NIHSS score. If there were depression performance in clinical manifestations, then they were given Hamilton Anxiety depression Scale assessment; If there were fever, cough and painful urination, then they were given chest, blood, sputum and urine bacterial culture examination. one year follow-up include: whether the patient is still alive and whether there was stroke, and the conditions of disability rehabilitation and daily living in order to assess the mRS score.

*Quality Control:* (1) Control selection bias: The formal-training neurologists consecutively selected the cerebral infarction patients who met the diagnostic criteria; (2) Control measurement bias: To improve the measurement accuracy, the physician learned NIHSS scale test, mRS scale score and Hamilton Anxiety and Depression Scale Measurement together, and obtained the qualifications; baseline NIHSS score of patients was completed within 24 hours after admission; 15 days and one year later, the NIHSS and mRS scale were respectively performed; the scoring was performed by the same person in order; (3) Control the confounding factors: Firstly conduct univariate analysis to find associated factors, and then perform multivariate logistic regression analysis to exclude confounding factors; (4) Reduce lost patients: Try to register multiple contact details when registering, such as telephone, home address; regular telephone to remind patients of outpatient follow-up; family follow-up for individual patients, complete the clinical data; control the lost cases not more than 10%; (5) Reduce data entry errors: SPSS17.0 statistical software was used for data entry, which was completed by two persons; one person input the data and another proofread; when all data entry was completed, proofread again.

*Statistical methods*

SPSS17 statistical software was used for data processing; the measurement data in line with normal distribution were expressed as $\bar{x} \pm SD$; differences between groups were compared using t test; measurement data inconsistent with the normal distribution were represented by the median and interquartile range and compared by rank sum test; count data were compared by chi-square test; logistic regression analysis was used for multivariate analysis; $P < 0.05$ was considered statistically significant.

## Results

*General information*

212 patients with acute cerebral infarction admitted in Department of Neurology, Xinqiao Hospital, The Third Military Medical University, from January 2013 to August 2013 were selected as subjects; in which, two cases were lost to follow up due to contact change, and nine cases refused referral; so these cases were excluded. Therefore, a total of 201 patients were included in the study, including 113 males (56.2%) and 88 females (43.8%), aged 32 to 89 years old, with a mean age of (61.15 ± 10.6) years. There were 132 cases with prehospital time more than one day (65.7%) and 69 cases with pre-hospital time less than one day (34.3%); brainstem infarction was found in 42 cases (20.9%); cerebellar infarction was found in 13 cases (6.5%); basal section infarction was found in 84 cases (41.8%); there were 24 cases of lobar infarction (11.9%) and 38 cases with multiple-sites infarction (18.9%); There were 125 cases with infarction volume no larger than 40 ml (62.2%) and 76 cases with infarction volume greater than 40 ml (37.8%); there were 99 cases with baseline NIHSS score ≤ 5 (49.3%) and 102 cases (50.7%) with baseline NIHSS score > 5; 13 cases had concurrent infections (including lung infections and urinary tract infection) (6.5 %); 19 cases were complicated by post-stroke depression (9.5%). Effective prognosis had been found in 61 cases in 15 days after admission (with NIHSS outcome scores as criteria) (30.3%), and ineffective prognosis had been found in 140 cases (69.7%); 1 year later, mRS assessment was performed, effective for 118 cases (58.7%) and ineffective for 83 cases (41.3%).

*Univariate analysis of short-term prognosis of acute cerebral infarction*

NIHSS outcome scores were taken as the dependent variable to conduct the univariate analysis for each possible factors univariate analysis; it showed that hospitalization time, brainstem infarction, infarction volume, infection and baseline NIHSS score were related with short-term prognosis ($P < 0.05$), shown in **Table 1**.

**Table 1.** The single factor analysis of the short-term outcome in patients with acute cerebral infarction

| Variables | Effective (n = 61) | No effective (n = 140) | $t/x^2$ | P |
|---|---|---|---|---|
| Age (Year, $\bar{x}$ ± SD) | 57.54 ± 10.23 | 64.23 ± 9.77 | 9.24 | 0.635 |
| Men (n, %) | 38 (62.3) | 75 (53.6) | 0.53 | 0.344 |
| Admission time (day, $\bar{x}$ ± SD) | 5.4 ± 3.1 | 6.1 ± 4.3 | 3.68 | 0.011 |
| Infarction Position | | | | |
| Brainstem (n, %) | 16 (26.2) | 26 (18.6) | 0.12 | 0.000 |
| Cerebellum (n, %) | 4 (6.6) | 9 (6.4) | 0.34 | 0.135 |
| Basal ganglia (n, %) | 21 (34.4) | 63 (45.0) | 8.12 | 0.092 |
| Lobar (n, %) | 8 (13.1) | 16 (11.4) | 0.75 | 0.364 |
| Multiple sites (n, %) | 12 (19.7) | 26 (18.6) | 2.45 | 0.873 |
| Infarct volume (ml, $\bar{x}$ ± SD) | 12.67 ± 23.4 | 41.34 ± 47.3 | 5.12 | 0.001 |
| Complication | | | | |
| Infection (n, %) | 2 | 11 | 4.23 | 0.004 |
| Depression after stroke (n, %) | 4 | 15 | 0.67 | 0.067 |
| Baseline NIHSS score (Piont, $\bar{x}$ ± SD) | 4.5 ± 3.4 | 7.2 ± 4.8 | 4.24 | 0.001 |

**Table 2.** The Multiple factors analysis of the short-term outcome in patients with acute cerebral infarction

| Variables | P | OR | 95% CI |
|---|---|---|---|
| Admission time | 0.157 | 1.424 | 0.533-3.004 |
| Infarct volume | 0.000 | 3.543 | 1.632-10.212 |
| Infection | 0.002 | 2.532 | 1.803-6.886 |
| Infarction Position (Brainstem) | 0.511 | 5.161 | 0.464-18.196 |
| Baseline NIHSS score | 0.013 | 1.880 | 1.462-6.679 |

*Multivariate analysis of short-term prognosis of acute cerebral infarction*

The statistically significant factors in above univariate analysis were enrolled in this multivariate logistic regression analysis; results showed that infarction volume, concurrent infection, and baseline NIHSS score were independent factors for short-term prognosis of acute cerebral infarction, shown in **Table 2**.

*Univariate analysis of long-term prognosis of acute cerebral infarction*

With mRS score as the dependent variable, univariate analysis was conducted for each possible factor; it showed that gender, age, basal ganglia infarction, post-stroke depression, and baseline NIHSS score were related with the long-term prognosis of acute cerebral infarction ($P < 0.05$); the Short-term prognosis was divided into effective and ineffective factors, taken as independent variables to conduct univariate analysis, which showed that effective short-term prognosis was related with long-term prognosis ($P < 0.05$), shown in **Table 3**.

*Multivariate analysis of long-term prognosis of acute cerebral infarction*

The statistically significant factors in above univariate analysis were enrolled in this multivariate logistic regression analysis, which showed that basal ganglia infarction, gender, baseline NIHSS score and effective short-term prognosis were independent predictors of long-term prognosis of acute cerebral infarction, shown in **Table 4**.

## Discussion

Acute cerebral infarction is the local brain blood supply disorder caused by a variety of reasons, leading to cerebral ischemia and hypoxia, thus resulting in corresponding clinical manifestations of neurologic deficits. Studying the prognosis of acute cerebral infarction has important clinical significance; according to the infarction site on the image to preliminarily judge the prognosis has an important guiding significance for clinicians. Cheng et al [4] plotted a map for the infraction sites of 101 patients with middle cerebral artery infarction and studied its relationship with the prognosis of cerebral infarction after one month, and found that ischemic damage of brain functional areas (corona radiata, internal capsule, insula) was related with high mRS scores. Ye Xiaofeng et al [5] studied the infarction prognosis in different regions of the middle cerebral artery and found

**Table 3.** The single factor analysis of the long-term outcome in patients with acute cerebral infarction

| Variables | Effective (n = 118) | No effective (n = 83) | $t/x^2$ | P |
|---|---|---|---|---|
| Age (Year, $\bar{x}$ ± SD) | 52.54 ± 13.13 | 65.01 ± 10.77 | 8.34 | 0.005 |
| Men (n, %) | 78 (66.1) | 35 (42.2) | 4.45 | 0.000 |
| Admission time (day, $\bar{x}$ ± SD) | 5.2 ± 4.2 | 7.3 ± 3.8 | 3.56 | 0.324 |
| Infarction Position | | | | |
| Brainstem (n, %) | 25 (21.2) | 17 (20.5) | 0.24 | 0.289 |
| Cerebellum (n, %) | 8 (6.8) | 5 (6.0) | 0.45 | 0.093 |
| Basal ganglia (n, %) | 57 (48.3) | 27 (32.5) | 8.12 | 0.002 |
| Lobar (n, %) | 18 (15.3) | 6 (7.2) | 0.89 | 0.786 |
| Multiple sites (n, %) | 10 (8.5) | 28 (33.7) | 1.56 | 0.667 |
| Infarct volume (ml, $\bar{x}$ ± SD) | 30.34 ± 21.4 | 45.58 ± 42.7 | 11.45 | 0.078 |
| Complication | | | | |
| Infection (n, %) | 7 | 5 | 5.45 | 0.187 |
| Depression after stroke (n, %) | 15 | 4 | 7.05 | 0.003 |
| Baseline NIHSS score (Piont, $\bar{x}$ ± SD) | 5.4 ± 4.1 | 7.6 ± 3.7 | 5.13 | 0.021 |
| Effective of short-term prognosis (n, %) | 55 (46.6) | 6 (7.2) | 4.32 | 0.027 |
| No-Effective short-term prognosis (n, %) | 63 (53.4) | 77 (92.8) | 11.24 | 0.875 |

**Table 4.** The Multiple factors analysis of the long-term outcome in patients with acute cerebral infarction

| Variables | P | OR | 95% CI |
|---|---|---|---|
| Age | 0.249 | 3.221 | 0.283-4.024 |
| Basal ganglia | 0.001 | 2.263 | 1.349-11.662 |
| Sex | 0.003 | 0.311 | 0.140-0.681 |
| Depression after stroke | 0.091 | 4.942 | 0.376-17.246 |
| Baseline NIHSS score | 0.002 | 1.761 | 1.372-6.758 |
| Effective of short-term prognosis | 0.024 | 0.487 | 0.141-0.895 |

that the long-term prognosis of anterior choroidal artery infarction was worse; Watershed stroke patients had good prognosis, which was mainly related to that whether the infarction areas were functional areas. While in this study, infarction site was independent of short-term prognosis, which was an independent factor of the long-term prognosis.

Many studies have confirmed that the prognosis of acute cerebral infarction had gender differences; Chinese scholars Zhang Bing et al [6] have found that in youth, females are more susceptible to cardiogenic cerebral infarction than males, with worse prognosis; Swedish scholars [7] Studies have found that the proportion of women refusing oral anticoagulation drugs higher than that of men, which may be due to the high incidence of cardiogenic cerebral infarction. Paolucci et al [8] divided the patients into two groups to conduct a control study and found that in the same severity, age and rehabilitation condition, prognosis of women was poorer than that of men, which may be caused by the differences in the physiology between men and women: the dependency and insecurity of females performing in the rehabilitation were higher than these of males, and the decline of muscle strength in elderly women was more serious than that in elderly men; research has shown that women have a high prevalence of depression after stroke, and their enthusiasm of active rehabilitation is poor, which can also explain the gender differences in cerebral infarction prognosis [9]. In this study, analysis of long-term prognosis was performed after excluding the confounding factors; it showed that women had poorer prognosis than men, which was consistent with the above findings. In this study, the analysis of the short-term prognosis did not find gender differences, which may be related to the un-shown female disadvantages in the short-term rehabilitation.

Zaidi et al [3] studied 201 patients with middle cerebral arterial occlusion and found that the mean infarction volume of recanalization patients with good outcomes (90 days mRS score ≤ 2) was significantly lower than that of

patients with adverse outcomes ($P < 0.01$), confirming that the final infarction volume was an independent predictor of prognosis in acute cerebral infarction. The study obtained the same conclusion in the analysis of the short-term prognosis, while the one-year follow-up found that there was no significant correlation between infarction volume and clinical prognosis, which was possibly due to that after acute cerebral infarction, the infraction volume was proportional to the destruction caused by brain edema in short term, thereby affecting the degree of neurological deficit, but a year later with resolution of cerebral edema, it had minimal effect on the functional areas.

Baseline NIHSS score is an indicator for the evaluation of the degree of neurological deficit. The study showed that NIHSS score can predict the short-term prognosis of acute cerebral infarction, independently associated with the daily activity of patients after two weeks or three months [10]. Song Tian et al [11] conducted a prospective study in 76 patients with acute cerebral infraction, which showed that baseline NIHSS score was an independent predictor for short-term prognosis of acute cerebral infarction, and patients with high baseline NIHSS scores relatively had poor prognosis ($P = 0.011$). This study showed that baseline NIHSS score was independently associated with both the short-term and long-term prognosis of acute cerebral infarction, indicating that baseline NIHSS score was indeed an ideal indicator to assess and predict the prognosis of acute cerebral infarction.

Infection after acute cerebral infarction is an independent risk factor for poor prognosis [12]; Katzan et al [13] reported that mortality of stroke complicated with pulmonary infection increased three times. In this study, the analysis of short-term prognostic factors showed that: concurrent infection was an independent risk factor for poor prognosis of acute cerebral infarction, which was consistent with the above findings. Tian Jinyong et al [14] studied 261 cases of stroke patients and found that post-stroke depression mostly affected the neurological rehabilitation of patients after stroke, which is not conducive to improve the prognosis; this study showed that there was no significant correlation between post-stroke depression and the prognosis of acute cerebral infarction, which may be due to that the small sample size or active antidepressant treatment for post-stroke depression offset the negative impact on the prognosis. In this paper, the age, the time of admission were not significantly correlated with and the prognosis, which may be related to the small sample size of this study and the different definitions of prognosis; a large-sample and multi-center study is required.

The correlation between short-term prognosis and long-term prognosis has not been reported at home and abroad; this study confirms that the effective short-term prognosis of acute cerebral infarction is an independent predictor of long-term prognosis, for patients with good short-term prognosis, the long-term prognosis is also good; is the long-term prognosis of patients with poor short-term prognosis poor? The answer is no. This study shows that there is no statistical correlation between poor short-term prognosis and long-term prognosis. The prognosis of acute cerebral infraction is the result of the interaction of many factors, such as patient's own condition and environmental factors; short-term prognosis is only one of the factors, so relying on short-term prognosis to predict the long-term or even lifelong prognosis is unscientific. At present, only actively intervening controllable factors (such as early in-time recanalization for patients with acute cerebral infarction to minimize final infarction volume; actively anti-infective therapy for susceptible strains for co-infected patients.) can ultimately improve the prognosis.

## Disclosure of conflict of interest

None.

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