Original Contribution

Serum albumin level is associated with the recurrence of acute ischemic stroke

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ABSTRACT

Background: Previous studies have confirmed that low serum albumin levels in acute ischemic stroke patients increased the risk for poor outcome and death, demonstrating the neuroprotective role of albumin. However, there are few studies investigating the relationship between albumin levels and recurrence of stroke. The aim of this study was to evaluate the effect of serum albumin level on the risk of recurrence in patients with acute ischemic stroke.
Methods: Seven hundred fifty-three consecutive patients with acute first-ever ischemic stroke were recruited in this study. Recurrent outcome was measured 1 year after stroke through home interviews (n = 692).
Results: Patients with recurrence had significantly lower serum albumin level than those without recurrence (37.07 ± 4.21 vs 38.91 ± 3.25). The multiple logistic regression adjustment for confounding factors showed that the association remained significant for patients in the second albumin quartile, the third quartile, and the fourth quartile compared with patients in the first quartile (adjusted odds ratio [aOR] = 0.543, 95% confidence interval [CI]: 0.307-0.959, P= .036; aOR = 0.449, 95% CI: 0.249-0.812, P= .008; and aOR = 0.290, 95% CI: 0.148-0.570, $P < .001$).
Conclusion: Lower serum albumin level increases the risk of recurrence in patients with acute ischemic stroke, suggesting that serum albumin level might be used as an indicator for stroke recurrence.

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1. Introduction

Stroke has been ranked as the leading causes of death and long-term disability in China and many other countries [1]. With the development of medicine and rehabilitation medicine, the situation of handicap degree and mortality has been ameliorated. However, increased recurrence of stroke has been observed in recent years, leading to doubled rate of disability and death. Surprisingly, traditional vascular risk factors, such as age, hypertension, diabetes, dyslipidemia, and smoking, cannot fully account for the recurrence of stroke.

Serum albumin is a unique multifunctional protein and has been shown to be neuroprotective [2–6]. Several studies have demonstrated the obvious protective influence of serum albumin in many diseases,

such as myocardial infarction and cardiovascular diseases [7–9]. In recent years, some studies have showed a neuroprotective effect of serum albumin in ischemic stroke on animal models.

Some reports have also suggested that relatively low serum albumin levels in acute ischemic stroke patients increased the risk for poor outcome [10] or death [11]. However, there are few studies investigating the relationship between albumin levels and recurrence of stroke. Therefore, the objective of this prospective cohort study with a follow-up period of 12 months was to evaluate the association between albumin level and stroke recurrence.

2. Methods

2.1. Patients

This prospective cohort study included 753 first-ever ischemic stroke patients during acute phase (the first week following a stroke) with a 1-year follow-up. All patients admitted into the neurological department at Huai-He Hospital in Kaifeng, China, from March 2014 to March 2015 were evaluated for eligibility for the study. Informed

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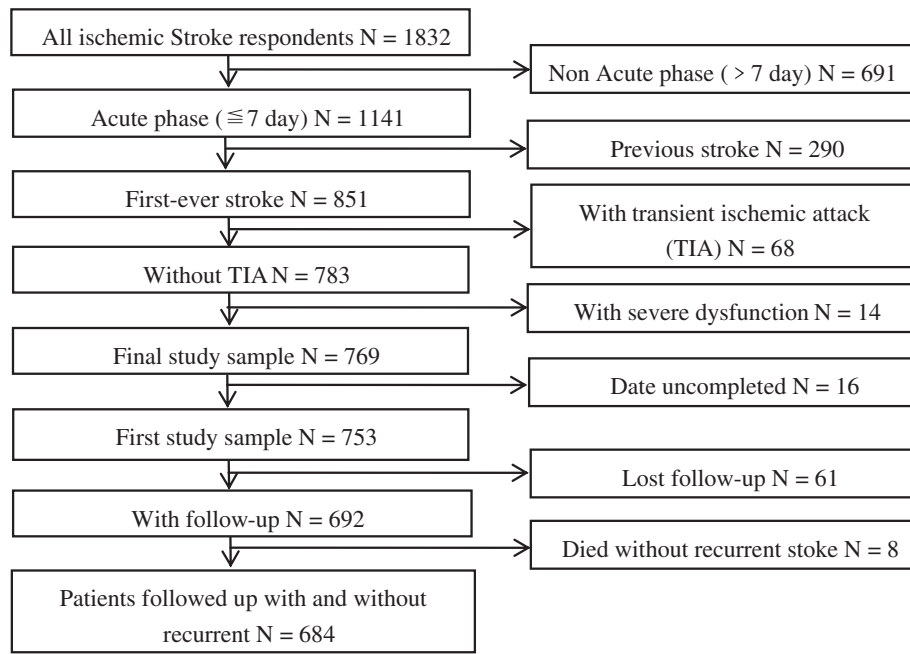
Fig. 1. Flowchart in the selection of study patients.

consent was obtained from all patients before this study. This study complies with the Declaration of Helsinki and was approved by the ethical committee of Henan University. All patients were examined for ischemic stroke, which was confirmed by computed tomographic scan and magnetic resonance imaging according to the fourth Chinese National Conference's recommendations on the diagnosis of cerebrovascular diseases [12]. Patients with major cardiac, renal, hepatic, and endocrinological disorders; skeletal disorders; malignant tumor; recent surgery; and recent infections were excluded. A flowchart illustrating the selection of patients is presented in Fig. 1. Six hundred ninety-two cases were included in this study after excluding 61 cases that were lost to follow-up.

2.2. Baseline survey

Sociodemographic variables included age, sex, marital status, and living arrangement. Lifestyle factors included smoking, alcohol drinking, family history, hypertension history, diabetes history, coronary heart disease history, hyperlipidemia, and body mass index (BMI). Hypertension was diagnosed as systolic blood pressure >140 mm Hg and/or diastolic blood pressure >90 mm Hg based on the average of the 2 blood pressure measurements, or patient's self-reported history of hypertension or antihypertensive use, supported by the Joint National Committee VI-VII. Diabetes was diagnosed if the fasting plasma glucose was >110 mg/dL or if patient was on antidiabetic medications. Smokers were defined as those smoking 1 or more cigarettes per day for 1 year or those with smoking cessation <5 years [13]. Alcohol drinking was defined as consumption of at least 1 alcoholic drink in a week and more years. A positive family history was defined as history of ischemic stroke in a first-degree relatives. Hyperlipidemia was diagnosed as elevated plasma level in at least one of total cholesterol, triglyceride, high-density lipoprotein, and low-density lipoprotein. Weight and height of patients were measured on admission. BMI was categorized according to Chinese weight criteria [14].

2.3. Blood sample collection

Blood samples for assessment of albumin were obtained from all patients within 24 hours of admission after stroke onset. Concentrations of albumin and other laboratory examinations (total cholesterol, triglyceride, high-density lipoprotein, low-density lipoprotein) were determined using the full automatic biochemical analyzer (Germany, SIEMENS ADVIA2400). Hypoproteinemia was diagnosed if the levels of albumin were <35 g/L.

2.4. Follow-up

Follow-up assessment was conducted in all patients by well-trained home interviewers at 1 year after hospital discharge. The information included recurrence, time of recurrent stroke, type of recurrence, survival status, and cause of death.

2.5. Statistical analysis

All statistical analyses were conducted with SPSS 17.0 (SPSS, Inc, Chicago, IL). Categorical variables are reported as frequency and percentage, and continuous variables are presented as median values or means ± standard deviations (SDs). The associations between albumin level and baseline demographic variables or cerebrovascular risk factors were examined using χ^2 test for categorical variables. For the comparisons between groups, χ^2 and Student t test or 1-way analysis of variance were conducted for categorical and continuous variables, respectively. In the multivariate analyses, we used the forward selection procedure to adjust for potential clinically relevant confounders, including age, sex, marital status, residence, smoking, alcohol drinking, family history, hypertension, diabetes, coronary heart disease, hyperlipidemia, and BMI. Statistical significance was defined as a P value < .05.

3. Results

3.1. Patients' characteristics

A total of 753 ischemic stroke patients were enrolled in the study, and the characteristics of all patients, including follow-up group and lost to follow-up group, are presented in Table 1. There was no significant difference between follow-up group and lost to follow-up group. Six hundred ninety-two patients (91.9%) completed the first year of follow-up with the mean of age being 64 years (SD = 12.8). The mean