Analysis of Factors Influencing Nutritional Status at Different Time Points in Hospitalized Stroke Patients: Postprint

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Abstract

Background: Stroke patients frequently develop malnutrition. Previous studies have predominantly focused on nutritional status at admission, with limited research on nutritional status during hospitalization and at discharge. Dynamic observation and analysis of influencing factors could improve nutritional status and prognosis in stroke patients.

Objective: To analyze the influencing factors of nutritional status in stroke patients at different time points (admission, 7 days, discharge).

Methods: This study enrolled 177 patients. Data on general information, nutritional status, swallowing function, and degree of neurological deficit were collected to analyze the relationship between various factors and nutritional status in stroke patients.

Results: Univariate analysis revealed that nutritional status at admission differed significantly between groups in terms of age, smoking and alcohol consumption history, nutritional support method, and WST score ($P<0.05$). At 7 days, significant differences were observed in age, post-stroke pneumonia, nutritional support method, Water Swallow Test (WST) score, and NIHSS score ($P<0.05$ to 0.001). At discharge, significant differences were found in nutritional support method, WST score, and NIHSS score ($P<0.05$ to 0.001). Multivariate Logistic regression analysis demonstrated that WST score (OR=2.041, 95%CI: 1.354-3.076) was a predictor of malnutrition at admission; age (OR=1.029, 95%CI: 0.994-1.065), nutritional support method, and NIHSS score (OR=1.108, 95%CI: 1.029-1.194) were predictors of malnutrition at 7 days; nutritional support method was an independent predictor of malnutrition at discharge.

Conclusion: WST score is an influencing factor for malnutrition at admission; age, nutritional support method, and NIHSS score are influencing factors for

malnutrition at 7 days; nutritional support method is an influencing factor for malnutrition at discharge.

Full Text

Analysis of Factors Influencing Nutritional Status in Hospitalized Stroke Patients at Different Time Points

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Abstract

Background: Stroke patients frequently experience malnutrition. Previous studies have primarily focused on nutritional status at admission, with limited research examining nutritional status during hospitalization and at discharge. Dynamic observation and analysis of influencing factors could improve nutritional outcomes and prognosis in stroke patients.

Objective: To analyze factors influencing nutritional status in stroke patients at three time points: admission, 7 days post-admission, and discharge.

Methods: This study enrolled 177 patients who met inclusion criteria. Data on general characteristics, nutritional status, swallowing function, and neurological deficits were collected to analyze relationships between various factors and nutritional status in stroke patients.

Results: Univariate analysis revealed statistically significant differences ($P<0.05$) between groups at admission in terms of age, smoking/alcohol history, nutritional support method, and Water Swallow Test (WST) score. At 7 days, significant differences ($P<0.05$ to $P<0.001$) were observed in age, post-stroke pneumonia, nutritional support method, WST score, and NIHSS score. At discharge, significant differences ($P<0.05$ to $P<0.001$) were found in nutritional support method, WST score, and NIHSS score. Multivariate logistic regression analysis identified WST score (OR=2.041, 95%CI: 1.354-3.076) as a predictor of malnutrition at admission; age (OR=1.029, 95%CI: 0.994-1.065), nutritional support method, and NIHSS score (OR=1.108, 95%CI: 1.029-1.194) as predictors at 7 days; and nutritional support method as an independent predictor at discharge.

Conclusion: WST score influences nutritional status at admission; age, nutritional support method, and NIHSS score influence nutritional status at 7 days; and nutritional support method influences nutritional status at discharge.

Keywords: Stroke; Nutritional status; Influencing factors

According to the Global Burden of Disease Study, stroke is the leading cause of death and disability among adults in China, with increasing prevalence. In 2019, approximately 17.04 million people in China suffered from stroke, ranking highest globally [1]. Stroke patients commonly experience swallowing disorders, hemiplegia, and consciousness disturbances, resulting in widespread nutritional risk and malnutrition [2]. Malnutrition not only impairs neurological and functional recovery but also represents a risk factor for post-stroke pneumonia and other complications [3]. While pharmacological treatments effectively prevent and manage disease progression, the importance of nutrition cannot be overlooked [4]. Previous research has predominantly focused on nutritional status at admission, with limited studies examining nutritional status dynamically throughout hospitalization. This study investigates the nutritional status of stroke inpatients in the rehabilitation department of The First Affiliated Hospital of Zhengzhou University at different time points, analyzes influencing factors, identifies primary causes of nutritional changes, prevents further deterioration, and provides theoretical guidance and evidence-based medical support for standardized nutritional management in stroke patients.

1.1 Study Participants

From January 2021 to December 2021, 177 stroke patients admitted to the rehabilitation department of The First Affiliated Hospital of Zhengzhou University were enrolled. General data were collected through patient interviews and medical record review.

Inclusion criteria: (1) Age 18-80 years; (2) First-ever stroke episode meeting diagnostic criteria [5,6] and confirmed by imaging (CT and/or MRI); (3) Time from onset to admission $ 7*days*; (4)$Clearconsciousness, stablevitalsigns, andabilitytocooperatewithtreatmen$ days at discharge.

Exclusion criteria: (1) Medical or surgical conditions affecting nutritional status, including severe trauma, surgery, malignancy, gastrointestinal disease, severe endocrine/metabolic disorders, or severe hepatic/renal dysfunction; (2) Rehabilitation treatment duration <7 days; (3) Patient refusal.

This retrospective study did not interfere with clinical treatment or increase medical costs and was approved by the Ethics Committee of The First Affiliated Hospital of Zhengzhou University (Approval No.: 2021-ky-0609-003).

1.2 Treatment Methods

All inpatients received conventional and comprehensive rehabilitation treatment, including anti-infection therapy, management of underlying conditions, neurotrophic support, blood pressure control/antiplatelet or anticoagulation therapy, lipid stabilization, circulation improvement, comprehensive hemiplegic limb training, swallowing disorder training, and speech therapy. Swallowing function

was assessed to determine appropriate nutritional support. Patients unable to eat normally received either nasogastric tube (NGT) feeding or intermittent oro-esophageal feeding (IOE) based on indications, contraindications, and patient preference. Both IOE and NGT feeding followed standardized protocols with energy intake of 20-25 kcal/kg/day and protein supplementation of 1.5-2 g/kg/day [3]. Patients at high nutritional risk who could not meet requirements through enteral nutrition or for whom enteral nutrition was contraindicated received parenteral nutrition via central or peripheral venous catheterization.

1.3 Data Collection

Within 24 hours of admission, the following data were collected and assessed: (1) General information: gender, age, comorbidities (major chronic diseases such as hypertension, diabetes, chronic respiratory disease), smoking/alcohol history, and nutritional support method (oral intake only, NGT only, IOE only, or combined with parenteral nutrition [PN]); (2) Neurological assessment: NIHSS [8] to evaluate stroke severity; (3) Swallowing function assessment: WST scoring.

1.4 Nutritional Status Assessment

The ambiguous definition of malnutrition has long challenged the medical community, and no specific measurement tool exists for stroke patients [9]. Research indicates that 83.23%-97% of hospitalized stroke patients have average hospital stays within 30 days [10], while commonly used scales assess weight loss or reduced intake over periods exceeding 30 days. After reviewing literature and consulting clinicians, laboratory indicators including serum prealbumin (PA), albumin (ALB), and transferrin (TRF) concentrations were selected as practical, widely used nutritional assessment parameters. The final evaluation criteria combined these laboratory indicators with short-term BMI changes. Malnutrition was defined as meeting $ $1 of the following five criteria$ [10] : (1) $Weight loss > 6^{2}$; (3) $Serum albumin < 35 g/L$; (4) $Serum transferrin < 1.80 g/L$; (5) $Serum prealbumin < 10 mg/dL$. $Nutritional status was assessed at admission, day 7, and discharge$ (3 days). For bedridden or wheelchair-dependent patients, weight was measured using the department' s patented medical scale (Patent Publication No.: CN110567566A).

1.5 Nutritional Risk Screening

Within 24 hours of admission, trained clinicians conducted nutritional risk screening using the NRS2002, comprising nutritional impairment score, disease severity score, and age score. A score $ $3 indicated nutritional risk, while < 3 indicated no risk$ [11]. $Considering height and weight differences between Asian and European populations, BM$ $18.5 kg/m^{2}$ $ classified as underweight and at malnutrition risk [12]. Nutritional risk screening at the other two time points was based on routine weight measurements, laboratory indicators (PA, ALB), and changes documented in medical records.

1.5 Statistical Methods

SPSS 26.0 software was used for statistical analysis. Continuous variables were expressed as mean ± standard deviation ($\bar{x}\pm s$). Normally distributed data with homogeneity of variance were analyzed using independent samples t-tests. Categorical variables were described as frequencies (percentages) and compared using ^{2} tests. Factors with statistical significance in univariate analysis were entered as independent variables in forward stepwise likelihood ratio binary unconditional logistic regression to identify influencing factors on nutritional status at different time points, with OR values and 95% CIs calculated.

2.1 General Characteristics and Nutritional Status

A total of 177 patients met inclusion criteria, including 103 males and 74 females, with a mean age of 59.0$±$11.7 years (range 35-80). Malnutrition was identified in 21 patients (11.86%) at admission, 57 patients (32.20%) at day 7, and 35 patients (19.77%) at discharge. The malnutrition rate at admission was significantly lower than at day 7 ($P<0.001$) and discharge ($P=0.041$). No statistically significant differences in nutritional risk were observed across time points (see).

Nutritional status of stroke patients at different time points n(%)

2.2.1 Univariate Analysis Results

Comparisons between malnourished and well-nourished patients at different time points revealed: (1) At admission, significant differences existed in age, smoking/alcohol history, nutritional support method, and WST score; (2) At day 7, significant differences were found in age, post-stroke pneumonia, nutritional support method, WST score, and NIHSS score; (3) At discharge, significant differences were observed in nutritional support method, WST score, and NIHSS score (see).

Results of univariate analysis at different time points in 177 stroke inpatients

2.2.2 Multivariate Analysis Results

Binary logistic regression was performed with nutritional status (malnourished vs. normal) at admission, day 7, and discharge (30$±$3 days) as dependent variables. Statistically significant indicators from univariate analysis were included as independent variables. Since nutritional support method was selected by physicians on admission day based on patient condition and preference, it was excluded from the admission model as it could not yet influence nutritional status. Age, WST score, and NIHSS score were continuous variables; categorical variable assignments are shown in .

Results indicated that WST score was a predictor of malnutrition at admission; age, nutritional support method, and NIHSS score were predictors at day 7; and

nutritional support method was an independent predictor at discharge. Hosmer-Lemeshow tests yielded P>0.05 for all models, indicating good fit (see).

Variable assignment of nutritional status related factors in stroke patients

Multivariate analysis of nutritional status of stroke patients at different time points

3.1 Enhancing Attention to Nutritional Status in Stroke Patients

Stroke patients frequently exhibit abnormal nutritional status due to disease characteristics. Nutritional status evolves dynamically with disease progression and directly affects outcomes while remaining modifiable. Therefore, analyzing factors influencing nutritional status at different time points and implementing appropriate interventions is essential. Among the 177 enrolled patients, the malnutrition rate was 11.86% at admission, with a nutritional risk rate of 47.46%, consistent with domestic and international findings [13,14]. Malnutrition rates increased significantly by day 7 and at discharge. The discharge malnutrition rate (19.77%) was substantially lower than Deng et al.'s report (29.7%) [15], possibly related to regional differences, treatment approaches, and IOE' s beneficial effects on nutritional status. Clinicians should dynamically assess nutritional status throughout hospitalization. Stroke patient management should align with President Xi Jinping' s Healthy China strategic goals, transitioning from traditional treatment to comprehensive health management spanning pre-hospital, in-hospital, and post-hospital phases. Enhanced attention to nutritional status provides better conditions for recovery and prognosis.

3.2 Influencing Factors on Nutritional Status in Stroke Patients

WST grading, as a swallowing function screening standard, was the only factor significantly affecting nutritional status at all three time points. Studies report post-stroke dysphagia incidence of 27%-64% [16], and researchers including Liu and Yan have identified swallowing dysfunction as a primary cause of malnutrition [17,18]. Swallowing function is closely related to nutritional intake, involving multiple neural levels and brain region circuits that interact and regulate the process. Stroke-related damage to any neural level can cause dysphagia [19]. Standardized screening, assessment, and treatment of swallowing function are essential. Appropriate swallowing rehabilitation training can help regain lost brain function, improve coordination and autonomous activity of swallowing-related muscles [20], restore swallowing function, improve nutritional status, and prevent further deterioration [21].

Nutritional support method was identified as an independent predictor of malnutrition at day 7 and discharge. The Chinese Expert Consensus on Standardized Nutritional Management in Stroke recommends enteral nutrition as first-line for patients unable to obtain adequate nutrition orally, provided there are no contraindications and tolerance is adequate [3]. Percutaneous endoscopic gastrostomy is less accepted in China due to its invasive nature; NGT feeding is

commonly used instead. In this study, the NGT group had 13.5 times higher odds of malnutrition compared to oral intake (OR=13.518). Patients receiving oral intake generally had better swallowing function and more adequate nutritional intake. With NGT feeding, food bypasses oral and pharyngeal phases, lacking stimulation of swallowing-related muscles, delaying swallowing recovery and affecting nutritional intake. Long-term NGT use also increases complications such as esophageal pressure ulcers and pulmonary infection [22], generating inflammatory cytokines, chemokines, and prostaglandins that activate inflammatory cells, trigger anorexia and hypercatabolic states, and contribute to malnutrition. Although this study did not directly demonstrate IOE' s impact, extensive previous research has shown IOE improves nutritional status in stroke and other neurological diseases [7,23,24]. IOE is applied only during meals, reducing complications associated with long-term tube feeding, allowing normal daily activities and rehabilitation training between meals, decreasing malnutrition from inadequate intake, and facilitating social reintegration.

Additionally, age was identified as a risk factor for malnutrition at admission and day 7. Advanced age is associated with decreased chewing ability, sensory impairments affecting appetite, and reduced gastrointestinal function impairing digestion [25]. Age' s influence diminished by discharge, possibly due to disease treatment, health education improving patient and caregiver awareness, and appropriate interventions. NIHSS score also influenced nutritional status at day 7 and discharge. The NIHSS, developed by the National Institutes of Health, assesses consciousness, language, neglect, visual field loss, eye movement, motor strength, ataxia, dysarthria, and sensory loss [8]. The scale demonstrates good reliability, validity, and internal consistency, with widespread clinical application [26]. Multivariate analysis showed each 1-point NIHSS increase raised malnutrition odds by 1.1 times (OR=1.108) at day 7. Clinicians should pay special attention to nutritional status and provide appropriate education when NIHSS scores are high.

3.3 Limitations and Future Directions

This single-center retrospective study examined only in-hospital nutritional status without post-discharge follow-up. Future prospective, multicenter studies with longitudinal follow-up are needed to better inform nutritional management and improve outcomes in stroke patients.

Conclusion

Malnutrition rates among hospitalized stroke patients are high, with approximately one-third developing malnutrition by day 7—higher than rates at admission and discharge. WST score influences nutritional status at admission; age, nutritional support method, and NIHSS score predict malnutrition at day 7; and nutritional support method predicts malnutrition at discharge. Nutritional status is dynamic, necessitating comprehensive, full-cycle assessment systems.

Early nutritional intervention and preventive measures can provide optimal support for stroke patients and advance Healthy China initiatives.

Author Contributions: Wang Ruobing, Wang Liugen, Li Heping, and Zeng Xi conceived and designed the study. Wang Ruobing and Wang Liugen collected, organized, and statistically analyzed data. Zeng Xi, Wang Liugen, and Li Heping provided administrative, technical, or material support. Wang Ruobing and Wang Liugen analyzed and interpreted results. Wang Ruobing drafted the manuscript. Zeng Xi provided overall quality control and writing guidance.

Conflict of Interest: The authors declare no conflicts of interest.

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Note: Figure translations are in progress. See original paper for figures.