Combination of Low Body Mass Index and Low Serum Albumin Level Leads to Poor Functional Recovery in Stroke Patients

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Background: Nutritional status is associated with the functional recovery of stroke patients. This study aimed to examine the influence of the combination of body mass index (BMI) and serum albumin level on functional recovery in subacute stroke patients. *Methods:* This retrospective cohort study included 259 subacute stroke patients (mean age 68.9 ± 12.3 years). Patients were categorized into 4 groups according to their BMI and serum albumin level: group 1, low BMI (<18.5 kg/m^2) and low serum albumin level (<3.5 g/dL); group 2, low BMI and high serum albumin level (≥3.5 g/dL); group 3, normal weight (≥18.5 kg/m^2) and low serum albumin level; and group 4, normal weight and high serum albumin level. The outcome variable was the motor subscale of the Functional Independence Measure (M-FIM) effectiveness. We defined the first quartile of M-FIM effectiveness as poor functional recovery. Multivariate logistic regression analysis was performed to examine the influence of the combination of BMI and serum albumin level on poor functional recovery. *Results:* Multivariate logistic regression analysis adjusted for baseline characteristics (reference, group 4) showed that group 1 was mostly associated with a significant risk of poor functional recovery (odds ratio, 4.13; 95% confidence interval, 1.53-11.15). *Conclusions:* Our results suggested that the combination of low BMI and low serum albumin level was more significantly associated with poor functional recovery in subacute stroke patients than either factor alone. The combination of BMI and serum albumin level should be taken into account when predicting functional recovery in subacute stroke patients. **Key Words:** Stroke—nutrition—BMI—albumin—functional recovery.

Introduction

Stroke is a leading cause of acquired disability. It is estimated that 25% to 74% of the 50 million stroke survivors worldwide require some assistance or are fully dependent on caregivers for activities of daily living (ADL) after stroke.[1] Previous systematic reviews showed that age, urinary continence, severity of paralysis, cognitive impairment, comorbidity, and premorbid independence were predictive factors associated with poststroke functional recovery.[2,3]

Recently, several previous studies investigated the relationship between functional recovery and body mass index (BMI) in stroke patients.[4-8] BMI is one of the indexes that reflect nutritional status. Some studies reported that underweight status (BMI <18.5 kg/m^2) significantly related

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to poor functional recovery in stroke patients.[4,5] However, several other studies indicated that there was no difference in functional recovery between underweight status and normal-weight status in stroke patients.[7,8] Thus, the influence of weight status on functional recovery remains unclear.

Serum albumin level is also an important indicator of malnutrition. Several studies showed that a high serum albumin level was associated with a better outcome in stroke patients.[9-11] On the other hand, several other studies indicated that serum albumin level was not significantly associated with Functional Independence Measure (FIM) improvement in stroke patients.[12,13] These previous studies may suggest that serum albumin level alone is also not a robust predictor of functional recovery in stroke patients. Functional recovery may be predicted in greater detail by evaluating the combination of BMI and serum albumin level.

The aim of this study was to investigate the effects of a combination of BMI and serum albumin level on functional recovery of subacute stroke patients. We hypothesized that a combination of low BMI and low serum albumin level is more significantly associated with poor outcome in subacute stroke patients than either factor alone.

Methods

Participants

This retrospective observational cohort study included 259 patients with subacute stroke who were admitted to our rehabilitation unit between April 2011 and March 2016. The diagnosis of stroke was based on the World Health Organization definition.[14] All patients underwent clinical examination by a physiatrist and an imaging test (computed tomography or magnetic resonance imaging). The inclusion criteria were first-ever unilateral, supratentorial stroke, and independent in ADL prior to the stroke. The exclusion criteria were subarachnoid hemorrhage, other neurological conditions, and medical conditions worsening during hospitalization, such as a recurrence of stroke or severe infection that would contraindicate rehabilitation.

Setting

The convalescent rehabilitation ward at our hospital is a 37-bed unit that employs a multidisciplinary team approach. In the Japanese medical insurance system, patients were referred from acute hospitals, typically about 30 days after stroke onset, and received hospital care in convalescent rehabilitation hospitals for up to 180 days.[15] All patients in this study had undergone rehabilitation programs every day during hospitalization. Rehabilitation programs were based on a comprehensive approach, and included physical therapy, occupational therapy, and speech therapy, as necessary. In this study, patients were provided 60-180 minute (median: 120 minutes, interquartile range: 100-140 minutes) rehabilitation sessions per day. This study was approved by the Ethics Committee of our hospital.

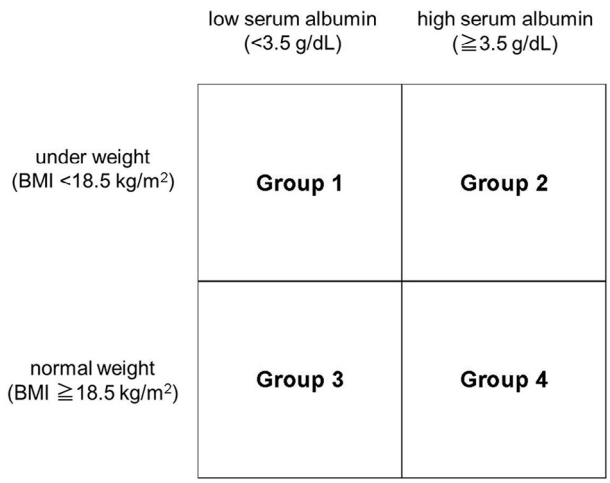

Figure 1. *Classification of participants according to the combination of body mass index (BMI) and serum albumin level.*

Variables

All variables for this retrospective study were investigated from the medical records system of our hospital. We investigated age, sex, lesion side of the brain, stroke type (cerebral infarction or cerebral hemorrhage), number of days from stroke onset to admission, length of stay, BMI, serum albumin level, Charlson comorbidity index,[16] Brunnstrom motor recovery stage,[17] presence of unilateral spatial neglect, presence of aphasia at admission, and FIM.[18] In this study, underweight status was defined as BMI <18.5 kg/m^2, according to the BMI categories for Asian populations recommended by the World Health Organization.[19] Low serum albumin level was defined as serum albumin level <3.5 g/dL.[20]

Participants were classified into 4 groups following a combination of BMI and serum albumin level: group 1, underweight status and low serum albumin level; group 2, underweight and serum albumin level ≥3.5 g/dL; group 3, normal-weight status and low serum albumin level; and group 4, normal-weight status and serum albumin level ≥ 3.5g/dL (Fig 1).

Outcome Measurement

Functional disability was assessed using the motor subscale of the FIM (M-FIM). M-FIM was evaluated at admission and at discharge. M-FIM is one of the most widely used assessment tools of ADL in patients with disability.[18] M-FIM is composed of 13 items divided into 4 subcategories: self-care (6 items), sphincter control (2 items), transfers (3 items), and locomotion (2 items). Each item is scored on a 7-point ordinal scale rating from a