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Original article

Pre-fracture nutritional status is predictive of functional status at discharge during the acute phase with hip fracture patients: A multicenter prospective cohort study

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SUMMARY

Background & aims: Malnutrition is common in patients with hip fractures, and elderly patients with hip fractures lose functional independence and often fail to recover previous functional status. The aim of this study was to determine whether pre-fracture nutritional status predicts functional status of patients with hip fracture at discharge from acute hospitals.

Methods: In the present multicenter prospective cohort study, pre-fracture nutritional status was assessed using the Mini Nutritional Assessment Short-Form (MNA-SF). At discharge from acute hospitals, functional status was evaluated using a functional independent measurement instrument (FIM). Subsequently, multiple regression analyses were performed using FIM as the dependent variable and MNA-SF as the independent variable.

Results: Among the 204 patients analyzed in the present study, the mean length of hospital stay was 26.2 ± 12.6 days, and according to MNA-SF assessments, 51 (25.0%) patients were malnourished, 98 (48.0%) were at risk of malnutrition, and 55 (27.0%) were well-nourished before fracture. At discharge, FIM scores were higher in patients who were well-nourished than in those who were malnourished or were at risk of malnutrition ($p < 0.01$). After adjustment for confounding factors, multiple regression analyses showed that MNA-SF was a significant independent predictor for FIM at discharge (well-nourished vs. malnourished, $\beta = -0.86$, $p < 0.01$).

Conclusions: Pre-fracture nutritional status was a significant independent predictor for functional status at discharge during the acute phase, warranting early assessment of nutritional status and early intervention for successful postoperative rehabilitation.

1. Introduction

The increasing prevalence of hip fractures in elderly patients is a major economic burden and leads to severe functional limitations and reduced self-care abilities [1]. Globally, the annual number of hip fractures was estimated at 1.6 million in 2000 and is expected to rise to a maximum of 6.3 million in 2050 [2]. Because the mortality rate at one year following hip fractures is high (20%–30%), it is regarded as the most severe osteoporotic fracture [1].

Many hip fracture patients suffer from the loss of functional independence, and among the 60% of patients who do not recover previous functional ability [3], about 40% cannot return to their homes after acute rehabilitation [4], due to remaining disabilities that prohibit self-care in remaining life [1]. In addition, functional status at discharge from acute hospitals was the only independent predictor in a previous study of 1-year mortality after hip fracture

Abbreviations: MNA-SF, Mini Nutritional Assessment Short-Form; FIM, Functional Independent Measure instrument; ADL, Activity of Daily Living; HDS-R, The Hasegawa Dementia Scale-Revised; BMI, Body Mass Index.

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[5]. Therefore, for patients with hip fracture, functional recovery is one of the most important rehabilitation goals, and the knowledge about the predicting factors for functional status is important.

Malnutrition is common in patients with hip fracture, and previous studies indicate that up to 60% of patients are malnourished on admission [6–8]. The condition was reported to be associated with longer hospitalization, readmission, and mortality [6–8]. Malnourished hip fracture patients also tend to suffer from dementia, have more sedentary time after surgery, suffer early complications, and have stronger catabolic responses to surgery. Thus, malnutrition may influence functional recovery after hip fracture, and early-phase nutritional intervention may improve outcomes for hip fracture patients. A few recent studies have reported the relationship between pre-fracture nutritional and functional status [9,10]. Goisser et al. suggested an association between pre-fracture nutritional and functional status as evaluated by the Barthel Index, on hospital discharge in the acute phase. However, the adjustment of confounding factors was not considered. In addition, the sample size ($n = 97$) was too small to perform multivariate analysis. Nuotio et al. demonstrated the association between nutritional status, assessed by MNA-SF, and postoperative mobility ability. However, they also did not adjust for postoperative potential confounding variables, e.g., delirium. Therefore, the relationship between pre-fracture nutritional status and functional status remains unclear.

In the present study, we investigated the relationship between nutritional status before fracture and functional status of hip fracture patients at discharge from acute hospitals. To facilitate generalizability, we performed a multicenter study of hip fracture patients aged 65–102 years.

2. Materials and methods

2.1. Study design

This multicenter prospective cohort study was conducted from June 2013 to November 2014. Subjects included patients with femoral neck, trochanteric, subtrochanteric, and basicervical hip fractures who were recruited upon consecutive admission to Nishi-Kobe Medical Center (a 475-bed facility), Kobe City Medical Center General Hospital (a 700-bed facility), and Saiseikai Hyogoken Hospital (a 250-bed facility) in Kobe at the capital of Hyogo prefecture in Japan. Patients aged ≥65 years in whom fractures incurred as a result of falls and required surgery were recruited. Among these, patients with a terminal malignant disease, uncontrolled chronic liver disease, and/or pre-fracture ambulation difficulty, as well as those with partial or no weight-bearing indications during postoperative rehabilitation, were excluded from analyses. Patients who discontinued postoperative rehabilitation due to unexpected events, such as death or bone dislocation, were also excluded. In each hospital, individual postoperative rehabilitation was provided by physical therapists for 20–40 min per day, 5–6 days per week. Physical therapy focused on transfer from bed to wheelchair, range of motion of the joint, and muscle strength, and walking exercise was performed starting postoperative day 1. The study was reviewed and approved by each hospital's institutional review board.

2.2. Data collection

2.2.1. Measurements

Demographic data included age, gender, comorbidity, type of residence, pre-fracture ambulation, fracture type, surgical procedure, fracture-to-surgery duration, laboratory data about albumin and CRP levels, and in-hospital postoperative complications, such as delirium, deep thrombophlebitis, pneumonia, and urinary tract infections, were collected from the medical records. Body mass index (BMI) was calculated based on self-reported or caregiver provided weight and height. We also recorded the complications that had led to the patients' hospitalization and why they had required treatment. Clinical data for muscle strength, calf circumference, and cognitive function were preoperatively assessed by physical therapists within 24 h of admission, and the incidence of in-hospital complications and lengths of hospital stays were also extracted from medical documentation at discharge. Hand grip strength assessed using a digital hand dynamometer was considered a measure of muscle function (T.K.K.5401; Takei Scientific Instruments, Niigata, Japan). Measurements were taken three times with the dominant hand and the highest value was recorded. Calf circumferences were measured using a stretchable flexible tape perpendicular to the long axis of the non-fractured lower leg to unaffected edema. Cognitive function was assessed using the Hasegawa Dementia Scale-Revised (HDS-R), which is a Japanese screening test for patients with dementia. The HDS-R comprises 10 items and a total score of 30. This Japanese cognitive function screening tool correlates well with the Mini-Mental State Examination [11]. Patients were classified as having normal (score > 20) or impaired cognitive function (<20 points).

2.2.2. Nutritional status

The pre-fracture nutritional status was assessed during the first few days after admission before surgery using the Mini Nutritional Assessment Short-Form (MNA-SF) by the physical therapist of each hospital; the tool is a validated, sensitive, reliable, and quick screening tool [12,13,20]. The questionnaire consisted of six items from the original MNA as follows: decline in food intake over the past three months, weight loss during the past three months, mobility, psychological stress or acute disease in the past three months, neuropsychological problems, and BMI or calf circumference. Since BMI was unavailable, calf circumference was applied to calculate MNA-SF because we calculated BMI through self-reported height and weight. Therefore, we applied calf circumference instead of BMI to score item F.

Depending on the total scores, the patients were classified as belonging to three groups: 12–14 points indicate well-nourished, 8–11 points indicate at risk of malnutrition, and 0–7 points indicate malnourished. In addition, MNA-SF is composed of some items based on memory, e.g., decline in food intake in the past 3 months. Therefore, in cases of patients with delirium and/or dementia, we asked the caregiver the relevant questions [14]. The MNA-SF scores were highly correlated with those of the original MNA in a previous study [15].

2.2.3. Functional outcomes

The ability to perform basic activities of daily living (ADL) at discharge was evaluated using a Functional Independent Measure (FIM) instrument. This tool is among the most widely used measurements for assessing the ability to perform ADL [16] and consists of 13 motor and 5 cognitive items that are individually scored 1–7 according to the amount of assistance required to perform each basic activity. The motor item includes eating, grooming, bathing, dressing upper body and lower body, toileting, bladder and bowel management, bed, chair, or wheelchair transfer, toilet transfer, tub transfer, walk/wheelchair, and the use of stairs. Five cognitive items include comprehension, expression, social interaction, problem solving, and memory. The total FIM scores ranged from 18 (reflecting full dependence) to 126 (reflecting complete independence). The present analyses were performed using scores of the 13 items of motor-FIM, which detects functional improvements with high sensitivity [17], ranging between 13 and 91.

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