Effect of nutritional status before femoral neck fracture surgery on postoperative outcomes: a retrospective study

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Research Article

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Abstract

Background

Although nutritional status is crucial in gait recovery after femoral neck fracture surgery, the relationship between preoperative nutritional status and postoperative outcomes remains unknown. This study examined the effects of preoperative nutritional status on postoperative outcomes in patients undergoing femoral neck fracture surgery.

Methods

Data regarding the joints of 137 patients (29 men, 108 women) who underwent bipolar hemiarthroplasty for femoral neck fractures at our hospital from January 2015 to December 2019 were retrospectively examined. The Geriatric Nutritional Risk Index (GNRI), an index of nutritional status, was used to classify patients into two groups: a normal group (GNRI ≥ 92; n = 62) and an undernourished group (GNRI < 92; n = 75). The study endpoints included age at surgery, sex, preoperative waiting period, intraoperative blood loss, surgery time, blood transfusion rate, complication rate, 6-month mortality rate, transfer rate, and percentage of patients unable to walk at discharge or transfer.

Results

The undernourished group was significantly older at surgery (83.3 ± 6.9 years versus [vs.] 79.6 ± 8.8 years; $p < 0.01$) and had a higher blood transfusion rate (41.3% [31/75] vs. 12.9% [8/62]; $p < 0.01$), a longer preoperative waiting period (5.5 ± 5.8 days vs. 3.9 ± 2.6 days; $p < 0.05$), a higher transfer rate (24% [18/75] vs. 9.7% [6/62]; $p < 0.05$), a higher complication rate (52% [39/75] vs. 35.5% [22/62]; $p < 0.05$), and a higher 6-month mortality rate (13.3% [10/75] vs. 0% [0/62]; $p < 0.01$) than the normal group. The most common complication was pneumonia. Patients in the undernourished group had worse rates of postoperative complications, transfer, and mortality than the normal group.

Conclusions

A poor nutritional status affects the gait function and systemic condition of patients undergoing femoral neck fracture surgery; therefore, early nutritional interventions may reduce mortality rates and shorten rehabilitation. These results suggest that the GNRI effectively predicts postoperative complications, mortality, and gait function.

Background

Proximal femoral fractures have become increasingly common, affecting nearly 1.5 million people worldwide each year. As the population ages, the annual number of femoral fractures is predicted to

increase to 6.3 million by 2050 [1–4]. With a 1-year mortality rate of 20 – 30%, proximal femoral fractures are considered serious osteoporotic fractures [4, 5]. A study found that delaying surgery for proximal femoral fractures by more than 4 days significantly increased mortality [6]. Proximal femoral fractures may lead to gait disturbances and impaired activities of daily living (ADLs). Therefore, predicting the risk factors for poor postoperative outcomes and the recovery of gait function is crucial for the aging population [7].

Undernutrition has been associated with exacerbating complications following proximal femoral fracture surgery as undernourished patients are less likely to be discharged home due to deterioration in their systemic condition [8]. In current practice, undernourished patients are being screened preoperatively using several nutrition assessments that predict complications and mortality [1, 9]. The Geriatric Nutritional Risk Index (GNRI) [10] was used to determine the patients' nutritional status in this study. GNRI is a simple index of nutritional status that can be calculated using only the serum albumin level, height, and body weight and that can be assessed at admission.

Although nutritional status is crucial in gait recovery after proximal femoral fracture surgery, the associations between preoperative nutritional status and postoperative outcomes are unknown. In the present study, nutrition status was assessed using the GNRI, and the effects of the preoperative nutritional status on postoperative outcomes were evaluated in patients who underwent treatment for femoral neck fractures at our hospital.

Methods

Patients

Data of 137 joints in 137 patients (29 men; 108 women) who underwent bipolar hemiarthroplasty (BHA) at our hospital for femoral neck fractures from January 2015 to December 2019 were retrospectively reviewed to assess nutrition status using the GNRI. This study was approved by the appropriate institutional review board (approval no.: 21R-042).

Patients with at least 6 months of follow-up data were included in this study. Patients for whom preoperative body weight, height, and serum albumin data were not available were not included in the study. In addition, patients who required wheelchairs or were bedridden before the surgery and those who underwent BHA for nonunion or osteonecrosis of the femoral head following osteosynthesis were also excluded from the study.

Nutritional index

The GNRI is a simple index developed by Bouillanne et al. that can be calculated using serum albumin, height, and body weight (GNRI = 1.489 × serum albumin (g/L) + 41.7 × (weight/ideal weight)) [10]. In this study, the ideal weight was calculated using the Lorenz equations (men: height (cm) – 100 – [(height

(cm) – 150)/4]; women: height (cm) – 100 – [(height (cm) – 150)/2.5]) [10]. Values for serum albumin and body weight were obtained on the day of admission.

A GNRI cutoff value of 92 was used to classify the patients into a normal group (GNRI ≥ 92; n =62) and an undernourished group (GNRI < 92; n = 75), as previously reported [9-11].

Endpoints

Patient age at surgery, sex, the preoperative waiting period, intraoperative bleeding volume, surgical time, blood transfusion rate, complication rate, 6-month mortality, transfer rate, and percentage of patients unable to walk at discharge or transfer were used as study endpoints. Patients were transferred to rehabilitation facility if a discharge to home was deemed too difficult at 2 weeks postoperatively.

Surgery

All patients underwent BHA via the posterior approach while in a lateral position. After the short external rotators and posterior capsule were incised and the femoral head was removed, a cementless system was implanted. The short external rotators and posterior capsule were then sutured to the greater trochanter. During rehabilitation, full weight-bearing was permitted, starting on the day following surgery.

Statistical analyses

All statistical analyses were performed using IBM SPSS Statistics (version 26; IBM, Corp., Armonk, NY, USA). The Student's *t*-test was used to assess age at surgery, the preoperative waiting period, intraoperative bleeding volume, and surgical time. Fisher's exact test was used to assess sex, the blood transfusion rate, complication rate, 6-month mortality rate, transfer rate, and percentage of patients unable to walk at discharge or transfer. Statistical significance was set at $p < 0.05$.

Results

Patients in the normal group (n = 62; 14 men and 48 women) were significantly younger at the time of surgery (mean age = 79.6 ± 8.8 years) than those in the undernourished group (mean age = 83.3 ± 6.9 years; n = 75; 15 men and 60 women) ($p < 0.01$). The intraoperative blood loss and surgical time were not significantly different between the groups. The blood transfusion rate was significantly higher in the undernourished group than in the normal group (41.3% [31/75] versus [vs.] 12.9% [8/62], $p < 0.01$). The preoperative waiting period was longer in the undernourished group than in the normal group (5.5 ± 5.8 days vs. 3.9 ± 2.6 days; $p < 0.05$). A higher percentage of patients in the undernourished group were unable to walk at discharge or transfer (25.3% [19/75] vs. 11.3% [7/62]; $p < 0.05$). The undernourished group contained a higher percentage of patients who required transfers due to the inability to walk (24% [18/75] vs. 9.7% [6/62]; $p < 0.05$) (Table 1).

Table 1
Patient characteristics

	Normal group	Undernourished group	p-value
Age (years)	79.6 ± 8.8	83.3 ± 6.9	0.009
Sex	Male, 14; Female, 48	Male, 15; Female, 60	0.44
Preoperative waiting period (days)	3.9 ± 2.6	5.5 ± 5.8	0.03
Intraoperative blood loss (mL)	169.7 ± 116.8	176.5 ± 111.9	0.71
Surgery time (min)	90.1 ± 25.2	81.4 ± 25.8	0.05
Blood transfusion rate (%)	12.9	41.3	0.0002
Transfer rate (%)	9.7	24	0.02
Percentage of patients unable to walk at discharge or transfer (%)	11	25.3	0.03
Complication rate (%)	35.5	52	0.04
6-month mortality rate (%)	0	13.3	0.002

The complication rate was significantly higher in the undernourished group than in the normal group (52% [39/75] vs. 35.5% [22/62]; $p < 0.05$) (Table 1). More patients in the undernourished group had pneumonia (Table 2).

Table 2
Patient complications in the normal group and the undernourished group

Normal group		Undernourished group	
Total	22	Total	39
Pneumonia	3 (13.6%)	Pneumonia	13 (33.3%)
Periprosthetic femoral fracture	5 (22.7%)	Urinary tract infection	6 (15.4%)
Enteritis	3 (7.3%)	Delirium or mental illness	6 (15.4%)
Other	9 (40.1%)	Other	14 (35.9%)

The 6-month mortality rate was significantly higher in the undernourished group than in the normal group (13.3% [10/75] vs. 0% [0/62]; $p < 0.01$) (Table 1). Among the 10 patients in the undernourished group who died within 6 months postoperatively, 6 had pneumonia.

Discussion

In this study, undernourished patients suffered more postoperative complications, transfers, and 6-month mortality rates. Approximately 60% of patients with proximal femoral fractures are undernourished, which severely affects postoperative mortality and complications [4, 12, 13]. A weakened immune function resulting from preoperative undernourishment increases the risks of infection and complications and has been associated with increased mortality [14, 15]. Heart failure and pneumonia are the common postoperative complications among patients with proximal femoral fractures. Roche et al. reported that pneumonia was more common than heart failure among patients with proximal femoral fractures [16], which is consistent with the results of the present study.

A preoperative scoring system to assess nutritional status has been developed, which can be used as a reliable indicator to predict postoperative outcomes [17]. In this study, the preoperative nutritional status was assessed using the GNRI, which can predict morbidity and mortality among elderly patients [10, 18]. However, there is no consensus on the ideal method for assessing nutritional status in patients with proximal femoral fractures, and a definite assessment method is yet to be established for this specific patient population [19]. The GNRI, which was originally developed to assess patients undergoing hemodialysis [10], is a reliable and valid nutritional index that is also useful for assessing nutritional status in patients with heart failure and stroke [7, 20]. The GNRI was used to assess the nutritional status before surgery for proximal femoral fractures in a recent study [19], and the results showed that undernourished patients had a higher 6-month mortality rate than normal patients, indicating that the GNRI is a useful preoperative predictor of mortality. In the present study, no patients in the normal group died within 6 months postoperatively, and the 6-month mortality rate of patients in the undernourished group was similar to that reported in a previous study [19].

Another previous study reported that preoperatively undernourished patients with proximal femoral fractures exhibited a diminished ability to perform ADLs and had decreased muscle strength at discharge, suggesting that preoperative nutritional status affects the recovery of ADLs in these patients [13]. In addition, low rates of discharge to home have been reported when there is an insufficient recovery of the ability to perform ADLs, which is known to affect the postoperative gait function [9]. The rate of gait recovery following proximal femoral fractures is approximately 50% at 1 year postoperatively, reducing the ability to perform ADLs after surgery. In previous studies, 40% of patients with diminished ADLs were discharged home [4, 5]. In this study, patients in the undernourished group were less likely to be capable of resuming ADLs postoperatively, less likely to be discharged home, and more likely to be transferred to another hospital.

A previous study regarding nutritional status at admission and length of hospital stay reported that undernutrition at admission is associated with longer hospital stays, higher complication rates, and higher mortality rates, suggesting that prolonged hospitalization is associated with postoperative complications related to undernutrition at admission [21]. The awareness of undernutrition in clinical practice is low; therefore, the rate of undernutrition remains underestimated. As a result, undernutrition before undergoing surgery for proximal femoral fractures remains untreated [22]. As undernutrition can deteriorate a patient’s gait function and systemic condition, early nutritional intervention may reduce

postoperative complications and mortality and shorten the duration of rehabilitation. Early postoperative nutritional interventions have been reported to reduce mortality and shorten the length of the hospital stay [23, 24]. In this study, undernutrition was associated with a prolonged hospital stay and higher transfer rate, indicating that early preoperative nutritional interventions could help improve patients' postoperative outcomes.

This study is not without limitations, including its retrospective design and short follow-up period. Long-term outcomes should be assessed in studies with larger sample size. Although the use of the GNRI allowed prediction of postoperative outcomes, the effects of comorbidities (including dementia) were not studied. Dementia is a risk factor for mortality following proximal femoral fracture surgery [2, 19] and is associated with postoperative infection, delirium, and pneumonia [25]. Furthermore, dementia may be a risk factor for undernutrition [26]. The association between dementia and nutritional status among elderly patients should be studied in surveys assessing postoperative outcomes. Another limitation of this study is that data regarding postoperative nutritional interventions were not standardized. Therefore, the effects of postoperative nutritional interventions on postoperative outcomes cannot be determined. In addition, muscle strength and other aspects of physical function should be assessed in future studies to determine how the preoperative nutritional status affects improvement in functional outcomes. Preoperative nutritional screening should be performed to determine whether early and effective nutritional interventions and rehabilitation can help restore the ability of undernourished patients to perform ADLs.

Conclusions

Nutritional status before femoral neck fracture surgery affects postoperative complications, mortality, and gait function. The GNRI is a simple screening tool that can be used at admission to effectively predict these outcomes. This study suggests that the GNRI may be useful for predicting not only postoperative complications and mortality but also gait function recovery after femoral neck fracture surgery.

Abbreviations

GNRI: Geriatric Nutritional Risk Index

ADL: activity of daily living

BHA: bipolar hemiarthroplasty

vs.: versus

Declarations

Ethics approval and consent to participate

This study was approved by the ethics committee of the authors' institution (approval no.: 21R-042). The authors state that this study conforms with the ethical standards laid down in the most recent version of the Declaration of Helsinki. All patients were informed about the study and consented to participate.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed within this study are included in this published article.

Competing interests

The authors declare that there is no conflict interest.

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Author Contributions

T.U. conceptualized and designed this study; K.Y. acquired and analyzed the data; K.Y. and T.U. drafted the article; and M.W. critically revised the important intellectual content of the manuscript; All authors approved the final version to be published.

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