ORIGINAL ARTICLE

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Predicting Postoperative Complications and Mortality in Total Joint Arthroplasty: The Role of the Geriatric Nutritional Risk Index

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Abstract

Objective: Total joint arthroplasty (TJA) significantly improves the quality of life of individuals with severe arthritis. Despite its success, postoperative complications can affect outcomes and increase healthcare costs. Malnutrition has been identified as a key predictor of adverse surgical outcomes, including increased risk of infection and impaired wound healing. This study aimed to assess the predictive value of the geriatric nutritional risk index (GNRI) for 90-day postoperative complications and one-year mortality in patients undergoing TJA. This study investigates whether lower GNRI scores are associated with higher incidences of complications and mortality.

Methods: A retrospective analysis was conducted on patients over 65 years of age who underwent elective hip or knee arthroplasty between 2013 and 2022. GNRI was calculated using postoperative serum albumin levels and the ratio of current body weight to ideal body weight. Patients were categorized on the basis of GNRI scores to evaluate their risk of postoperative complications and mortality.

Results: The study included 723 patients, with a mean age of 70.4±2.7 years and a mean body mass index of 26.31±0.98. Postoperative GNRI identified 55.7% (n=403) of patients as having normal nutritional status, 41.5% (n=300) as low risk, and 2.8% (n=20) as moderate/severe risk. Complications within the 90-day postoperative period were observed in 4.7% (n=34) of patients, and the 1-year mortality rate was 2.1%. Patients in the moderate/severe malnutrition category had significantly higher rates of complications and mortality ($p<0.001$).

Conclusion: Lower postoperative GNRI values are significantly associated with increased rates of 90-day complications and 1-year mortality in patients with TJA, highlighting the importance of nutritional status in surgical outcomes. GNRI is a valuable tool for identifying patients at risk of postoperative complications and mortality following TJA. Addressing nutritional deficiencies preoperatively could enhance recovery and reduce adverse outcomes, emphasizing the need for nutritional assessments in the surgical management of elderly patients.

Keywords: Total knee arthroplasty, total hip arthroplasty, total joint arthroplasty, geriatric nutritional risk index, malnutrition

INTRODUCTION

Total joint arthroplasty (TJA) is recognized as a highly successful intervention for alleviating pain and improving the quality of life in patients with severe arthritis. Among orthopedic procedures, hip and knee replacements are notably prevalent, particularly in the United States, with projections indicating a surge in demand, largely attributed to an increasingly aged population (1-3). Despite the overall success of these surgeries, complications although infrequent, can impose significant financial burdens on both patients and the healthcare system (4). Considering this, preoperative patient factors have been extensively studied to predict adverse surgical outcomes, with malnutrition emerging as a critical determinant of such outcomes, affecting wound healing and increasing the risk of infections (5,6).

In the elderly, malnutrition is a critical issue, worsening morbidity and mortality rates, diminishing functional capacities, and lowering the quality of life. This condition, which is both preventable and manageable, becomes particularly concerning when combined with the catabolic effects of surgery, leading to muscle wasting and adversely affecting post-surgical recovery.

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These effects can lead to longer hospital stays, higher complication rates, and increased mortality, underscoring the importance of addressing nutritional deficiencies to improve surgical outcomes and patient recovery (7-10).

The geriatric nutritional risk index (GNRI) is an effective metric for evaluating the nutritional status of older adults, incorporating serum albumin levels and the ratio of current to ideal body weight to identify malnutrition risks. GNRI has proven useful in the early detection of malnutrition, facilitating appropriate interventions to mitigate its impact. Furthermore, this index has been applied to predict postoperative complications and mortality risks, offering valuable insights for patient management, particularly in patients undergoing dialysis or those with existing cardiovascular conditions (11-13).

Therefore, this study was designed to explore the predictive value of GNRI for assessing the risk of 90-day postoperative complications and 1-year mortality following TJA. We aimed to determine whether lower postoperative GNRI scores correlate with increased incidences of complications and mortality. We hypothesized that patients demonstrating diminished GNRI values post-surgery would experience higher rates of adverse outcomes, emphasizing the importance of nutritional status in surgical recovery and long-term health.

METHODS

Study Approval and Ethical Considerations

The study received approval from the Clinical Research Ethics Committee of the University of Health Sciences Turkey, Prof. Dr. Cemil Taşcıoğlu City Hospital (approval number: E-48670771-514.99-226507389, date: 11.10.2023) and adhered to the ethical guidelines of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion. This retrospective study focused on patients aged 65 years and older who underwent total elective knee or hip arthroplasty from 2013 to 2022. The exclusion criteria included patients younger than 65 years, those undergoing nonelective and emergency procedures, and individuals lacking comprehensive demographic data such as albumin levels, height, and weight.

Participant Selection and Data Collection

Eligible patients were those aged 65 years and above who had undergone elective knee or hip arthroplasty within the specified period. Comprehensive demographic and clinical information was gathered, including age, sex, body mass index (BMI), American Society of Anesthesiologists classification, Charlson comorbidity index (CCI), preoperative and postoperative albumin levels, smoking status, type of surgical procedure, and a detailed history of comorbid conditions such as diabetes, congestive heart failure, hypertension, chronic obstructive pulmonary disease, dyspnea, anemia, preoperative dialysis, disseminated cancer, significant weight loss, chronic steroid use, and osteoarthritis.

Nutritional Status Assessment

The GNRI formula was employed to assess nutritional status: GNRI = [1.489× albumin (g/L)] + [41.7× (body weight/ideal weight)] (14). The ideal body weight was calculated on the basis of a BMI of 22 kg/m^2 (15). For patients whose actual body weight exceeded their ideal weight, the ratio was adjusted to 1, considering the possibility of undernutrition in obese individuals (16). GNRI scores >98 indicated normal nutritional status, scores between 92 and 98 suggested low risk, and scores <92 were categorized as moderate to severe risk (17).

Outcome Measures

Early complications, including surgical site infections and periprosthetic joint infections within the first 90 days after surgery, were documented. In addition, all-cause mortality within the first year following surgery was recorded.

Statistical Analysis

Data analysis was conducted using the SPSS software version 25.0. Descriptive statistics are presented as percentages, means, and standard deviations. The normal distribution of variables was assessed using histogram plots and the Kolmogorov-Smirnov test. For normally distributed variables, one-way ANOVA was applied to compare groups. Categorical data analysis used the Pearson chi-square test. Binary logistic regression analysis was performed to identify risk factors associated with complications and mortality, with p-values <0.05 as indicative of statistical significance.

RESULTS

In this study, 723 patients who underwent TJA were analyzed. Of these, 77.4% (n=560) were women. The procedures consisted of 65.4% (n=473) total knee arthroplasties and 34.6% (n=250) total hip arthroplasties. The average age of participants was 70.4±2.7 years, with a mean CCI of 5.13±0.89 and a BMI of 26.31±0.98 (Table 1). Initial assessment of the GNRI based on preoperative albumin levels indicated that all patients had a normal nutritional status (GNRI >98).

Postoperative GNRI evaluation revealed that 55.7% (n=403) of patients maintained normal nutritional status, 41.5% (n=300)

were categorized as having low nutritional status, and 2.8% (n=20) were in moderate to severe nutritional status. Within the 90-day postoperative period, 4.7% (n=34) of the cohort experienced infection-related complications. The study observed a one-year mortality rate of 2.1%. A significant association was found between postoperative GNRI categories and the incidence of complications and mortality rates, with those in the moderate/severe malnutrition category exhibiting significantly higher rates ($p<0.001$ for both comparisons). No significant differences were observed when comparing postoperative GNRI with patient age, BMI, and CCI scores (Table 2).

Detailed logistic regression analysis identifying risk factors for complications and mortality among the study participants is presented in Table 3 and Table 4.

Table 1. Demographic data of patients included in the study

Age (years)	**70.4±2.7**
Gender n (%) Female Male	 560 (77.4%) 163 (22.6%)
Body mass index (kg/m²)	26.31±0.98
Surgical procedure (n, %) Total knee arthroplasty Total hip arthroplasty	 473 (65.4%) 250 (34.6%)
ASA class (n, %) 1 2 3 4	 25 (3.4%) 357 (49.4%) 324 (44.8%) 17 (2.4%)
Charlson comorbidity index	5.13±0.89
Complication (n, %)	34 (4.7%)
Mortality (n, %)	15 (2.1%)

ASA: American Society of Anesthesiologists

DISCUSSION

A crucial discovery from this research is the correlation between postoperative serum markers and the GNRI, highlighting that a GNRI less than 92 is significantly associated with increased risks of early postoperative complications and mortality. This finding aligns with those of prior studies that have evaluated the prognostic value of preoperative nutritional assessments (1,15,18).

Table 2. Comparison of the patients included in the study according to the GNRI groups after surgery

	Normal risk (n=403)	Low risk (n=300)	Moderate/Severe risk (n=20)	p-value
Age (years)	70.39±2.72	70.4±2.69	70.55±2.31	0.967*
Body mass index (kg/m²)	26.35±1	26.23±0.94	26.63±0.98	0.089*
Charlson comorbidity index	5.11±0.87	5.17±0.93	5.05±0.73	0.619*
Complication (n, %)	1 (0.3%)	23 (7.7%)	10 (50%)	<0.001**
Mortality (n, %)	5 (1.24%)	5 (1.66%)	5 (25%)	<0.001**

GNRI: Geriatric nutritional risk index
* One-way ANOVA test
** Pearson chi-square test

Table 3. Binary logistic regression analysis of complications in patients included in the study

Risk factors	B	Exp(B)	p-value	95% confidence interval Lower-Upper
Age (years)	-0.029	0.972	0.713	0.834-1.133
Body mass index (kg/m²)	0.230	1.259	0.294	0.819-1.937
Charlson comorbidity index	-0.032	0.969	0.897	0.601-1.562
Postoperative GNRI	-0.505	0.603	<0.001	0.516-0.706

GNRI: Geriatric nutritional risk index, B: Estimated coefficient, Exp(B): Exponential value of B

Table 4. Binary logistic regression analysis of mortality in the patients included in the study

Risk factors	B	Exp(B)	p-value	95% confidence interval Lower-Upper
Age (years)	0.052	1.053	0.629	0.853-1.300
Body mass index (kg/m²)	0.251	1.285	0.377	0.737-2.242
Charlson comorbidity index	1.168	3.216	0.001	1.613-6.414
Postoperative GNRI	-0.116	0.018	0.018	0.808-0.980

GNRI: Geriatric nutritional risk index, B: Estimated coefficient, Exp(B): Exponential value of B

This implication suggests a potential strategy to mitigate postoperative complications and mortality by preventing the decline from normal nutritional status to malnutrition in the geriatric population undergoing surgery.

The literature has consistently documented the link between preoperative hypoalbuminemia and the heightened risk of adverse postoperative outcomes (19-21). In this study, all participants had normal preoperative albumin levels; however, a 4.7% incidence of early postoperative infections was observed, indicating that postoperative albumin levels might offer a predictive value for such complications when used in GNRI calculations.

The phenomenon of malnutrition in obese patients, though less apparent, is a significant concern (22). Huang et al. (23) identified malnutrition in 8.3% of obese individuals based on specific biochemical markers, noting that these patients faced a higher rate of complications compared with their well-nourished obese counterparts. Considering that the average BMI of participants in this study places them in the overweight category, the risk of overlooking malnutrition in patients with higher than ideal body weight is evident.

The GNRI formula adjustment for individuals with body weight exceeding their ideal weight suggests that albumin levels below specific thresholds could inaccurately represent patients as being at lower nutritional risk than they actually are. This study's data showed that early complications predominantly occurred in those classified within the low nutrition group based on postoperative GNRI values.

Study Limitations

This study's retrospective nature, variability in surgical practitioners, and relatively modest sample size compared with the broader literature constitute its primary limitations. Nonetheless, it represents one of the initial attempts to leverage postoperative nutritional assessments, through GNRI, to predict outcomes following TJA. Future research with a prospective design and larger cohorts, encompassing a comprehensive range of risk factors, is essential to validate and expand upon these findings.

CONCLUSION

The transition from normal to malnourished status post-surgery, as indicated by hypoalbuminemia, significantly impacts the risk of complications and mortality within the first year after TJA. The outcomes of this study underscore the importance of considering postoperative albumin levels in nutritional risk assessments. Consequently, further randomized controlled trials are required to confirm these insights and guide clinical practice toward improved postoperative care and nutritional management.

Ethics

Ethics Committee Approval: This study was approved by the Clinical Research Ethics Committee of the University of Health Sciences Turkey, Prof. Dr. Cemil Taşcıoğlu City Hospital (approval number: E-48670771-514.99-226507389, date: 11.10.2023).

Informed Consent: Informed consent was obtained from all participants.

Authorship Contributions

Surgical and Medical Practices: M.Y., A.Y., N.E., M.S.S., T.O.B., H.G., Concept: M.Y., A.Y., N.E., M.S.S., T.O.B., H.G., Design: M.Y., A.Y., N.E., M.S.S., T.O.B., H.G., Data Collection or Processing: M.Y., A.Y., N.E., M.S.S., T.O.B., Analysis or Interpretation: M.Y., A.Y., N.E., M.S.S., T.O.B., H.G., Literature Search: M.Y., A.Y., N.E., M.S.S., T.O.B., H.G., Writing: M.Y., A.Y., N.E., M.S.S., T.O.B.

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