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Complications - Other

Can Serum Albumin Level and Total Lymphocyte Count be Surrogates for Malnutrition to Predict Wound Complications After Total Knee Arthroplasty?

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ABSTRACT

Background: Although the serum albumin level and total lymphocyte count (TLC) have been reported as valid and reliable markers for defining malnutrition, their cutoff levels and predictive values for wound complications in patients undergoing total knee arthroplasty (TKA) remain questionable.
Methods: A total of 3169 TKAs performed between April 2003 and December 2013 were retrospectively reviewed. We determined the prevalence of malnutrition on applying different definitions, with various cutoff values of serum albumin and TLC and analyzed the variations in outcome. The differences between groups with and without malnutrition in terms of functional outcome and complications were determined using Student's *t* test and analysis of variance. Multivariate logistic regression analysis was conducted to identify the independent risk factors.
Results: Among all the patients (N = 3169), the serum albumin level and TLC varied widely, with means of 4.1 g/dL and 2189 cells/mm^3, respectively. The prevalence of malnutrition (21%) as per the conventional definition (serum albumin level <3.5 g/dL or a serum TLC <1500 cells/mm^3) dropped to only 1.6% when malnutrition was defined as serum albumin <3.5 g/dL "and" TLC <1500/mm^3, indicating a very small overlap between the 2 markers. No differences were observed between 2 groups in functional outcomes and incidence of wound complications.
Conclusion: Our findings call into question the values of serum albumin level and TLC as a surrogate of malnutrition for predicting wound complications after TKA.

Most studies have documented an association between malnutrition and increased morbidity in orthopedic surgery. Indeed, malnutrition has been reported as a risk factor for postoperative complications after total knee arthroplasty (TKA) and total hip arthroplasty, mainly in the form of periprosthetic joint infections, delayed wound healing, and increased length of hospital stay [1-9]. These complications may have devastating effects and often impose a huge burden on not only the individual patients but also the health care system and economy [10-14]. Furthermore, the prevalence of malnutrition in patients undergoing total joint arthroplasty (TJA) has been reported to be as high as 50% [15,16]. Considering these facts, restraining these complications by comprehensive management of malnutrition in patients undergoing TJA is of paramount importance.

Malnutrition can be defined in various ways including by serological marker evaluation [2,4,17,18], anthropometric measurements [5,7,17,19], and nutrition scoring tools [20,21]. Among the various methods to define malnutrition, the most commonly used definition for malnutrition is a serum albumin level <3.5 g/dL or a serum total lymphocyte count (TLC) <1500 cells/mm^3 [2,4,20,22]. However, the cutoff values for defining malnutrition and the

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Each author certifies that his or her institution has approved the human protocol for this investigation, all investigations were conducted in conformity with ethical principles of research, and informed consent was obtained.

This study was performed at Seoul National University Bundang Hospital, Bundang-gu, Gyeonggi-do, Korea.

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predictive values of these markers remain unclear [1,23-25] and the most appropriate tests in specific patient populations are still ill-defined [23-27]. However, although it seems that strong scientific evidence is lacking for the use of these cutoff values to define malnutrition and to exploit its association with postoperative complications, most investigators have nonetheless used these cutoff values and have given their valuable inferences [2-4,16,28-30].

Therefore, the overall aim of this study was to determine whether the serum albumin level and TLC can be used as proper surrogates for malnutrition in patients undergoing TKA. We determined the distribution of serum albumin and TLC in patients undergoing TKA and the prevalence of malnutrition, both according to the commonly used cutoff values and other conceivable values. Further, we also determined whether the presence of malnutrition diagnosed according to these various definitions was associated with the functional outcomes of index TKA and surgically treated wound complications. We hypothesized that the values of the 2 serologic markers would have a meaningful distribution pattern to define malnutrition. Moreover, it was also hypothesized that the presence of malnutrition would adversely affect the functional outcomes and would increase the incidence of wound complications.

Patients and Methods

We retrospectively reviewed prospectively collected data on a consecutive series of 3178 TKAs performed between April 2003 and December 2013. We included only patients with a diagnosis of primary osteoarthritis in an attempt to reduce potential outcome confounders. Nine knees were excluded because of a history of septic arthritis. Thus, data from 3169 TKAs were used for the analysis in this study, including 2964 and 205 TKAs in females and males, respectively. The mean age of the patients was 69.2 years (range, 49-89) and follow-up data of at least 1 year were available for all patients. A total of 1211 patients were operated for bilateral TKAs. All patients underwent preoperative serum albumin and TLC evaluation. A comprehensive review was also performed for possible confounding factors, including age, gender, body mass index, hemoglobin, glycated hemoglobin (HbA1c), and operation time. This study was approved by the institutional review board of our hospital, and all patients provided informed consent concerning the use of their medical records.

All surgeries were performed using a tourniquet in standard vertical laminar air-flow operating rooms. We administered antibiotic prophylaxis just before and 24 hours after the surgery. All surgeries were performed by a single surgeon (one of the authors) using the medial para-patellar approach. The patella was routinely resurfaced, and all implants were fixed with cement (Palacos; HeraeusKulzer GmbH, Hanau, Germany). The selection of the implant was made at the surgeon's discretion, without any preset selection criteria. Postoperatively, a compressive dressing was applied with immobilization of the knee for the first 24 hours. On the second postoperative day, the compressive dressing and hemovac drainage were removed, and the knees were placed in a continuous passive-motion machine. Subsequently, all patients were encouraged to walk with crutches or a walker, and started active and passive range of motion (ROM) exercises. The knee ROM exercises and weight bearing were gradually increased.

All clinical information was prospectively collected using predesigned data sheets and maintained in a database by an independent investigator (one of authors). The clinical information included demographic data, preoperative clinical status and postoperative functional status, and wound condition during the follow-up visits (2 weeks, 6 weeks, 3 months, 6 months, 1 year, 2 years, and every 3 years thereafter). During the hospital stay and follow-up period, extreme vigilance was exercised for any evidence of wound complications (drainage, hemarthrosis, skin necrosis, and dehiscence) or periprosthetic joint infection. The Musculoskeletal Infection Society criteria were used for the diagnosis of infection [31]. A surgical site infection that occurred within 1 year after TKA was considered as an infectious complication. At every follow-up visit, the patients' knees were examined clinically for surgical site status, active and passive ROM, and deformity. In addition, functional outcome scores, including the American Knee Society [32], Western Ontario and McMaster Universities Osteoarthritis Index [33],and Short Form-36 [34] scores as well as the subjective patient satisfaction, using a 1- to 4-point Likert scale based on the grading system developed by the British Orthopaedic Association [35,36], were obtained at 1, 2, 5, and 10-year follow-up visits and recorded in the medical records and database. Any patients who underwent surgical treatments for postoperative wound complications were thoroughly scrutinized and noted for the clinical courses and ultimate outcomes.

All statistical analyses were carried out using SPSS for Windows (version 21.0; SPSS Inc., Chicago, IL), and a P value $< .05$ was considered significant. Quantitative variables are described as means with ranges. The prevalence of malnutrition was determined according to the established definition as serum albumin <3.5 g/dL "OR" TLC <1500/mm^3 and again using the definition of serum albumin <3.5 g/dL "AND" TLC <1500/mm^3. Furthermore, the prevalence was determined after applying various conceivable cutoff values of malnutrition in terms of serum albumin and TLC (serum albumin < or >3.0, 3.5, 4.0, and 4.5 g/dL; and TLC < or >1200, 1500, 1800, and 2100/mm^3), and the changes in prevalence were assessed. Differences in the functional outcomes and the incidence of surgically treated would complications between patients with and without malnutrition, as defined by the established definitions and different cutoff values, were compared using the Student's t test or the chi-square test. To ascertain the definition of postoperative would complications, we decided to include only surgically treated wound complications. In comparing functional outcomes, we considered a difference of 5° in ROM and 6% in the outcome scales to be clinically important, as the motion arc is measured to the nearest 5°, and as a 6% difference in the maximum score has been suggested as the minimal clinically important difference for Western Ontario and McMaster Universities Osteoarthritis Index and Short Form-36 [37].

The differences between the groups with and without malnutrition defined by the conventional definition were determined by using Student's t test and analysis of variance (Table 1); to avoid the confounding effects of other parameters, including age, gender, hemoglobin, BMI, HbA1c, diabetic status, and operative time, multivariate logistic regression analysis was performed using these parameters as covariates. The odds ratios and 95% CIs were obtained for all confounders and risk factors. Obesity was defined as BMI $\geq$25.0 kg/m^2, as proposed by the Western Pacific Regional Office of the World Health Organization [38]. The cutoff value for HbA1c was set as 8.0% [39]. As HbA1c status was available only for known diabetic patients in our study, multivariate logistic regression analysis was performed with and without HbA1c and also after considering the diabetic status of the patients to eliminate possible bias.

Results

Serum albumin level and TLC showed wide ranges (2.7-5.2 g/dL and 507-5670 cells/mm^3, respectively) with means of 4.1 g/dL and 2189 cells/mm^3, respectively, and the prevalence of malnutrition showed substantial differences according to the definitions of