Arthroplasty Today xxx (2016) 1–4

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original research

Surgical site infection and transfusion rates are higher in underweight total knee arthroplasty patients

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ARTICLE INFO

Article history:
Received 7 February 2016
Received in revised form
30 March 2016
Accepted 31 March 2016
Available online xxx

Keywords:
Arthroplasty, replacement, knee
Body mass index
Perioperative complication
Prosthesis-related infections
Underweight

ABSTRACT

Background: Underweight (UW) patients undergoing total hip arthroplasty have exhibited higher complication rates, including infection and transfusion. No study to our knowledge has evaluated UW total knee arthroplasty (TKA) patients. We, therefore, conducted a study to investigate if these patients are at increased risk for complications, including infection and transfusion.

Methods: A case-control study was conducted using a prospectively collected institutional database. Twenty-seven TKA patients were identified as UW (body mass index [BMI] < 18.5 kg/m^2) from 2000-2012 and were matched for age, gender, date of surgery, age-adjusted Charlson comorbidity index, rheumatoid arthritis, and diabetes. These patients were compared to 81 normal weight patients (BMI 18.5-24 kg/m^2). Demographic variables were compared, along with wound complications, surgical site infection (SSI), blistering, deep vein thrombosis, pulmonary embolism, transfusion, revision, flexion contracture, hematoma formation, and patellar clunk.

Results: The average BMI was 17.1 kg/m^2 (range 12.8-18.4) for UW and 23.0 kg/m^2 (range 19.0-25.0) for normal weight patients ($P < .001$). UW TKA patients were more likely to develop SSIs (3/27, 11.1% vs 0/81, 0.0%, $P = .01$) and were more likely to require transfusions (odds ratio = 3.4, confidence interval 1.3-9.1; $P = .02$).

Conclusions: Our study demonstrates that UW TKA patients have a higher likelihood of developing SSI and requiring blood transfusions. The specific reasons are unclear, but we conjecture that it may be related to decreased wound healing capabilities and low preoperative hemoglobin. Investigation of local tissue coverage and hematologic status may be beneficial in this patient population to prevent SSI. Based on the results of this study, a prospective evaluation of these factors should be undertaken.

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Introduction

Body mass index (BMI) abnormalities have been closely associated with poorer outcomes in surgical patients. Most studies have focused on obese patients, as they comprise 34.9% of the adult population in the United States [1]. These patients have increased readmission rates, a higher incidence of infections, and greater complication rates compared to normal weight (NW) patients [2-7]. However, much less is known regarding the outcomes of underweight (UW) surgical patients, since they only make up 2.3% of the US population and 0%-3.66% of patients in European nations [8,9].

In the field of general surgery, UW patients (BMI < 18.5 kg/m^2) have a higher risk of mortality, morbidity, and poorer outcomes compared to overweight and obese patients [10-13]. With regard to total joint arthroplasty, UW total hip arthroplasty (THA) patients have been identified as having a higher incidence of infection, transfusion, dislocation, readmission, and mortality [2-4,14,15]. These patients also have been reported to have lower postoperative functional health scores [16].

Although specific studies have been conducted evaluating UW THA patients, no previous study has been performed evaluating

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.artd.2016.03.005.

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http://dx.doi.org/10.1016/j.artd.2016.03.005
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Please cite this article in press as: J. Manrique, et al., Surgical site infection and transfusion rates are higher in underweight total knee arthroplasty patients, Arthroplasty Today (2016), http://dx.doi.org/10.1016/j.artd.2016.03.005

UW patients undergoing elective, primary, and total knee arthroplasty (TKA). Therefore, the purpose of this study was to investigate whether UW patients undergoing TKA are at increased risk for complications and poorer outcomes. We hypothesize that UW TKA patients have a higher rate of complications compared to NW TKA patients.

Material and methods

After institutional review board approval #08R.207, a retrospective, single institution, case-control study was conducted including patients from January 2000 to December 2012. We identified patients from our prospective institutional database that underwent primary TKA (International Classification of Diseases Ninth Revision procedure code: 81.54 and Current Procedural Terminology code: 27447). All patients had available weight and height data at the time of hospital admission. Patients were classified into the following groups: UW (BMI < 18.5 kg/m^2), NW (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), or obese (30.0 kg/m^2) [13]. We identified 27 UW patients that underwent primary, unilateral TKA, and each patient's electronic medical record was reviewed for verification of weight and height data obtained in the electronic query.

These UW patients were matched to a cohort of NW patients with similar demographic characteristics in a 3:1 ratio (81:27 patients). Matching was based on age (±7 years), gender (male/female), date of surgery (±5 years), Charlson comorbidity index age adjusted ([CCI] age adjusted, ±3), the presence of diabetes (yes/no), and the presence of rheumatoid arthritis (RA, yes/no). CCI was used as it provides a quantification of health and predicts mortality [17]. Demographic and surgical variables, such as gender, CCI, length of hospital stay (LOS), preoperative and postoperative laboratory values, transfusions, and complications were recorded. Specific complications that were recorded in the chart included wound drainage, poor wound healing, surgical site infection (SSI), blistering, deep vein thrombosis, pulmonary embolism, dislocation, fracture, revision, flexion contracture development, and hematoma. These diagnoses were determined by the physician and treated accordingly. These complications are among those evaluated and included by the Complications Workgroup of the Knee Society [18]. The definition used for deep incisional SSI was the one specified by the Centers for Disease Control criteria [19]. The SSI criteria was used instead of the Musculoskeletal Infection Society and International Consensus Meeting definitions for periprosthetic joint infection [20] because the Musculoskeletal Infection Society and International Consensus Meeting criteria were not available during the entire duration of our study.

This states that the patient must have the infection occurring within 1 year if implant is in place, and the infection appears to be related to the operative procedure with involvement of deep soft tissues. In addition, it must include one of the following 3:

1. Purulent drainage from the deep incision of the surgical site.
2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain, or tenderness, unless culture of the incision is negative.
3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosis of a deep incisional SSI by a surgeon or attending physician.

The study population had a mean age of 69.9 years (range 41.6-89.8) and was composed of 6 males and 21 females. The average BMI for this group was 17.0 kg/m^2 (range 12.8-18.4). The control group had a mean age of 69.5 years (range 38.0-90.5), with 63 females and 18 males. The average BMI for the controls was 23.0 kg/m^2 (range 19.0-25.0). The follow-up average was 3.8 years (range 1.1-7.9 years) for UW patients and 5.3 for NW patients (range 1.0-13.6 years). There were no differences between the groups with regard to age (69.9 vs 69.5; $P = .90$), gender (80% female vs 80% female; $P = 1.0$.), diabetes (6.7% vs 6.7%; $P = 1.0$), RA (29.6% vs 29.6%; $P = 1.0$), or CCI (4.2 vs 4.1; $P = .59$.). Patients in the UW group had a lower BMI (17.0 kg/m^2 vs 22.9 kg/m^2; $P < .001$), lower weight (51.6 kg vs 63.4 kg; $P < .001$), greater height (174 cm vs 165.0 cm; $P = .003$). Patients in both groups had a higher incidence of RA (29.6%) compared to the general population (1%) [21]. The demographic characteristics of all patients are shown in Table 1.

All patients were operated by any of 7 orthopaedic, arthroplasty fellowship-trained surgeons who all used the same protocol in the same hospital setting. The same preoperative and postoperative protocol guided management as per year of surgery. All surgeries were performed using a tourniquet, the approach was made through a medial parapatellar approach, and all knees were posterior-stabilized, cemented knees. No blood preserving elements, such as fibrin glue, sealants, or retransfusion drains, were used during the study period. Prophylactic antibiotic was administered to all patients within one hour preoperatively and for 24 hours postoperatively, as per protocol. Cefazolin was used routinely, but if a penicillin allergy was documented, vancomycin was used instead. Blood loss was calculated from the preoperative hematocrit (Hct) levels and Hct levels one day after the surgery, according to a previously validated formula presented by Rosencher et al. [22].

Statistical analysis

Statistical analysis was performed on continuous variables using Wilcoxon rank sum test and categorical variables were analyzed using Fischer's exact test. Logistic regression was used to determine the odds ratio (OR) for requiring postoperative transfusion in the UW patients. R 3.1.1 (R Foundation for Statistical Computing, Vienna, Austria) was used for data analysis.

Results

UW TKA patients had a higher rate of SSI (3/27, 11.1%) compared with NW patients (0/81, 0%; 95% confidence interval [CI]: 0.0-4.0; $P = .01$). UW patients had an increased risk of SSI (OR: 23.3; 95% CI: 1.2-466.5; $P = .04$) compared with NW patients. The 3 patients who developed SSI in the UW group all underwent explantation and debridement, for an intended 2-stage exchange arthroplasty.

Preoperatively, UW patients had lower hemoglobin (Hb) (12.3 g/dL ± 1.5) and Hct (36.8% ± 4.3) levels than NW patients (Hb 13.0 g/dL ± 1.3, $P = .04$; Hct 39.0% ± 3.4, $P = .01$). Postoperative Hb (8.8 g/dL ± 1.0), and Hct (26.6% ± 3.0) was also lower in UW

Table 1
Patient demographics.

Demographics	Underweight, n = 27	Normal weight, n = 81	*P*-value
Age, mean (y)	69.9 ± 13.6	69.5 ± 13.4	.90
Gender			
Male	6	18	1
Female	21	72	
Weight, mean (kg)	51.6 ± 7.9	63.4 ± 9.2	<.001
Height, mean (cm)	174.0 ± 15.7	165.6 ± 9.5	.01
BMI, mean (kg/m^2)	17.0 ± 7.9	23.0 ± 1.5	<.001
CCI age adjusted, mean	4.2 ± 1.3	4.1 ± 1.4	.59
Rheumatoid arthritis	8	24	1
Diabetes	2	6	1

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