The Journal of Arthroplasty 31 (2016) 1407–1412

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Health Policy & Economics

Assessing In-Hospital Outcomes and Resource Utilization After Primary Total Joint Arthroplasty Among Underweight Patients

Afshin A. Anoushiravani, BSc [a], Zain Sayeed, MSc, MHA [b], Monique C. Chambers, MD, MSL [c], Theodore J. Gilbert, MSc [c], Steven L. Scaife, MSc [d], Mouhanad M. El-Othmani, MD [d], Khaled J. Saleh, MD, FRCS(C), MHCM [e, *]

[a] Albany Medical College, Albany, New York
[b] Chicago Medical School, North Chicago, Illinois
[c] Division of Orthopaedics and Rehabilitation, Department of Surgery, Southern Illinois University School of Medicine, Springfield, Illinois
[d] Center for Clinical Research, Southern Illinois University School of Medicine, Springfield, Illinois
[e] Orthopaedic Education Inc., Springfield, Illinois

ARTICLE INFO

Article history:
Received 12 September 2015
Received in revised form
11 December 2015
Accepted 17 December 2015
Available online 27 February 2016

Level of Evidence:
III
retrospective cohort study

Keywords:
total knee arthroplasty
total hip arthroplasty
nutritional status
resource utilization
low body mass index
postoperative outcomes

ABSTRACT

Background: Poor nutritional status is a preventable condition frequently associated with low body mass index (BMI). The purpose of this study is to comparatively analyze low (≤19 kg/m^2) and normal (19-24.9 kg/m^2) BMI cohorts, examining if a correlation between BMI, postoperative outcomes, and resource utilization exists.
Methods: Discharge data from the 2006-2012 National Inpatient Sample were used for this study. A total of 3550 total hip arthroplasty (THA) and 1315 total knee arthroplasty (TKA) patient samples were divided into 2 cohorts, underweight (≤19 kg/m^2) and normal BMI (19-24.9 kg/m^2). Using the Elixhauser Comorbidity Index, all cohorts were matched for 27 comorbidities. In-hospital postoperative outcomes and resource utilization among the cohorts was then comparatively analyzed. Multivariate analyses and chi-squared tests were generated using SAS software. Significance was assigned at $P < .05$.
Results: Underweight patients undergoing THA were at higher risk of developing postoperative anemia and sustaining cardiac complications. In addition, underweight patients had a decreased risk of developing postoperative infection. Resource utilization in terms of length of stay and hospital charge were all higher in the underweight THA cohort. Similarly, in the underweight TKA cohort, a greater risk for the development of hematoma/seroma and postoperative anemia was observed. Underweight TKA patients incurred higher hospital charge and were more likely to be discharged to skilled nursing facilities.
Conclusion: Our results indicate that low-BMI patients were more likely to have postoperative complications and greater resource utilization. This serves a purpose in allowing orthopedic surgeons to better predict patient outcomes and improve treatment pathways designed toward helping various patient demographics.

Total joint arthroplasty (TJA) is considered the most effective means of definitively treating degenerative joint disease. With the passage of the Affordable Care Act (ACA) and the implementation of bundle payment systems, a greater focus has been placed on quality of care. By 2020, 2 million TJAs will be done in the United States, including >1.5 million total knee arthroplasties (TKAs) and >500,000 total hip arthroplasties (THAs) [1]. These revised projections do not consider potential future changes because of the ACA, which has made TJA accessible to millions more Americans [1,2]. Thus, orthopedists must prepare for this large influx of TJAs by efficiently risk stratifying surgical candidates and optimizing postoperative outcomes and resource utilization.

Poor nutritional status is a preventable condition resulting from a diet low in essential nutrients. Optimization of preoperative nutrition in TJA aims to effectively manage medical comorbidities and reduce adverse postoperative outcomes [3,4]. Several studies have demonstrated that poor nutrition predisposes patients to surgical site infections, delayed wound healing, and longer

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.arth.2015.12.053.

* Reprint requests: Khaled J. Saleh, MD, FRCS (C), MHCM Orthopaedic Education Inc., 5304 Cromwell Place, Springfield, IL, 62711.

http://dx.doi.org/10.1016/j.arth.2015.12.053
0883-5403/

inpatient functional recovery times [5,6]. Nutritional status has been assessed through the analysis of serum albumin (<3.5 g/dL), total lymphocyte count (<1500 cells/mm^3), and body mass index (BMI). [7-9] Although all 3 markers have been linked to poor nutritional status, the relationship between excessively low BMI (≤19 kg/m^2) and greater risk for postoperative complications has not been thoroughly evaluated. The purpose of our study is to use a national validated database to compare the in-hospital postoperative outcomes and resource utilization between patients with low (≤19 kg/m^2; underweight) and normal (19-24.9 kg/m^2) BMI undergoing TJA.

Materials and Methods

Data for this study were obtained from the National Inpatient Sample (NIS) from 2006 to 2012. The NIS was established by the Healthcare Cost and Utilization Project and incorporates approximately 20% of US inpatient hospital stays [10]. In 2012, the NIS database included entries from 4378 hospitals from 44 states, representing approximately 7.3 million hospitalizations [10]. The patient samples were weighted to offer an insightful perspective on national estimates. The entries in the NIS database include up to 15 International Classification of Disease 9th Revision, Clinical Modification (ICD-9-CM) diagnostic and procedural codes. This information is then reported in a uniform and deidentified manner, allowing for retrospective observational cohort studies to assess and compare in-hospital postoperative outcomes and resource utilization trends [11].

Using ICD-9-CM procedure codes, a total of 401,152 and 858,091 patients underwent primary THA (81.51) and TKA (81.54), respectively. We stratified each cohort corresponding to low and normal BMI “matching” for age, gender, and 27 diagnosed comorbidities using the modified Elixhauser Comorbidity Index (Table 1) [12]. The Elixhauser Comorbidity Index is a validated prognostic tool focusing on comorbidities with the greatest effect on clinical outcomes and resource utilization [12]. We excluded weight loss and obesity from our matching criteria because of the nature of this study. In total, 3550 THA (low and normal BMI) and 1315 TKA (low and normal BMI) patient samples were identified after “matching.” Chi-square analysis of patient demographic and Elixhauser Comorbidity criteria demonstrated no statistical significance among low- and normal-BMI samples undergoing TJA (Table 2).

Definition of Outcomes

Postoperative outcomes were identified using ICD-9-CM diagnosis codes for any of 12 in-hospital complications recorded (Table 3) [12]. In-hospital mortality was reported within the NIS database but was not identified with a specific code. Resource utilization was assessed through hospital length of stay (LOS), hospital charge, and disposition to home or a rehabilitation facility. Hospital charge is representative of how much the hospital billed the patient, whereas hospital cost, which is not available in the NIS database, is indicative of the amount spent by the hospital to provide care [13].

Statistical Analysis

Multivariate comparisons examining the normal and underweight cohorts were made using the chi-square test for categorical data and independent-sample *t*-test for continuous data. All *P* values <.05 were deemed statistically significant. Linear regression models were used to determine the odds ratio (OR) with respect to 95% confidence interval (CI). All statistical analysis was performed using SAS 9.3 software (SAS Institute Inc, Cary, NC) for Windows.

Results

Analysis of the matched underweight and normal-BMI cohorts after primary TJA demonstrated an increased risk for in-hospital

Table 1
Elixhauser Comorbidity Index with Corresponding ICD-9-CM Codes.

Elixhauser Comorbidity Index	
AIDS	042-044.9
Alcohol abuse	291.1, 291.2, 291.5, 291.8, 291.9, 303.90-303.93, 305.00-305.03, v11.3
Deficiency anemia	291.1, 291.2, 291.5, 291.8, 291.9, 303.90-303.93, 305.00-305.03, v11.3
Rheumatoid arthritis/collagen vascular disease	701.0, 710.0-710.9, 714.0-714.9, 720.0-720.9, 725
Chronic blood loss anemia	280.0
Peripheral vascular disorders	440.0-440.9, 441.2, 441.4, 441.7, 441.9, 443.1-443.9, 447.1, 557.1, 557.9, v43.4
CHF	398.91, 402.11, 402.91, 404.11, 404.13, 404.91, 404.93, 428.0-428.9
Chronic Pulmonary Disease	490-492.8, 493.00-493.91, 494, 495.0-505, 506.4
Coagulopathy	286.0-286.9, 287.1, 287.3-287.5
Depression	300.4, 301.12, 309.0, 309.1, 311
Diabetes (uncomplicated)	250.00-250.33
Diabetes (complicated)	250.40-250.73, 250.90-250.93
Drug abuse	292.0, 292.82-292.89, 292.9, 304.00-304.93, 305.20-305.93
HTN	401.1, 401.9, 402.10, 402.90, 404.10, 404.90, 405.11, 405.19, 405.91, 405.99
Hypothyroidism	243-244.2, 244.8, 244.9
Liver disease	070.32, 070.33, 070.54, 456.0, 456.1, 456.20, 456.21, 571.0, 571.2, 571.3, 571.40-571.49, 571.5, 571.6, 571.8, 571.9, 572.3, 572.8, v42.7
Lymphoma	200.00-202.38, 202.50-203.01, 203.8-203.81, 238.6, 273.3, v10.71, v10.72, v10.79
Fluid and electrolyte disorder	276.0-276.9
Metastatic cancer	196.0-199.1
Other neurologic disorder	331.9, 332.0, 333.4, 333.5, 334.0-335.9, 340, 341.1-341.9, 345.00-345.11, 345.40-345.51. 345.80-345.91, 348.1, 348.3, 780.3, 784.3
Paralysis	342.0-342.12,342.9-344.9
Psychosis	295.00-298.9, 299.10-299.11
Pulmonary acirculation disorder	416.0-416.9, 417.9
Renal failure	403.11, 403.91, 404.12, 404.92, 585, 586, v42.0, v45.1, v56.0, v56.8
Solid Tumor w/o metastasis	140.0-172.9, 174.0-175.9, 179-195.8, v10.00-v10.9
Peptic ulcer disease excluding bleeding	531.70, 531.90, 532.70, 532.90, 533.70. 533.90, 534.70, 534.90, v12.71
Valvular Disease	093.20-093.24, 394.0-397.1, 424.0-424.91, 746.3-746.6, v42.2, v43.3