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Should All Patients Be Included in Alternative Payment Models for Primary Total Hip Arthroplasty and Total Knee Arthroplasty?

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ABSTRACT

Background: Alternative payment models in total joint replacement incentivize cost effective health care delivery and reward reductions in length of stay (LOS), complications, and readmissions. If not adjusted for patient comorbidities, they may encourage restrictive access to health care.
Methods: We prospectively evaluated 802 consecutive primary total hip arthroplasty and total knee arthroplasty patients evaluating comorbidities associated with increased LOS and readmissions.
Results: During this 9-month period, 115 patients (14.3%) required hospitalization >3 days and 16 (1.99%) were readmitted within 90 days. Univariate analysis demonstrated that preoperative narcotic use, heart failure, stroke, chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), and liver disease were more likely to require hospitalization >3 days. In multivariate analysis, CKD and COPD were independent risk factors for LOS >3 days. A Charlson comorbidity index >5 points was associated with increased LOS and readmissions.
Conclusion: Patients with CKD, COPD, and Charlson comorbidity index >5 points should not be included in alternative payment model for THA and TKA.

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In 2015, expenditures for total hip and knee arthroplasties (THAs and TKAs) by Centers for Medicare and Medicaid Services (CMS) exceeded 7.3 billion dollars [1-3]. Alternative payment models such as bundled payment initiatives (BPIs) aim to reduce overall health care expenditures by incentivizing cost effective, evidence based, health care delivery [3-6]. Compared to traditional fee-for-service models in which excessive care and overutilization of resources are financially advantageous to the health care system, in bundled payment models, health care providers, and payors share in risk and the potential savings achieved through quality improvement measures aimed to optimize outcomes and minimize complications and readmissions [7]. Iorio et al [2] demonstrated that implementation of a bundled payment initiative in a group of 721 arthroplasty patients resulted in a decreased length of stay (LOS) form 4.27 to 3.53 days and cost reductions in the inpatient component over historical baseline.

However, in this era of declining hospital margins and decreasing physician reimbursements, the specter of costly complications and readmissions after THA or TKA may lead to restriction of access to health care [6,8]. Adjustment for case complexity and exclusion of certain conditions can be an option if these patients cannot realistically be managed under the stipulations of the bundle plan [6]. Currently, CMS THA and TKA bundles do not make allowances for such adjustments or exclusions. Studies have examined the relationship between certain patient comorbidities and the development of postoperative complications [9-12], but little information is available on the patient factors associated with prolonged hospitalization and higher readmission risk after elective primary THA/TKA. Therefore, the purpose of this study is to (1) determine the risk factors that predispose patients to require hospitalization beyond 3 days after THA/TKA; (2) determine risk factors associated with 90-day readmissions; and (3) evaluate whether the Charlson comorbidity index (CCI) could be used to predict an increased LOS and risk for 90-day readmission.

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Materials and Methods

We prospectively evaluated a consecutive series of 802 elective, primary THA (n = 273) and TKA (n = 529) patients at a single institution over a 9-month period. This study was approved and conducted according to guidelines set by our institutional review board. There were 324 men and 478 women with a mean age of 62.3 years (range 20-92 years). The mean body mass index was 33.1 kg/m^2 (range 17-59 kg/m^2). Patients under the age of 18 years and those who underwent arthroplasty procedures for fracture or malignancy were excluded from the study.

Before surgery, all patients underwent preoperative evaluation and optimization by a single group of internists and were medically comanaged by the same group during their inpatient stay. Patient demographics and risk factors were identified and entered into an arthroplasty database. These included comorbidities as defined by the CCI [13]. As validated in their original article, one point was assigned for patients with a history of myocardial infarction, congestive heart failure (CHF), peripheral vascular disease, dementia, cerebrovascular disease, chronic obstructive pulmonary disease (COPD), connective tissue disease, gastrointestinal ulcer, chronic liver disease, or diabetes. Two points were assigned for each of hemiplegia, moderate to severe chronic kidney disease (CKD), diabetes with end-organ damage, any tumor, leukemia, or lymphoma. Three points were assigned for moderate to severe liver disease as evidenced by factors such as encephalopathy or coagulopathy. Finally, 6 points were assigned for metastatic disease or acquired immune deficiency syndrome. As part of the CCI calculation, an age score was also assigned to each patient (range 0-5) to define a composite CCI score (Table 1). Preoperative narcotic requirement was also recorded if the patient had any active narcotic prescription in their electronic medical record before surgery.

Patient factors including age, body mass index, comorbidities (ie, CHF, COPD, CKD, diabetes, cirrhosis), procedure type (TKA vs THA), and CCI were correlated to hospital LOS greater than 3 days and 90-day readmission using univariate and multivariate analysis to determine the risk factors associated with prolonged hospitalization and readmission. CKD was defined as a glomerular filtration rate <60 mL/min; a moderate to severe grading included patients with grade 3 kidney dysfunction or worse, represented by a glomerular filtration rate <45 mL/min/1.73m^2. In patients with liver disease, a grading of moderate to severe was defined as evidence of encephalopathy or ascites documented in the electronic medical record, coagulopathy with an international normalized ratio (INR) >1.5, or elevated bilirubin >2.5mg/dL. Diabetes was defined as a preoperative hemoglobin A1C >6.5% or any fasting glucose level >200 mg/dL documented in the medial record; CHF was defined by correlating echocardiogram reports with preoperative cardiac assessments performed by a patient's cardiologist or internal medicine physician.

Table 1
Calculation of CCI and Age Score to Determine the Composite CCI.

Point Value	Comorbidity
1	Myocardial infarction, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic obstructive pulmonary disease, connective tissue disease, gastrointestinal ulcer, chronic liver disease, diabetes
2	Hemiplegia, moderate to severe kidney disease, diabetes with end-organ damage, tumor, leukemia, lymphoma
3	Moderate to severe liver disease
6	Metastatic disease, AIDS
Age (y)	**Point Value**
40-49	0
50-59	1
60-69	2
70-79	3
80-89	4
>90	5

CCI, Charlson comorbidity index.

Statistical Analysis

An a priori power analysis was first performed to determine the appropriate sample size to adequately power the study. Because our primary outcome variable was binary, whether or not a patient required prolonged hospitalization greater than 3 days, we chose to analyze our data using univariate logistic regression models. The Wald test has been validated as an accurate measure for power analysis [14]. Based on a recently published consecutive series of total joint arthroplasty patients at the same institution with a 19% rate of LOS >3 days [10], we would need a minimum of 741 patients to achieve a power of 0.80 to detect an odds ratio (OR) of 1.3 assuming a type I error rate of 0.05.

Statistical analysis was first performed comparing risk factors of patients that required LOS greater than 3 days and those that did not. Descriptive statistics of all patients in the study population are given in Table 2. Binary and categorical variables between the 2 groups were analyzed using a chi-square test. When expected variables were less than 5, we used the Fisher's exact test. Continuous variables such as age and BMI were analyzed with the Student *t* test. The level of statistical significance was set at $P < .05$. Univariate logistic regression analysis of all risk factors was then performed, with all relationships being considered significant at $P < .05$. To control for confounding variables, a multivariate logistic regression analysis was then performed to identify independent risk factors correlated with LOS greater than 3 days. Finally, a separate univariate model was created to identify any correlation between CCI and LOS greater than 3 days and 90-day readmission.

Results

In this consecutive series of unselected patients undergoing primary THA and TKA, the mean LOS was 3.12 days (range 1-25 days). The average hospitalization for THA patients was 3.15 days (range 1-25 days) compared to a mean of 3.21 days for TKA patients (range 1-60 days) ($P = .699$). One hundred fifteen patients (14.3%) required inpatient hospitalization beyond 3 days. Univariate analysis demonstrated that patients with preoperative narcotic use (OR 1.55, 95% CI 1.03-2.31, $P = .033$), CHF (OR 3.20, 95% CI 1.59-6.43,

Table 2
Patient Demographics for Those Included in the Study Population.

Variable	Value
Total patients	802
Male/female (%)	40.3/59.6
Mean age (y)	62.3
Mean BMI (kg/m^2)	33.1
Mean CCI	2.83
CHF (% of patients)	4.9
COPD (% of patients)	4.1
CKD (% of patients)	8.7
Diabetes (% of patients)	21.0

BMI, body mass index; CCI, Charlson comorbidity index; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CKD, chronic kidney disease.

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