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Are There Identifiable Risk Factors and Causes Associated with Unplanned Readmissions Following Total Knee Arthroplasty?

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ABSTRACT

We conducted a retrospective review of 3218 primary total knee arthroplasties (TKA) performed over two years at an urban academic hospital network using clinical and administrative data. Increased length of stay (LOS) was associated with readmission ($P < 0.001$). Readmission was not associated with age ($P = 0.100$), gender ($P = 0.608$), body mass index ($P = 0.329$), or staged bilateral procedures ($P = 0.420$). The most common readmitting diagnoses were post-operative infection (22.5%), hematoma (10.1%), pulmonary embolus (7.9%) and deep vein thrombosis (5.6%). Of readmissions, 53.9% were for surgical reasons and 46.1% were for medical reasons. Certain interventions described in previous literature may be more successful in minimizing unplanned readmissions by focusing on patients with extended LOS, elevated infection risk and low socioeconomic status.

Total knee arthroplasty (TKA) is among the most commonly performed surgeries in the United States, with more than 600,000 procedures performed annually [1,2]. Demand for TKA is expected to rise over the coming decades as well, with a projected 3.48 million procedures performed annually by 2030 [3]. Thus, TKA plays a significant role in total health care costs and utilization and will continue to do so going forward.

Prevention of unplanned hospital readmissions has become a major focus in cost containment efforts by health care payers, policy makers, and providers. The Centers for Medicare & Medicaid Services (CMS) began withholding reimbursement for the treatment of certain hospital-caused diseases, such as central line-acquired infections, in 2008 [4]. Under the Patient Protection and Affordable Care Act (PPACA) of 2009, The Center for Medicare & Medicaid Services (CMS) has begun instituting reimbursement penalties for 30-day readmissions associated with certain conditions, specifically after hospitalizations for heart failure, acute myocardial infarction, and pneumonia [5]. In August of 2013, CMS announced an expansion of this policy to elective total knee arthroplasty (TKA) for fiscal year 2015 [6]. Since private insurers often emulate Medicare's payment methods, we can expect many insurers to follow suit [7]. Therefore, if this proposal is successfully implemented, hospitals will have a strong financial incentive to decrease such readmissions.

While unplanned readmission rates have received increasing attention recently, there are a relatively limited number of studies focusing on readmissions after primary TKA. Recent work has suggested an association with black race, increased length of stay (LOS), decreased age, and male gender [8]. Overall though, current literature on the subject is mixed and inconclusive. A better understanding of the factors associated with such readmissions will be essential in efforts to identify and prevent potential future readmissions. The purpose of this study is to identify the risk factors and causes for unplanned readmissions following TKA.

Patients and Methods

Study Design and Setting

A retrospective review of 3218 consecutive primary TKAs performed over two years from July 1, 2009 to June 30, 2011 at an urban academic hospital network was conducted using clinical and administrative data. Patients were admitted to the institution under review, a large urban

The work was performed at the Hospital of the University of Pennsylvania.
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tertiary care academic center with over 1700 beds distributed at 3 hospitals and more than 78,000 admissions annually.

Data Sources

Data for eligible TKA hospitalizations under review between 2009 and 2011 were obtained from the institution's clinical data warehouse. All readmissions to the institution were captured, regardless of department. Furthermore, a medical chart review was performed for readmitted patients to identify the cause of readmission. Demographic information collected for this study included age, gender, and race or ethnicity. Clinical information included height, weight, length of stay (LOS), and staged bilateral procedures.

Patients

For this study, we used a sample of convenience composed of patients admitted to the institution under review. Patients who had undergone total knee arthroplasty during the study period were identified on the basis of the ICD-9 procedure code for primary TKA (81.54). Readmissions were included only if occurring for unforeseen causes; unplanned 30-day readmissions were identified using ICD-9 codes and patient-specific identifiers. Planned readmissions, most commonly for in-house acute inpatient rehabilitation or skilled nursing facility, were excluded. Revision TKA procedures were not included.

Patient Characteristics

Patients with unplanned readmissions were compared to non-readmitted patients on the basis of age, gender, race, body mass index (BMI), LOS, Medical Severity Diagnosis-Related Group (MS-DRG) weighting, and whether the TKA was the second episode of a staged bilateral procedure. We also conducted a medical record review of all readmitted patients to determine the most common readmitting diagnoses after total knee arthroplasty. Subsequently, we compiled the readmitting diagnoses into clinically meaningful groups. Staged procedures were typically scheduled one week apart, and patients were discharged from the hospital between cases. Postoperative pain was managed with a multimodal anesthesia protocol. MS-DRG weights were calculated in accordance with CMS policy.

Statistical Analysis

Categorical data (gender, race, and number of staged bilateral procedures) were compared using the chi-square test. The Mann–Whitney U-test was used to analyze differences between continuous non-parametric variables. These included age, BMI, and LOS. For all calculations, statistical significance was defined by P values of less than 0.05. Odds ratios (OR), 95% confidence intervals (CI), and P values were calculated using bivariate and multivariate logistic regression.

Results

We identified 3218 patients who had a total knee arthroplasty during the observation period. The average age at the time of surgery was 63 years, and the average BMI was 32.8 kg/m^2. Sixty-six percent of the patients were women. The 30-day readmission rate at our institution was 5.53%, comprised of 178 readmissions among 165 patients. Readmission was associated with increased LOS ($P < 0.001$). Age ($P = 0.100$), BMI ($P = 0.329$), gender ($P = 0.608$), race ($P =$ 0.084–0.761), and staged bilateral procedures ($P = 0.420$) were not associated with readmissions. However, a trend toward white race being protective against readmission was observed ($P = 0.084$) (Table 1). Average MS-DRG weight among readmitted patients was 2.57 versus 2.48 among non-readmitted subjects with a strong trend toward significance (P value $= 0.074$).

Similar associations were demonstrated by bivariate logistic regression (Table 2); LOS is significantly associated with a 10% increased odds of readmission. This association is unchanged after adjusting for gender and race in multivariate regression.

The most common diagnoses associated with readmissions were post-operative infection (22.5%), hematoma (10.1%), pulmonary embolus (7.9%), deep venous thrombosis (5.6%), and uncontrolled pain (5.6%). Surgical causes constituted 53.9% while medical causes constituted 46.1% of all readmissions (Table 3).

Discussion

The purpose of this study was to identify risk factors and causes for unplanned readmissions at our institution. Patients with increased LOS were significantly more likely to be readmitted in this study population, which is consistent with previous literature across various fields [9–11]. Prior literature has suggested that extended LOS is associated with increased levels of comorbidity and complications, including both severity and number of complications, which likely explains the elevated rate of readmission as well as the relatively high MS-DRG weights observed among these patients [12–14]. In other words, longer LOS suggests that a patient may be relatively sicker, so it is not surprising that these patients are more likely to experience problems leading to unplanned readmissions. On the other hand, some studies report decreased LOS correlating with increased readmissions, suggesting that there may be a tradeoff between these two hospital performance measures [15,16]. These conflicting results likely reflect two simultaneous phenomena: rushing patients out the door can lead to readmissions, while sick patients who are predisposed to complications and readmission might be identified by relatively long LOS. In our study, it did not appear that shorter LOS was associated with unplanned readmissions. Styron et al [17] also demonstrate that in addition to higher comorbidity levels, increased LOS may be associated with low surgeon volume. Therefore provider characteristics, particularly volume, may impact LOS as well. Similarly, Schairer et al [18] found LOS to be a risk factor for readmission after TKA, as were revision TKA, discharge disposition, and fluid-electrolyte disorders in their retrospective study. Dailey et al [19] also demonstrated that LOS was a significant risk factor for readmission in a retrospective review.

Race may be correlated with socioeconomic status in the study population, so the trend toward decreased readmissions among white patients likely represents the impact of numerous socioeconomic factors. Coupled with socioeconomic differences, the observed trend toward white race being protective ($P = 0.084$) and black race being

Table 1
Patient Characteristics.

	All Patients (N = 3218)		Readmitted (N = 165)		Not Readmitted (N = 3053)		
	N or Mean	% or SD	N or Mean	% or SD	N or Mean	% or SD	*P* Value
Age (years)	63.0	10.9	63.9	12.6	62.9	10.8	0.100
Gender							
Female	2125	66.0%	112	67.9%	2013	65.9%	0.608
Male	1093	34.0%	53	32.1%	1040	34.1%	–
Race							
White	2152	66.9%	100	60.6%	2049	67.1%	0.084
Black	908	28.2%	55	33.3%	851	27.9%	0.129
Native American	3	0.1%	0	0.0%	3	0.1%	0.687
Asian	48	1.5%	2	1.2%	46	1.5%	0.761
Other	63	2.0%	4	2.4%	58	1.9%	0.633
Unknown	50	1.6%	4	2.4%	46	1.5%	0.353
BMI	32.8	7.6	33.4	8.2	32.7	7.6	0.329
LOS (days)	3.8	2.1	4.70	4.12	3.75	1.95	<**0.001**
Staged Bilateral Procedures	69	2.1%	5	3.0%	64	2.1%	0.420