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Causes and Frequency of Unplanned Hospital Readmission After Total Hip Arthroplasty

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Abstract

Background Total hip arthroplasty (THA) is a beneficial and cost-effective procedure for patients with osteoarthritis. Recent initiatives to improve hospital quality of care include assessing unplanned hospital readmission rates. Patients presenting for THA have different indications and medical comorbidities that may impact rates of readmission.

Questions/purposes This study measured (1) the unplanned hospital readmission rate in primary THA, revision THA, and antibiotic-spacer staged revision THA to treat infection. Additionally, we determined (2) the medical and surgical causes of readmission; and (3) the risk factors associated with unplanned readmission.

Methods A total of 1415 patients (988 primary THA, 344 revision THA, 82 antibiotic-spacer staged revision THA to

treat infection) from a single institution were included. All hospital readmissions within 90 days of discharge were reviewed. Patient demographics and medical comorbidities were included in a Cox proportional hazards model to assess risk of readmission.

Results The overall unplanned readmission rate was 4% at 30 days and 7% at 90 days. At 90 days, primary THA (5%) had a lower unplanned readmission rate than revision THA (10%, $p < 0.001$) and antibiotic-spacer staged revision THA (18%, $p < 0.001$). Medical diagnoses were responsible for almost one-fourth of unplanned readmissions, whereas over half of surgical readmissions were the result of dislocation, surgical site infection, and postoperative hematoma. Type of procedure, hospital stay greater than 5 days, cardiac valvular disease, diabetes with end-organ complications, and substance abuse were each associated with increased risk of unplanned readmission.

Conclusions Higher rates of unplanned hospital readmissions in revision THA rather than primary THA suggest that healthcare quality measures that incorporate readmission rates as a proxy for quality of care should distinguish between primary and revision procedures. Failure to do so may negatively impact tertiary referral hospitals that often care for patients requiring complex revision procedures.

Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

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Introduction

THA is an effective treatment for degenerative joint disease [18, 19] and has been shown to be both clinically effective and cost-effective [13, 22]. Rates of hip replacement are expected to increase dramatically as the population ages and

the prevalence of hip osteoarthritis increases [9]. Even so, complications associated with THA can result in inferior outcomes and increased costs [4]. Recently, there has been increased focus on improving the value of healthcare services and reducing the costs of care [2, 10, 14, 24].

Readmission to the hospital after an index procedure is expensive and is considered a key undesirable outcome by the World Health Organization [25]. In 2004, almost 20% of Medicare beneficiaries were rehospitalized within 30 days of discharge from a prior hospitalization at an estimated cost of 17.4 billion USD [8]. Beginning in 2013, Medicare will reduce payments for unplanned readmissions for underperforming hospitals with higher rates of readmission compared with the national average through their value-based purchasing program. Although this assessment will begin only for patients with specific diagnoses [15], it is clear that there is increased emphasis on the transparent evaluation of healthcare value by measuring specific quality metrics [23]. Thus, to address the unsustainable growth in healthcare costs in the long term, it is prudent to identify and potentially mitigate preventable causes of hospital readmissions.

Perioperative complications in total joint arthroplasty have been well described [12, 16, 17]. However, studies that have examined short-term complications after discharge tend to focus on specific common diagnoses that are found in administrative claims data [11, 26]. The purpose of this study was to compare the unplanned 90-day hospital readmission rates at one institution for patients undergoing primary and revision THA using patient-level data and to characterize the causes and risk factors associated with unplanned readmissions.

Patients and Methods

Patient Selection

Consecutive patients who underwent THA at a single institution between 2005 and 2011 were identified using an administrative claims database with International Classification of Diseases, 9th Revision (ICD-9) and Current Procedural Terminology codes for primary THA (81.51; 27130), revision THA (00.70–00.73, 81.53; 27134, 27137, 27138), and antibiotic spacer implantation/removal (84.56, 84.57; 27091). Patients were grouped by type of procedure: (1) primary THA; (2) revision THA; and (3) infected THA with staged implant removal, placement of cement-eluting antibiotic spacer, and finally revision THA. Patients were excluded if they did not meet minimum followup of 90 days. Patient medical comorbidities were identified using the Elixhauser definitions, which define groups of medical diagnoses using ICD-9 codes [6]. Additionally, patient severity of illness was assessed using the All Payer

Refined Diagnosis Related Group Severity of Illness scale [7] but was not included in the multivariate analysis because it was unavailable before 2007.

Hospital Readmission

All hospital readmissions within 90 days of discharge that were identified from the administrative record were further evaluated by reviewing patients' medical records. Planned hospital admissions were defined as when it was predetermined before the initial procedure that the patient would return for a second hospitalization; all other hospitalizations were classified as unplanned. Causes of readmission were grouped as surgical or medical. Patients were censored after one hospital readmission to ensure that patients with multiple hospital readmissions did not excessively weight the results.

Patient Characteristics

A total of 1415 patients met inclusion criteria for the study; 415 patients were excluded for insufficient followup (Table 1). There were 989 patients who underwent a primary THA, 344 who underwent a revision THA, and 82 who underwent a revision THA after staged antibiotic spacer to treat an infected THA. The average age was 58.8 ± 15.0 years for primary THA, 59.6 ± 14.5 years for revision THA, and 59.6 ± 14.5 years for infected THA. There were more women in the primary THA group than in the other two groups. Severity of illness scores were higher in the primary THA group than the revision THA group ($p = 0.014$) or the infected revision THA group ($p = 0.017$), but the infected THA group had more medical comorbidities than revision THA ($p = 0.01$) and primary THA ($p < 0.001$). Patients in the infected THA group had a longer length of hospital stay than primary THA ($p < 0.001$) or revision THA ($p < 0.001$). Medi-Cal (California's Medicaid program) patients made up a higher percentage of the infected THA group (18.3%) than the primary (12.8%) or revision (7.9%) THA groups ($p = 0.001$). Medicare patients contributed more to the revision THA group (44.8%) than primary THA (33.5%) or infected THA (32.9%), whereas private payer patients made up approximately half of all groups (47.4%, 53.7%, and 48.8%, respectively).

Statistical Analyses

Comparisons were made using a t-test for continuous variables and a chi-square test for categorical variables. Readmission rates were measured using a time-to-readmission analysis, and failure curves were compared using a

Table 1. Patient demographics

Demographic	Primary THA	Revision THA	Antibiotic spacer	p value
Total	989	344	82	–
Age (years)	58.8 ± 15.0	61.8 ± 13.6	59.2 ± 11.0	0.001*
Female	581 (58.7%)	191 (55.5%)	35 (42.7%)	0.015*
Length of stay (days)	4.05 ± 2.3	5.41 ± 5.8	13 ± 17.4	< 0.001*
Discharge to inpatient rehabilitation	108 (10.9%)	53 (15.4%)	12 (14.6%)	0.072
Discharge to skilled nursing	134 (13.5%)	59 (17.2%)	16 (19.5%)	0.123
APR SOI	2.24 ± 1.1	2.07 ± 1.2	1.95 ± 1.3	0.009*
Total comorbidities	2.07 ± 1.9	2.38 ± 2.1	3.11 ± 2.6	< 0.001*

Values are numbers with percentage in parentheses or mean ± SD; * statistical significance at $p < 0.05$; APR SOI = All Payer Refined Diagnosis Related Group Severity of Illness scale.

log-rank test. Risk factors for unplanned readmission were assessed using a Cox proportional hazards model, which included patient demographic, surgical, and medical comorbidity information. Variables were included in the risk model if they showed a univariate association with readmission with a p value < 0.2 . The final risk model removed variables stepwise if the p value was > 0.1 . All other comparisons were considered statistically significant if the p value was < 0.05 .

Results

Readmission Rate

The rate of unplanned readmissions was 4.3% ($n = 61$ of 1415) at 30 days and 6.6% ($n = 93$ of 1415) at 90 days. The all-cause 90-day readmission rate was 8.8% ($n = 124$ of 1415). Ten patients in the primary THA group (1.0%) had a planned readmission for a contralateral primary THA. There were 25 patients in the infected THA group (30.5%) who had planned readmissions for antibiotic spacer removal and revision THA. Patients were readmitted from the emergency department (43.0%), directly from the clinic (36.6%), and transferred from other hospitals (20.4%). Unplanned hospital readmissions included a surgical intervention in 59.1% of cases. Patients with private insurance had fewer unplanned readmissions than Medi-Cal patients (5.3% versus 9.7%, $p = 0.027$) but had a similar rate of readmission as Medicare patients (6.6%, $p = 0.313$).

The 30-day unplanned readmission rates for primary, revision, and infected THA were 3.5%, 5.5%, and 8.5%, respectively. The infected THA group had significantly more readmissions than the primary THA group ($p = 0.027$). At 90 days, the infected THA group (18.3%) had significantly higher readmission rates than revision THA (9.9%, $p = 0.034$) and primary THA (4.5%, $p < 0.001$); revision THA was also higher than primary THA ($p < 0.001$).

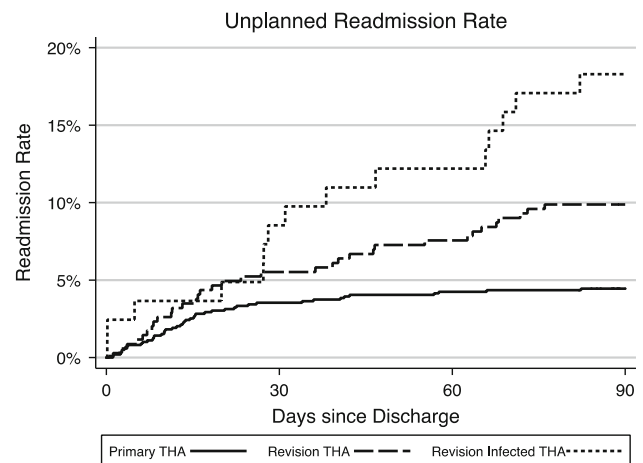


Fig. 1 Ninety-day unplanned readmission rates for THA were significantly higher for the revision THA and infected THA groups compared with primary THA.

(Fig. 1). There were no differences in age or sex between readmitted and not readmitted patients, but readmitted patients were more likely to have had an index hospital stay more than 5 days ($p < 0.001$), have been discharged to a skilled nursing facility ($p = 0.001$), and have more medical comorbidities ($p < 0.001$) (Table 2).

Causes of Readmission

Surgical complications were responsible for 74.7% ($n = 68$ of 90) of readmissions, whereas medical causes accounted for 25.3% ($n = 23$ of 90) (Table 3). The majority of surgical causes were the result of dislocation (32.4%, $n = 22$ of 68), surgical site infection (SSI) (23.5%, $n = 16$ of 68), and postoperative hematoma (10.3%, $n = 7$ of 68). However, there were differences between groups for the main causes of readmission. Dislocation occurred more often in revision THA (4.4%) than primary THA (0.7%, $p < 0.001$). SSI occurred in 0.3% of patients undergoing primary THA

Table 2. Demographics of readmitted and not readmitted patients

Demographics	Readmitted	Not Readmitted	Odds ratio	SE (95% CI)	p value
Demographics					
Number	93	1323	–	–	–
Age (years)	58.3 ± 15.8	59.6 ± 14.4	0.99	0.0 (1.0–1.0)	0.388
Female	57 (61.3%)	750 (56.7%)	1.21	0.3 (0.8–1.9)	0.387
Surgical characteristics					
THA group					
Primary THA	44 (4.4%)	945 (95.6%)	Reference	Reference	Reference
Revision THA	34 (9.9%)	310 (90.1%)	2.36	0.6 (1.5–3.8)	<0.001*
Antibiotic spacer	15 (18.3%)	67 (81.7%)	4.81	1.6 (2.5–9.1)	<0.001*
Length of stay over 5 days	46 (49.5%)	235 (17.8%)	4.53	1.0 (2.9–7.0)	<0.001*
Discharged to rehabilitation	17 (18.3%)	156 (11.8%)	1.67	0.5 (1.0–2.9)	0.067
Discharged to skilled nursing facility	20 (21.5%)	189 (14.3%)	1.64	0.4 (1.0–2.8)	0.060
Patient medical comorbidities					
APR severity of illness (1–4)	2.0 ± 1.3	2.2 ± 1.1	0.89	0.1 (0.7–1.1)	0.210
Osteoporosis	5 (5.4%)	38 (2.9%)	1.92	0.9 (0.7–5.0)	0.182
Tobacco use	33 (35.5%)	407 (30.8%)	1.24	0.3 (0.8–1.9)	0.345
Morbid obesity	9 (9.7%)	70 (5.3%)	1.92	0.7 (0.9–4.0)	0.080
Total comorbidities	3.0 ± 2.3	2.2 ± 2.0	1.20	0.1 (1.1–1.3)	<0.001*

Values are number with percentage in parentheses or mean ± SD; * statistical significance at $p < 0.05$; CI = confidence interval; APR = All Payer Refined Diagnosis Related Group.

compared with 1.7% of patients with revision THA ($p = 0.005$) and 9.8% of patients with infected TKA ($p < 0.001$). Similarly, hematoma occurred in 0.3% of primary THA cases compared with 0.6% in revision THA ($p = 0.169$) and 2.4% in infected THA ($p = 0.05$).

Risk Factors

Revision THA was independently associated with increased risk of unplanned readmission ($p = 0.007$), whereas staged antibiotic spacer revision THA showed a trend for increased risk ($p = 0.062$). Additionally, patients with a hospital stay longer than 5 days are more likely to have a hospital readmission ($p < 0.001$) (Table 4). Patient comorbidities that were independently associated with increased risk of readmission were cardiac valvular disease, diabetes with end-organ complications, and substance abuse.

Discussion

Unplanned hospital readmissions are an unfortunate event for patients and increase the overall cost of treatment. In light of recent pressure to reduce hospital readmissions among common diagnoses and procedures, this study evaluated the unplanned hospital readmission rate after primary and revision THAs. In this observational cohort study of patients undergoing THA, we found that primary THAs had lower

readmission rates than revision or staged antibiotic cement spacer THAs. One-fourth of unplanned readmissions were for medical causes, whereas the majority were the result of surgical complications. Additionally, almost half of readmissions were attributable to dislocation, SSI, or postoperative hematoma, which in many cases are considered preventable causes of readmission. The type of procedure, an index hospital length of stay over 5 days, and certain patient medical comorbidities (cardiac valvular disease, diabetes, and substance abuse) were found to have independent risk of unplanned hospital readmission.

This retrospective study has some limitations. We only captured patients whose readmissions took place at our hospital and thus may have underestimated the rate of readmissions insofar as some patients likely were readmitted elsewhere. Additionally, as a referral center that treats a large number of complex patients, our overall readmission rates may not generalize well to other referral centers or to community practices, depending on the profile of patients and procedures. However, this limitation should be at least partially mitigated by the way we grouped patients by procedure type. Additionally, we only evaluated the earliest procedure for each patient, so complicated patients with multiple procedures or multiple readmissions have not unfairly weighted these results. Finally, although most information was identified from primary record review, medical comorbidity diagnoses were obtained from administrative data, which assumes accuracy in coding. However, it has been shown that comorbidity data in

Table 3. Causes of readmission

Cause	0–90 days	0–30 days	31–60 days	61–90 days
Medical	23 (25.3%)	16 (27.1%)	5 (29.4%)	2 (13.3%)
Pneumonia	2 (8.7%)	2 (12.5%)	–	–
Abdominal pain	1 (4.3%)	1 (6.2%)	–	–
Acute renal failure	1 (4.3%)	1 (6.2%)	–	–
Anemia	1 (4.3%)	1 (6.2%)	–	–
Breast cancer	1 (4.3%)	1 (6.2%)	–	–
Constipation	1 (4.3%)	1 (6.2%)	–	–
Chronic obstructive pulmonary disease	1 (4.3%)	1 (6.2%)	–	–
Medication compliance	1 (4.3%)	1 (6.2%)	–	–
Lower extremity edema	1 (4.3%)	1 (6.2%)	–	–
Nausea/vomiting	1 (4.3%)	1 (6.2%)	–	–
Neutropenic fever	1 (4.3%)	1 (6.2%)	–	–
Pulmonary edema	1 (4.3%)	1 (6.2%)	–	–
Pyelonephritis	1 (4.3%)	1 (6.2%)	–	–
Rheumatoid arthritis flare	1 (4.3%)	1 (6.2%)	–	–
Sick sinus syndrome	1 (4.3%)	1 (6.2%)	–	–
Cardiac tamponade	1 (4.3%)	–	1 (20.0%)	–
Cough	1 (4.3%)	–	1 (20.0%)	–
Pancreatitis	1 (4.3%)	–	1 (20.0%)	–
Polycystic kidney disease	1 (4.3%)	–	1 (20.0%)	–
Small bowel obstruction	1 (4.3%)	–	1 (20.0%)	–
Diabetes	1 (4.3%)	–	–	1 (50.0%)
Placement/social	1 (4.3%)	–	–	1 (50.0%)
Surgical	68 (74.7%)	43 (72.9%)	12 (70.6%)	13 (86.7%)
Dislocation	22 (32.4%)	13 (30.2%)	5 (41.7%)	4 (30.8%)
Surgical site infection	16 (23.5%)	9 (20.9%)	4 (33.3%)	3 (23.1%)
Hematoma	7 (10.3%)	3 (7.0%)	1 (8.3%)	3 (23.1%)
Noninfected draining wound	6 (8.8%)	5 (11.6%)	1 (8.3%)	–
Acetabular cup loosening	4 (5.9%)	1 (2.3%)	1 (8.3%)	2 (15.4%)
Periprosthetic fracture	3 (4.4%)	3 (7.0%)	–	–
Cellulitis	2 (2.9%)	2 (4.7%)	–	–
Dehiscence	2 (2.9%)	2 (4.7%)	–	–
Pain management	2 (2.9%)	2 (4.7%)	–	–
Deep vein thrombosis	1 (1.5%)	1 (2.3%)	–	–
Osteolysis	1 (1.5%)	1 (2.3%)	–	–
Pulmonary embolism	1 (1.5%)	1 (2.3%)	–	–
Tendonitis	1 (1.5%)	–	–	1 (7.7%)

administrative claims are accurate and if anything are underreported [1]. Thus, it is unlikely that these results show a falsely elevated risk of readmission associated with comorbidities.

Our results for 90-day unplanned readmission rates of 4.5% and 9.9% for primary and revision THA, respectively, are consistent with previous findings using cross-sectional patient samples. de Vries et al. [4] reported a 5.1% unplanned readmission rate for primary THA using a national database in the Netherlands, whereas Mahomed et al. [11] reported rates of 4.6% for primary THA and

10.0% for revision THA in a Medicare population in the United States. All-cause readmission rates at 90 days were reported by Zhan et al. [26] at 8.9% and 15.7% for primary and revision THA, respectively, using national- and state-level claims databases. Studies that use administrative claims databases rely on identifying complications before analysis; causes of readmission such as medical complications may be missed. Although claims databases offer increased power as a result of large sample size, one of the major advantages to our study design is the ability to confirm every hospital readmission with medical record

Table 4. Independent risk factors for readmission

Risk factor	Hazard ratio	SE (95% CI)	p value
Revision THA (versus primary)	1.84	0.4 (1.2–2.9)	0.007
Antibiotic spacer THA (versus primary)	1.85	0.6 (1.0–3.5)	0.062
Hospital stay over 5 days	3.26	0.7 (2.1–5.1)	<0.001
Diabetes with complications	11.55	6.8 (3.6–36.8)	<0.001
Cardiac valve disease	2.52	0.9 (1.3–5.1)	0.009
Substance abuse	2.05	0.9 (0.9–4.8)	0.094

CI = confidence interval.

verification. The literature has established a role for using administrative claims data for such analyses, but our study suggests that it is important to cross-reference these results with the clinical record to best target quality-of-care improvement initiatives based on such results.

Informed analysis of readmission rates in the context of an adverse outcome assessment requires separating planned and unplanned readmissions. We found that one-fourth of all readmissions were planned. Evaluating hospital performance with calculations based solely on administrative claims data may indiscriminately label all readmissions as complications, which would result in inaccurate quality data and could possibly lead to undeserved financial penalties. Planned readmissions were mostly for staged procedures for treatment of patients referred with an infection using protocols that are the standard of care associated with resection of implants with implantation of an antibiotic cement spacer and subsequent revision THA in a second stage [5]. However, this group of patients with planned two-stage procedures also had the highest rate of unplanned readmissions after the second stage of their procedure. Revision THA has been shown to have higher readmission rates than primary THA [3], and our results show that staged antibiotic spacer revision for infected THA has a greater risk for unplanned readmission than other patients undergoing revision THA. However, in the multivariate risk model, revision and antibiotic spacer THA showed similar risk, suggesting that factors such as patient comorbidities may be responsible for different readmission rates between these two groups of patients undergoing revision THA. Thus, assessments that distinguish patients based on procedure should stratify these groups separately when evaluating outcomes and quality data for THA.

Unplanned hospital readmissions resulting from medical causes occurred in 25% of cases, which is comparable to what has been reported after other orthopaedic procedures. In studies that also used detailed medical record review, medical complications contributed to 18% of unplanned

readmissions after spine fusion for adult spinal deformity and 25% of readmissions after TKA [20, 21]. Jencks et al. [8] also found multiple different causes of hospital readmission after major hip or knee surgery, but as a result of the use of administrative claims data, the authors did not delineate all causes of readmission. Although the specific medical causes of readmission in this study were quite varied, this finding emphasizes the importance of preprocedure medical evaluation to identify and optimize comorbid medical conditions. Importantly, diabetes, cardiac valvular disease, and substance abuse each independently raise the risk of unplanned readmission and should be specifically addressed during preoperative counseling in an effort to optimize these conditions before elective surgery. Dislocation, infection, and hematoma accounted for the majority of surgical complications. These serious complications after total joint arthroplasty occur in the early postoperative course and may be related to other factors such as provider procedure volume and process standardization, which have been shown to affect quality of care [16]. However, these results highlight the potential impact of surgical process optimization with emphasis on targeted reductions in dislocation, infection, and postoperative hematoma complications.

Unplanned hospital readmissions add to the cost associated with elective surgical procedures such as THA. Accurate assessment and benchmarking of readmission rates for THA must differentiate among primary, revision, and staged antibiotic spacer arthroplasty procedures, because complications and readmissions after revision THAs may be inherently more common than after primary procedures. Additionally, it is important to distinguish planned readmissions from unplanned readmissions, because failure to do so would inappropriately inflate the readmission rate for revision THA cases for infection that require a two-stage treatment plan. Dislocation, SSI, and hematoma were responsible for almost half of the unplanned readmissions among patients undergoing THA in our hospital. These conditions may serve as targets for cost-effective process improvements to reduce expensive hospital readmissions. Finally, the independent risk factors identified here can help to improve risk stratification both for planning treatment options for patients and for more accurately assessing quality and value after primary and revision THA.

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