Risk Factors for Early Revision After Primary Total Hip Arthroplasty in Medicare Patients

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Published online: 29 May 2013

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Abstract

Background Patient, surgeon, health system, and device factors are all known to influence outcomes in THA. However, patient-related factors associated with an increased risk of early failure are poorly understood, particularly in elderly patients.

Questions/purposes We identified specific demographic and clinical characteristics associated with increased risk of early revision in Medicare patients with THA.

Methods The Medicare 5% national sample administrative database was used to calculate the relative risk of

revision within 12 months following primary THA as a function of baseline medical comorbidities in 56,030 Medicare patients who underwent primary THA between 1998 and 2010. The impact of 29 comorbid conditions on risk of early revision was examined using Cox regression, controlling for age, sex, race, US Census region, socioeconomic status, and all other baseline comorbidities.

Results Depression, rheumatologic disease, psychoses, renal disease, chronic urinary tract infection, and congestive heart failure were associated with revision THA within

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12 months of the index arthroplasty ($p \leq 0.038$ for all comparisons; risk factors listed in order of significance).

Conclusions This information is important when counseling elderly patients with THA regarding the risk of early failure and for risk stratifying publicly reported outcomes in Medicare patients with THA.

Level of Evidence Level II, prognostic study. See Instructions for Authors for a complete description of levels of evidence.

Introduction

Patient, surgeon, health system, and device factors are all known to influence THA outcomes [1]. Prior studies have identified risk factors associated with reduced implant survivorship, such as younger age, male sex, higher activity level, and metal-on-metal bearings [10, 21, 22]. However, early failures that occur within the first 12 months after primary THA often result in devastating outcomes, and patient-related factors associated with an increased risk of early revision are poorly understood, particularly in elderly patients.

Elderly patients who undergo THA often have comorbid illnesses and are known to be at increased risk for perioperative morbidity and mortality [13–15]. Previous investigators have identified independent risk factors for periprosthetic joint infection (rheumatologic disease, obesity, coagulopathy, preoperative anemia) and mortality (congestive heart failure, metastatic cancer, psychosis, renal disease, dementia, cerebrovascular disease, chronic pulmonary disease) after primary THA [4].

Using the Medicare 5% national sample administrative database, we identified specific demographic and clinical factors associated with an increased risk of revision during the first 12 months after primary THA in Medicare patients.

Patients and Methods

We used the 5% sample of the Centers for Medicare & Medicaid Services (CMS) Medicare claims database, which includes Part A (inpatient), Part B (physician), and outpatient claims, to identify patients who underwent primary THA (ICD-9-CM Procedure Code 81.53) between 1998 and 2010. Patients younger than 65 years old were excluded from the study because they had major disabilities and therefore represented a population that differed from the general Medicare population. Patients enrolled in a health maintenance organization (HMO) were excluded because HMO claims are not available in the Medicare 5% sample database and therefore these patients would have incomplete claims history. Patients not enrolled in both

Part A and Part B of Medicare were also excluded because of their incomplete claim history. Nonresidents were also excluded for the same reason.

Unique encrypted Medicare beneficiary identifiers were used to track patients longitudinally during the 13-year study period. A linked denominator file that accompanies the analytic data sets was used to track each patient's Medicare enrollment status. This annual Medicare denominator file contains information regarding the date of death of the enrollees and was used to identify patients who died during the 1-year followup period. Revision surgery during the study period (ie, through December 31, 2010) was identified by the occurrence of the ICD-9-CM Procedure Code 81.53 or 00.70–00.73 from the Part A files of the Medicare data set.

The preoperative comorbid conditions analyzed in our study were compiled from diagnoses included in Part A, Part B, or outpatient claims submitted during the 12-month period before the primary THA. Only patients who had been enrolled in Medicare during the entire 12-month period before their THA were included in the study; this ensured that a full year of baseline comorbidity information would be available for each patient. To avoid misclassification of postoperative complications as preexisting comorbid conditions, only comorbid conditions that were identified in administrative claims dated at least 30 days before the date of the index THA procedure were classified as preexisting conditions.

The study cohort consisted of 56,030 Medicare patients who underwent primary THA between 1998 and 2010. The mean age was 75.2 years (SD = 6.2 years), 65% were women, and 94.2% were white. Patients were geographically dispersed throughout the different US Census regions, 7.4% had public assistance for their Medicare premiums, and 76.8% had a Charlson Comorbidity Index [6] of less than 3 (Table 1). The prevalence of each comorbid condition ranged from a high of 75% for hypertension to a low of 0.4% for drug abuse (Table 2). The cumulative incidence of revision during the first 12 months after primary THA for the entire cohort was 2.03%.

Statistical Methods

We examined the impact of 29 comorbid conditions on the risk of revision THA within 12 months following primary THA using multivariate Cox regression, controlling for age, sex, race, US Census region, public assistance (indicated by Medicare premiums and deductibles subsidized by the state because of the patient's financial status), and all other baseline comorbidities. The 29 comorbid conditions included the specific diseases used to determine the Charlson Comorbidity Index [6] and other diseases used as comorbidity indexes in previous analyses of administrative databases because of their

Table 1. Demographic characteristics of the 56,030 patients with primary THA

Demographic characteristic	Total number of patients	Total number of patients with revision
Sex		
Female	36,406 (65.0%)	676 (65.2%)
Male	19,624 (35.0%)	361 (34.8%)
Race		
White	52,792 (94.2%)	987 (94.3%)
Black	2397 (4.3%)	44 (4.2%)
Others	841 (1.5%)	15 (1.4%)
Age		
65–69 years	12,388 (22.1%)	25.7 (24.8%)
70–74 years	15,133 (27.0%)	270 (26.0%)
75–79 years	14,242 (25.4%)	260 (24.1%)
80–84 years	9561 (17.1%)	173 (16.7%)
≥ 85 years	4705 (8.4%)	77 (7.4%)
US Census region		
Midwest	16,966 (30.3%)	294 (28.3%)
Northeast	10,597 (18.9%)	160 (15.4%)
South	18,794 (33.5%)	380 (36.6%)
West	9673 (17.3%)	203 (19.6%)
Public assistance status		
Public assistance	4142 (7.4%)	100 (9.6%)
No public assistance	51,888 (92.6%)	937 (90.4%)
Charlson Comorbidity Index		
0	19,242 (34.3%)	329 (31.7%)
1–2	23,792 (42.5%)	424 (40.9%)
3–4	9269 (16.5%)	188 (18.1%)
≥ 5	3727 (6.7%)	96 (9.3%)

association with increases in the length of hospital stay, hospital charges, and mortality [8]. In addition, other conditions identified in previous clinical studies as risk factors for early revision THA were included [19].

We calculated both the crude relative risk (RR) and the adjusted hazard ratio (HR) for each comorbid condition and used the Wald chi-square statistic to evaluate the significance of the HR. The resulting p value for the HR was used to rank the degree of association of each comorbid condition with risk of revision surgery within 1 year after primary THA. Thus, the ranking of a specific condition indicated the relative degree of association or significance of its presence with risk of revision surgery within 1 year after primary THA.

Results

Among the clinical and demographic factors analyzed (Table 3), the most significant independent risk factors for

Table 2. Prevalence of comorbid conditions among Medicare patients with primary THA

Comorbid condition	Disease prevalence (%)
Hypertension	74.8
Anemia	31.9
Ischemic heart disease	31.9
Hypercholesterolemia	28.8
Malignancy	25.1
Cardiac arrhythmia	25.0
Urinary tract infection	24.1
Chronic pulmonary disease	23.2
Diabetes	20.6
Hypothyroidism	20.4
Valvular disease	16.3
Peripheral vascular disease	15.8
Cerebrovascular disease	14.0
Congestive heart failure	12.8
Depression	9.8
Rheumatologic disease	9.4
Coagulopathy	8.3
Renal disease	7.4
Obesity	7.0
Psychosis	5.0
Chronic liver disease	3.2
Pulmonary circulation	2.2
Dementia	2.0
Peptic ulcer disease	1.7
Metastatic tumor	1.6
Lymphoma	1.2
Alcohol abuse	1.0
Hemiplegia/paraplegia	0.6
Drug abuse	0.4

revision THA within 12 months (in order of significance; $p \leq 0.038$ for all comparisons) were depression (HR = 1.64; 95% CI, 1.39–1.93), rheumatologic disease (HR = 1.32; 95% CI, 1.11–1.57), psychoses (HR = 1.34; 95% CI, 1.08–1.68), renal disease (HR = 1.29; 95% CI, 1.06–1.58), chronic urinary tract infection (HR = 1.15; 95% CI, 1.01–1.32), and congestive heart failure (HR = 1.20; 95% CI, 1.01–1.43). The most common overall reasons for revision were mechanical complication, dislocation, infection, and periprosthetic fracture (Table 4).

Discussion

THA outcomes have previously been characterized at the population level for the Medicare population [3, 16, 17]. Most studies have shown that THA is associated with high rates of success as defined by decreased pain and improved

Table 3. Results of multivariable Cox regression analysis to evaluate independent risk factors for rate of revision THA within 12 months after primary THA

Comorbid condition	Risk of revision with condition (%)	Risk of revision without condition (%)	Crude relative risk (95% CI)	Adjusted hazard ratio (95% CI)	Wald's χ^2	p value
Depression	3.53	1.86	1.89 (1.63–2.20)	1.64 (1.39–1.93)	34.30	< 0.001
Rheumatologic disease	2.72	1.95	1.39 (1.18–1.65)	1.32 (1.11–1.57)	9.67	0.002
Psychosis	3.46	1.95	1.78 (1.45–2.17)	1.34 (1.08–1.68)	6.80	0.009
Renal disease	2.86	1.96	1.46 (1.22–1.75)	1.29 (1.06–1.58)	6.28	0.012
Chronic urinary tract infection	2.43	1.90	1.28 (1.13–1.45)	1.15 (1.01–1.32)	4.40	0.036
Congestive heart failure	2.68	1.93	1.39 (1.19–1.61)	1.20 (1.01–1.43)	4.30	0.038
Ischemic heart disease	2.32	1.89	1.23 (1.10–1.38)	1.12 (0.98–1.28)	2.73	0.098
Drug abuse	5.06	2.01	2.51 (1.44–4.38)	1.53 (0.86–2.75)	2.07	0.151
Alcohol abuse	3.31	2.01	1.64 (1.06–2.54)	1.34 (0.86–2.11)	1.65	0.200
Cerebrovascular disease	2.48	1.95	1.27 (1.09–1.48)	1.11 (0.94–1.30)	1.57	0.210
Hypertension	2.11	1.78	1.19 (1.04–1.36)	1.09 (0.94–1.26)	1.41	0.234
Anemia	2.30	1.90	1.22 (1.08–1.37)	1.08 (0.95–1.22)	1.30	0.254
Chronic pulmonary disease	2.36	1.93	1.22 (1.08–1.39)	1.08 (0.94–1.23)	1.15	0.284
Pulmonary circulation	2.03	2.03	1.00 (0.68–1.47)	0.81 (0.55–1.21)	1.03	0.311
Peptic ulcer disease	2.79	2.01	1.38 (0.96–2.00)	1.18 (0.81–1.73)	0.77	0.380
Malignancy	1.95	2.05	0.95 (0.83–1.09)	0.95 (0.82–1.09)	0.59	0.443
Hypercholesterolemia	2.00	2.03	0.98 (0.87–1.12)	0.96 (0.84–1.09)	0.45	0.501
Diabetes	2.24	1.97	1.14 (0.99–1.30)	1.05 (0.91–1.21)	0.44	0.505
Peripheral vascular disease	2.16	2.00	1.08 (0.93–1.25)	0.95 (0.81–1.12)	0.40	0.526
Chronic liver disease	2.11	2.02	1.04 (0.76–1.43)	0.92 (0.67–1.28)	0.24	0.625
Cardiac arrhythmia	2.23	1.96	1.14 (1.01–1.29)	1.03 (0.90–1.19)	0.19	0.663
Hemiplegia/paraplegia	2.77	2.02	1.37 (0.72–2.62)	1.15 (0.59–2.23)	0.16	0.687
Metastatic tumor	1.80	2.03	0.89 (0.55–1.43)	0.92 (0.57–1.50)	0.11	0.746
Lymphoma	1.85	2.03	0.91 (0.53–1.57)	0.91 (0.52–1.60)	0.10	0.752
Valvular disease	2.21	1.99	1.11 (0.96–1.29)	0.98 (0.84–1.15)	0.05	0.817
Hypothyroidism	2.19	1.98	1.10 (0.96–1.26)	1.01 (0.88–1.17)	0.020	0.889
Dementia	2.55	2.02	1.26 (0.88–1.81)	0.97 (0.67–1.42)	0.02	0.892
Coagulopathy	2.28	2.00	1.14 (0.94–1.38)	1.01 (0.83–1.24)	0.02	0.901
Obesity	2.25	2.01	1.12 (0.91–1.38)	1.01 (0.81–1.25)	0.003	0.957

Conditions are listed in descending order of the degree of association with revision THA within 12 months after primary THA, based on the hazard ratio's p value.

function in patients who suffer from disabling arthritis of the hip [12]. However, complications requiring revision surgery within the first 12 months after primary THA are associated with increased costs and poor clinical outcomes. Identifying risk factors for early failure is important for informing shared medical decision making in elderly patients who are considering elective THA for management of their hip pain and for risk stratification of publicly reported outcomes. We identified specific demographic and clinical factors associated with an increased risk of revision during the first 12 months after primary THA in Medicare patients.

Our study has several important limitations. First, we relied on administrative claims data (which did not include laterality) to identify revisions and risk factors for early

failure. However, previous investigators have reported reasonable correlation between administrative claims and the clinical record when evaluating causes and types of revision TJA procedures [2]. Second, our study was limited to Medicare patients, and therefore our findings may not be generalizable to the broader population of younger patients who undergo primary THA. However, given that older patients have more comorbid conditions, we believe that it is important to identify risk factors for early revision THA in the elderly population. Finally, our findings are limited to risk factors for failures that occur during the first 12 months after primary THA, and therefore it is unclear whether the same or other risk factors are associated with a higher long-term risk of revision THA. However, the impact of patient comorbidities on the risk of early failure

Table 4. Most common reasons for revision THA

ICD-9-CM diagnosis code	Diagnosis	Number of patients
996.4	Mechanical complication of internal orthopaedic device implant and graft	508 (44.3%)
996.42	Dislocation of prosthetic joint	140 (12.2%)
996.66	Infection and inflammatory reaction due to internal joint prosthesis	120 (10.5%)
996.44	Periprosthetic fracture around prosthetic joint	62 (5.4%)
996.41	Mechanical loosening of prosthetic joint	53 (4.6%)
996.77	Other complications due to internal joint prosthesis	46 (4.0%)
996.43	Broken prosthetic joint implant	29 (2.5%)
996.47	Other mechanical complication of prosthetic joint implant	23 (2.0%)
736.39	Other acquired deformities of hip	18 (1.6%)
718.35	Recurrent dislocation of joint, pelvic region, and thigh	13 (1.1%)
821.01	Fracture of shaft of femur (closed)	12 (1.0%)
996.67	Infection and inflammatory reaction due to other internal orthopaedic device, implant, and graft	12 (1.0%)

after THA has important clinical and policy implications for surgeons, hospitals, and patients.

Previous investigators have evaluated risk factors for complications and revision after THA. Conroy et al. [7] investigated risk factors for revision for dislocation after primary THA as reported in the Australian Orthopaedic Association National Joint Replacement Registry and found patients with fractured neck of the femur (RR = 2.0), rheumatoid arthritis (RR = 2.0), or avascular necrosis (RR = 1.6) had a significantly increased risk of revision for dislocation. Pederson et al. [18] used the Danish Hip Arthroplasty Registry to evaluate the extent to which diabetes affects the risk of revision THA. They found that diabetes was associated with an increased risk of revision due to deep infection (RR = 1.45; 95% CI, 1.00–2.09), particularly in patients with Type 2 diabetes (RR = 1.49; 95% CI, 1.02–2.18), those with diabetes for less than 5 years before THA (RR = 1.69; 95% CI, 1.24–2.32), those with complications due to diabetes (RR = 2.11; 95% CI, 1.41–3.17), and those with cardiovascular comorbidities before surgery (RR = 2.35; 95% CI, 1.39–3.98). Graw et al. [11] compared time to revision between primary minimally invasive (MI) THA and traditional THA among patients who were referred to their practice for revision THA. They found that MI THA was associated with a significantly increased risk of early revision compared with conventional THA (1.4 years versus 14.7 years, odds ratio = 26.5). Finally, Schrama et al. [20] evaluated

differences in the risk of revision THA for infection among patients with rheumatoid arthritis and osteoarthritis. Using data from the Norwegian Arthroplasty Register, they reported a higher risk of late (> 6 years postoperatively) infection leading to revision THA in patients with rheumatoid arthritis compared to patients with osteoarthritis [20].

As the United States shifts from volume- to value-based payment and delivery systems [5, 9, 23], increased emphasis has been placed on public reporting of physician performance and patient outcomes, including complication and revision rates for elective surgical procedures such as THA. Furthermore, the United States has initiated a THA outcomes registry, the American Joint Replacement Registry, which will be used to track revision rates among patients with THA in the United States. It is important that publicly reported THA outcomes and THA registry results be appropriately risk adjusted for factors outside the control of the surgeon, such as patient comorbidities, which are known to influence patient outcomes. The patient comorbidities identified in our study could be used in risk adjustment models for public reporting of THA outcomes and THA registries to appropriately account for patient characteristics associated with an increased risk of early revision THA.

In conclusion, depression, rheumatologic disease, psychoses, renal disease, chronic urinary tract infection, and congestive heart failure are associated with an increased risk of early revision after primary THA in Medicare patients. This information is important when counseling elderly patients with regarding the risk of early failure and for risk stratifying publicly reported outcomes in Medicare patients with THA.

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