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Patient-related Risk Factors for Postoperative Mortality and Periprosthetic Joint Infection in Medicare Patients Undergoing TKA

Kevin J. Bozic MD, MBA, Edmund Lau MS, Steven Kurtz PhD, Kevin Ong PhD, Daniel J. Berry MD

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Abstract

Background The impact of specific baseline comorbid conditions on the relative risk of postoperative mortality and periprosthetic joint infection (PJI) in elderly patients undergoing TKA has not been well defined.

Questions/purposes We calculated the relative risk of postoperative mortality and PJI associated with 29 comorbid conditions in Medicare patients undergoing TKA.

Patients and Methods The Medicare 5% sample was used to calculate the relative risk of 90-day postoperative mortality and PJI as a function of 29 preexisting comorbid conditions in 83,011 patients who underwent primary TKA between 1998 and 2007.

Results The independent risk factors for 90-day postoperative mortality (in decreasing order of significance) were congestive heart failure, metastatic cancer, renal disease, peripheral vascular disease, cerebrovascular disease, lymphoma, cardiac arrhythmia, dementia, pulmonary circulation disorders, and chronic liver disease. The independent risk factors for PJI (in decreasing order of significance) were congestive heart failure, chronic pulmonary disease, preoperative anemia, diabetes, depression, renal disease, pulmonary circulation disorders, obesity, rheumatologic disease, psychoses, metastatic tumor, peripheral vascular disease, and valvular disease.

Conclusions We believe this information important when counseling elderly patients regarding the risks of mortality and PJI after TKA and risk-adjusting publicly reported TKA patient outcomes.

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

Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.
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K. J. Bozic (✉)
UCSF Department of Orthopaedic Surgery and Philip R. Lee Institute for Health Policy Studies, University of California, 500 Parnassus, MU 320W, San Francisco, CA 94143-0728, USA
e-mail: kevin.bozic@ucsf.edu

E. Lau
Exponent, Inc, Menlo Park, CA, USA

S. Kurtz, K. Ong
Exponent, Inc, Philadelphia, PA, USA

D. J. Berry
Department of Orthopaedic Surgery, Mayo Clinic, Rochester, MN, USA

Introduction

Despite the success of TKA in terms of alleviating pain and improving function in patients with disabling arthritis of the knee, devastating complications such as periprosthetic joint infection (PJI) and death can and do occur [8]. Multiple clinical risk stratification classification systems, including the Charlson CoMorbidity Index [4], the American Society of Anesthesiologists physical status classification (ASA Class) [1], and the All Patient Revised-Diagnosis Related Group Severity of Illness and Risk of Mortality [10], are reliable predictors of morbidity and mortality in certain surgical patients. However, none of these classification systems has been validated in patients undergoing TKA. Furthermore,

most surgeons and patients are not familiar with them, and therefore, they are not helpful for preoperative counseling regarding the risks of death and PJI after TKA.

Kurtz et al. [8] previously used the Medicare administrative claims data set to study the risk of PJI after TKA in Medicare patients. This study identified the presence of preexisting patient comorbidities, as defined by the Charlson CoMorbidity index, as a risk factor for PJI along with other factors such as longer procedure duration, lower socioeconomic status, and male gender. However, although the Charlson CoMorbidity Index provides a useful surrogate for the overall health status of surgical patients based on a composite score from 19 conditions, it is not helpful in elucidating the impact of specific diseases on patient outcomes, because patients with different combinations of preexisting conditions may have similar Charlson scores. As a result, the impact of specific baseline comorbid conditions on the relative risk of postoperative mortality and PJI, particularly in the elderly TKA population, has not been well defined. We therefore evaluated the impact of specific baseline comorbid conditions on the relative risk of postoperative mortality and PJI in Medicare patients undergoing TKA.

Patients and Methods

We used the 5% national sample of the Medicare database to evaluate the association between baseline medical comorbidities and the relative risk of 90-day postoperative mortality and PJI in 83,011 patients who underwent primary TKA between 1998 and 2007 with at least 1 year of enrollment before the surgery. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code 81.54 and Current Procedural Terminology, Fourth Edition, code 27447 were used to identify patients undergoing unilateral primary TKA. This study excluded patients who were younger than 65 years old or health maintenance organization enrollees. We excluded health maintenance organization enrollees because their expenditures are not submitted to the Centers for Medicare & Medicaid Services for processing and, therefore, claims from these beneficiaries were not available or may be incomplete.

Using each patient's unique encrypted Medicare beneficiary identifier, the patients were followed longitudinally throughout the 10-year study period. We tracked the patient's enrollment status and 90-day postoperative mortality using a linked "denominator" file that accompanied the analytic data sets. The annual Medicare denominator file contains information regarding the date of death, if applicable, of the enrollees and was used to determine the prevalence of 90-day postoperative mortality. Any PJI that was diagnosed during the time period under study (ie, up to the latest followup, December 31, 2007) was identified with ICD-9-CM diagnosis code 996.66 (infection resulting from an internal joint prosthesis) from services provided in any setting, including inpatient, outpatient, office, skilled nursing facility, hospice care, and home health agencies. This ICD-9-CM code is reportedly associated with a high degree of specificity and concordance with the corresponding clinical diagnosis of PJI in the medical record [3]. Preoperative comorbid conditions were compiled from diagnoses in either Part A (inpatient) or Part B (outpatient) claims submitted during the 12-month period before the operation. We included only patients who were enrolled during the entire 12-month period in the study so that a full year of baseline comorbidities could be observed. To minimize misclassification of postoperative complications (eg, postoperative anemia) as preexisting comorbid conditions, we only included those comorbid conditions that were identified in the administrative claims records at least 30 days before surgery.

We used multivariate Cox regression to evaluate the association between the 29 comorbid conditions (Table 1) and 90-day postoperative mortality and PJI. The analysis controlled for age, gender, race, Census region, receipt of public assistance (identified by Medicare buy status for patients whose Medicare premiums and deductibles were subsidized by the state as a result of their financial status), and all other baseline comorbidities. These comorbid conditions were based on the specific diseases that are used to determine the composite Charlson CoMorbidity Index [4] as well as other diseases that are used as comorbidity measures for administrative databases, which were associated with increases in length of hospital stay, hospital charges, complications, and mortality [5]. In addition, preexisting diseases that have been identified in clinical studies as risk factors for PJI were also included [17]. We calculated both the crude relative risk and adjusted hazard ratio associated with each comorbid condition. The p value associated with the test of significance (Wald's chi square statistic) for the hazard ratio was used to rank the strength of the association of each comorbid condition with 90-day postoperative mortality or PJI while controlling for the other comorbid conditions and other patient factors, as noted previously. The corresponding p values associated with the test statistics for the hazard ratio indicated the relative degree of association or significance of the presence of that specific condition to the outcomes of interest (eg, postoperative mortality or PJI).

Results

The results of our analyses demonstrated 10 conditions that are independently associated with an increase in the risk of 90-day postoperative mortality (Table 2). In decreasing order of significance ($p < 0.005$ for all comparisons), the risk factors for postoperative mortality after TKA in

Table 1. Comorbid conditions included in the analysis of risk factors for PJI and 90-day postoperative mortality after TKA

Comorbid conditions	Disease prevalence
Hypertension	70%
Ischemic heart disease	27%
Hypercholesterolemia	25%
Diabetes	22%
History of malignancy	20%
Cardiac arrhythmia	19%
Chronic pulmonary disease	18%
Hypothyroidism	18%
Urinary tract infection	17%
Valvular disease	12%
Peripheral vascular disease	12%
Cerebrovascular disease	10%
Congestive heart failure	10%
Preoperative anemia	9%
Rheumatologic disease	7%
Depression	7%
Obesity	6%
Coagulopathy	4%
Psychoses	3%
Renal disease	3%
Chronic liver disease	2%
Pulmonary circulation	1%
Peptic ulcer disease	1%
Dementia	1%
Lymphoma	1%
Metastatic tumor	1%
Alcohol abuse	0%
Hemiplegia/paraplegia	0%
Drug abuse	0%

PJI = prosthetic joint infection.

Medicare patients were congestive heart failure (hazard ratio [HR], 2.15; 95% confidence interval [CI], 1.71–2.69), metastatic cancer (HR, 4.40; CI, 2.67–7.26), renal disease (HR, 2.23; CI, 1.68–2.96), peripheral vascular disease (HR, 1.49; CI, 1.20–1.87), cerebrovascular disease (HR, 1.49; CI, 1.19–1.87), lymphoma (HR, 2.20; CI, 1.22–4.0), cardiac arrhythmia (HR, 1.26; CI, 1.04–1.54), dementia (HR, 1.84; CI, 1.10–3.07), pulmonary circulation disorders (HR, 1.72; CI, 1.07–2.76), and chronic liver disease (HR, 1.50; CI, 1.01–2.21). Hypercholesterolemia was associated with a decreased risk of postoperative mortality (HR, 0.64; CI, 0.50–0.80).

Our analyses identified 13 conditions that are independently associated with an increase in the risk of PJI (Table 3). In decreasing order of significance, the independent risk factors for PJI were congestive heart failure (HR, 1.28; 95% CI, 1.13–1.46), chronic pulmonary disease (HR, 1.22; CI, 1.10–1.36), preoperative anemia (HR, 1.26; CI, 1.09–1.45), diabetes (HR, 1.19; CI, 1.06–1.34), depression (HR, 1.28; CI, 1.08–1.51), renal disease (HR, 1.38; CI, 1.11–1.71), pulmonary circulation disorders (HR, 1.42; CI, 1.06–1.91), obesity (HR, 1.22; CI, 1.03–1.44), rheumatologic disease (HR, 1.18; CI, 1.02–1.37), psychoses (HR, 1.26; CI, 1.02–1.57), metastatic tumor (HR, 1.59; CI, 1.03–2.47), peripheral vascular disease (HR, 1.13; CI, 1.01–1.27), and valvular disease (HR, 1.15; CI, 1.01–1.31).

Discussion

Death and PJI are rare but devastating complications of TKA. Identifying the impact of specific baseline comorbid conditions on the relative risk of postoperative mortality and PJI, especially in elderly patients, is important for informing discussions between patients and their surgeons when considering elective TKA. Our results indicate that certain baseline comorbid conditions, including congestive heart failure, are associated with a substantially increased risk of postoperative mortality and PJI in elderly patients undergoing TKA.

Our study is limited by a number of factors. First, we relied on administrative claims data, which may not always correlate precisely with the clinical record [12], to identify baseline patient comorbidities. However, the prevalence of each comorbid condition (Table 1) is similar to what has been reported in other population-based studies of patients undergoing TKA [7, 18]. Further study is necessary to better understand the correlation between administratively coded and clinically valid comorbidities. Because our findings are based on the elderly Medicare population, it is unclear if our findings are generalizable to patients younger than 65 years of age. In addition, potentially relevant characteristics such as the patient's body mass index to indicate the degree of obesity is also not available in the earlier years of the Medicare data set. Because we relied on the diagnoses from the claims records, rather than using clinical criteria such as positive culture or abnormal serology, to identify cases involving PJI, the number of patients with PJI may have been overestimated. However, our previous work demonstrated most deep infections recorded in the Medicare data set were diagnosed while the patient was hospitalized, and most were diagnosed by an orthopaedic surgeon or infectious disease specialists [15], which lend support that these infections were adequately identified from the database. Finally, although we have identified specific comorbidities associated with an increased risk of postoperative mortality and PJI, it is unclear whether certain combinations of risk factors (eg, diabetes and congestive heart failure) result in higher than anticipated risk of mortality and PJI. Further study is necessary to better understand the synergistic effect of

Table 2. Results of multivariable Cox regression analysis to evaluate the independent risk factors for 90-day postoperative mortality in Medicare patients undergoing TKA

Comorbid conditions	Risk of 90-day postoperative mortality with condition	Risk of 90-day postoperative mortality without condition	Crude relative risk (95% CI)	Adjusted hazard ratio (95% CI)	Wald's chi-square	p
Congestive heart failure*	1.93%	0.49%	3.94 (3.27–4.75)	2.15 (1.71–2.69)	43.64	<0.0001
Metastatic cancer*	3.43%	0.61%	5.64 (3.60–8.86)	4.40 (2.67–7.26)	33.61	<0.0001
Renal disease*	2.20%	0.58%	3.80 (2.87–5.03)	2.23 (1.68–2.96)	30.82	<0.0001
Hypercholesterolemia†	0.45%	0.69%	0.65 (0.52–0.82)	0.64 (0.50–0.80)	14.14	0.0002
Peripheral vascular disease*	1.30%	0.54%	2.42 (1.98–2.95)	1.49 (1.20–1.87)	12.63	0.0004
Cerebrovascular disease*	1.31%	0.55%	2.39 (1.95–2.94)	1.49 (1.19–1.87)	12.02	0.0005
Lymphoma*	1.76%	0.62%	2.84 (1.57–5.14)	2.20 (1.22–4.0)	6.78	0.0092
Cardiac arrhythmia*	1.12%	0.51%	2.19 (1.82–2.62)	1.26 (1.04–1.54)	5.39	0.0203
Dementia*	2.44%	0.61%	3.98 (2.43–6.51)	1.84 (1.10–3.07)	5.36	0.0206
Pulmonary circulation disorders*	2.11%	0.61%	3.47 (2.27–5.29)	1.72 (1.07–2.76)	5.07	0.0243
Chronic liver disease*	1.20%	0.61%	1.96 (1.29–2.96)	1.50 (1.01–2.21)	4.14	0.0420
Chronic pulmonary disease	0.95%	0.56%	1.70 (1.41–2.07)	1.18 (0.97–1.43)	2.75	0.0973
Diabetes	0.79%	0.58%	1.37 (1.14–1.66)	1.17 (0.96–1.42)	2.35	0.1249
Ischemic heart disease	0.97%	0.50%	1.95 (1.64–2.32)	1.16 (0.96–1.39)	2.29	0.1304
Depression	0.87%	0.61%	1.43 (1.06–1.91)	1.25 (0.91–1.72)	1.94	0.1639
Anemia	1.03%	0.59%	1.76 (1.38–2.24)	1.17 (0.90–1.53)	1.32	0.2503
Peptic ulcer disease	0.75%	0.63%	1.21 (0.54–2.69)	0.65 (0.29–1.47)	1.07	0.3002
Alcohol abuse	1.66%	0.62%	2.67 (1.11–6.39)	1.43 (0.56–3.65)	0.56	0.4549
Urinary tract infection	0.80%	0.59%	1.36 (1.11–1.67)	1.07 (0.87–1.32)	0.40	0.5266
Obesity	0.56%	0.63%	0.88 (0.61–1.28)	0.89 (0.60–1.31)	0.36	0.5464
Valvular disease	1.00%	0.57%	1.73 (1.40–2.15)	0.93 (0.74–1.18)	0.33	0.5654
Rheumatologic disease	0.67%	0.62%	1.08 (0.78–1.49)	0.92 (0.66–1.28)	0.27	0.6065
Hypertension	0.66%	0.55%	1.21 (0.99–1.47)	0.95 (0.78–1.16)	0.22	0.6374
Drug abuse	0.62%	0.63%	0.99 (0.14–7.01)	0.64 (0.09–4.70)	0.20	0.6584
Coagulopathy	1.05%	0.61%	1.73 (1.23–2.43)	1.07 (0.76–1.52)	0.17	0.6843
Hypothyroidism	0.63%	0.63%	1.00 (0.80–1.26)	0.97 (0.77–1.23)	0.06	0.8073
Malignancy	0.82%	0.58%	1.40 (1.15–1.71)	0.98 (0.79–1.22)	0.02	0.8773
Psychoses	0.93%	0.62%	1.51 (1.02–2.23)	0.98 (0.61–1.59)	0.01	0.9411
Hemiplegia/paraplegia	1.36%	0.62%	2.18 (0.82–5.79)	1.01 (0.37–2.78)	0.00	0.9838

* Condition that is statistically significantly associated with an increased adjusted risk of 90-day post operative mortality in Medicare patients undergoing THA; conditions are listed in descending order of the degree of association with 90-day postoperative mortality based on the p value associated with the hazard ratio; †condition that is associated with a decreased risk of 90-day postoperative mortality; PJI = prosthetic joint infection; CI = confidence interval.

combinations of comorbid conditions on the risk of postoperative mortality and PJI in elderly patients undergoing TKA.

Previous investigators have attempted to evaluate the risk factors for mortality and PJI after TKA (Table 4) [8]. In a study involving Medicare patients undergoing TKA, Kurtz et al. [8] identified male gender, public assistance for Medicare premiums, and patient comorbidities, based on the Charlson CoMorbidity Index, as risk factors for PJI. However, as noted, the Charlson CoMorbidity index, which is a composite score reflecting the number and severity of comorbid conditions, provides limited clinical applicability. We focused on identifying which specific patient comorbidities are associated with an increased risk of postoperative mortality and PJI to provide a basis for improved communication and clinical decision-making between surgeons and their patients. Parvizi et al. [16] reviewed the records of 22,540 patients who had undergone elective TKA at a single institution between 1969 and 1997 to identify patients who died within 30 days after the procedure. Mortality rates were determined according to age, gender, diagnosis, implant type, and fixation mode. The 30-day mortality rate was higher for patients with preexisting cardiovascular disease and/or pulmonary disease and simultaneous bilateral TKA. Gill et al. [6]

Table 3. Results of multivariable Cox regression analysis to evaluate independent risk factors for PJI in Medicare patients undergoing TKA

Comorbid conditions	Risk of PJI with condition	Risk of PJI without condition	Crude relative risk (95% CI)	Adjusted hazard ratio (95% CI)	Wald's chi-square	p
Congestive heart failure*	4.27%	2.60%	1.64 (1.47–1.84)	1.28 (1.13–1.46)	14.97	<0.0001
Chronic pulmonary disease*	3.57%	2.58%	1.38 (1.26–1.52)	1.22 (1.10–1.36)	14.58	<0.0001
Preoperative anemia*	3.71%	2.67%	1.39 (1.23–1.58)	1.26 (1.09–1.45)	10.18	0.0014
Diabetes*	3.32%	2.60%	1.28 (1.17–1.40)	1.19 (1.06–1.34)	9.17	0.0025
Depression*	3.69%	2.69%	1.37 (1.19–1.58)	1.28 (1.08–1.51)	8.53	0.0035
Renal disease*	3.99%	2.72%	1.46 (1.20–1.79)	1.38 (1.11–1.71)	8.68	0.0038
Pulmonary circulation disorders*	4.98%	2.73%	1.82 (1.39–2.38)	1.42 (1.06–1.91)	5.37	0.0205
Obesity*	3.72%	2.70%	1.38 (1.19–1.59)	1.22 (1.03–1.44)	5.25	0.0219
Rheumatologic disease*	3.43%	2.71%	1.27 (1.10–1.46)	1.18 (1.02–1.37)	4.85	0.0277
Pyschoses*	4.03%	2.72%	1.48 (1.23–1.79)	1.26 (1.02–1.57)	4.54	0.0331
Metastatic tumor*	4.69%	2.75%	1.71 (1.17–2.49)	1.59 (1.03–2.47)	4.36	0.0369
Peripheral vascular disease*	3.37%	2.68%	1.26 (1.12–1.41)	1.13 (1.01–1.27)	4.30	0.0381
Valvular disease*	3.48%	2.66%	1.31 (1.17–1.47)	1.15 (1.01–1.31)	4.26	0.0390
Ischemic heart disease	3.37%	2.53%	1.33 (1.22–1.45)	1.11 (1.00–1.23)	3.62	0.0572
Cardiac arrhythmia	3.35%	2.62%	1.28 (1.16–1.41)	1.11 (0.99–1.24)	3.41	0.0649
Coagulopathy	3.76%	2.72%	1.38 (1.16–1.65)	1.16 (0.96–1.41)	2.26	0.1327
Urinary tract infection	3.08%	2.59%	1.14 (1.03–1.27)	1.09 (0.97–1.21)	2.08	0.1488
Cerebrovascular disease	2.93%	2.74%	1.07 (0.94–1.21)	0.91 (0.78–1.06)	1.57	0.2108
Lymphoma	3.99%	2.75%	1.45 (0.99–2.14)	1.34 (0.85–2.11)	1.53	0.2155
Peptic ulcer disease	4.40%	2.74%	1.60 (1.16–2.22)	1.23 (0.87–1.75)	1.43	0.2321
Malignancy	2.99%	2.70%	1.11 (1.00–1.22)	1.07 (0.95–1.20)	1.33	0.2484
Hypercholesterolemia	2.72%	2.77%	0.98 (0.89–1.08)	0.94 (0.85–1.05)	1.18	0.2763
Hemiplegia/paraplegia	4.42%	2.75%	1.61 (0.94–2.74)	1.32 (0.77–2.27)	1.00	0.3175
Chronic liver disease	3.54%	2.74%	1.29 (1.02–1.64)	1.08 (0.84–1.39)	0.40	0.5285
Alcohol abuse	3.99%	2.76%	1.45 (0.83–2.52)	1.11 (0.63–1.97)	0.13	0.7174
Hypothyroidism	2.72%	2.77%	0.98 (0.88–1.09)	0.98 (0.87–1.10)	0.11	0.7413
Drug abuse	4.35%	2.76%	1.58 (0.76–3.26)	1.14 (0.49–2.66)	0.10	0.7569
Hypertension	2.81%	2.64%	1.07 (0.97–1.17)	1.01 (0.92–1.12)	0.06	0.8025
Dementia	3.35%	2.76%	1.22 (0.80–1.84)	1.03 (0.66–1.61)	0.02	0.8839

* Condition that is statistically significantly associated with an increased adjusted risk of periprosthetic joint infection in Medicare patients undergoing TKA; conditions are listed in descending order of the degree of association with PJI based on the hazard ratio's p value; PJI = prosthetic joint infection; CI = confidence interval.

prospectively collected data on 3048 patients who underwent primary elective TKA between 1976 and 1996. Fourteen of the 3048 procedures resulted in death within 90 days after surgery. Patients with cardiac comorbidities had a 16 times higher risk of mortality and risk of mortality in patients who were 85 years and older was 14 times higher. Six patients had a history of cardiac disease defined as a previous hospital admission with a diagnosis of myocardial infarction or ischemic heart disease and cardiac failure.

Pulido et al. [17] previously evaluated the risk factors associated with PJI after TJA from 4185 patients undergoing TKA from a single institution from January 2001 to April 2006 using a retrospective cohort study design. Higher ASA score, morbid obesity, bilateral arthroplasty, knee arthroplasty, allogeneic transfusion, postoperative atrial fibrillation, myocardial infarction, urinary tract infection, and longer hospitalization were all identified as risk factors associated with the development of PJI within the first year after TJA. Lee et al. [11] used a case-control study design to evaluate risk factors for surgical site infections in elderly patients who underwent orthopaedic surgery at Duke University Medical Center and seven community hospitals in North Carolina and Virginia between 1991 and 2002. In the bivariate analysis, six

Table 4. Data from previous studies examining risk factors for PJI and mortality in patients undergoing TKA

	Pulido et al. [17] (2008) (PJI)	Lee et al. [11] (2006) (SSI)	Lai et al. [9] (2007) (PJI)	Parvizi et al. [16] (2001) (mortality)	Gill et al. [6] (2003) (mortality)	Bozic et al. (current study) (PJI)	Bozic et al. (current study) (mortality)
Obesity	OR: 3.23, 95% CI (1.6–6.5), p = 0.001					HR: 1.22, 95% CI (1.03–1.44), p = 0.0219	HR: 0.89, 95% CI (0.60–1.31), p = 0.5464
ASA score > 2	OR: 1.95, 95% CI (1.0–3.7), p = 0.04						
Bilateral TKA	OR: 5.85, 95% CI (2.5–13.9), p < 0.0001						
Allogeneic blood transfusion	OR: 2.11, 95% CI (1.1–3.9), p = 0.02						
Postoperative atrial fibrillation	OR: 6.22, 95% CI (1.4–28.5), p = 0.02						
Postoperative myocardial infarction	OR: 20.4, 95% CI (2.1–199.9), p = 0.009						
Postoperative urinary infection	OR: 5.45, 95% CI (1.0–8.7), p = 0.04						
Longer hospital stay	OR: 1.09, 95% CI (1.0–1.1), p = 0.0003						
Administrative healthcare facility		OR: 6.25, 95% CI (2.27–16.67), p < 0.001					
Chronic obstructive pulmonary disease		OR: 2.19, 95% CI (0.99–4.86), p = 0.05					

Table 4. continued

	Pulido et al. [17] (2008) (PJI)	Lee et al. [11] (2006) (SSI)	Lai et al. [9] (2007) (PJI)	Parvizi et al. [16] (2001) (mortality)	Gill et al. [6] (2003) (mortality)	Bozic et al. (current study) (PJI)	Bozic et al. (current study) (mortality)
Charlson score of ≥ 3		OR: 11.28, 95% CI (2.78–45.76), $p < 0.001$					
Inability to bathe independently		OR: 3.62, 95% CI (1.93–6.81), $p < 0.001$					
Inability to dress independently		OR: 3.34, 95% CI (1.81–6.18), $p < 0.0001$					
Diabetes			OR: 3.91, 95% CI (1.06–14.44), $p = 0.04$			HR: 1.19, 95% CI (1.06–1.34), $p = 0.0025$	HR: 1.17, 95% CI (0.96–1.42), $p = 0.1249$
Total number of comorbid conditions			OR: 1.35, 95% CI (0.94–8.00), $p = 0.005$				
Preexisting cardiovascular and/or pulmonary disease				Prevalence: 43/47 (91.5%), $p < 0.002$			
Simultaneous bilateral TKA				Prevalence: 13/47 (27.7%), $p < 0.002$			
Increasing patient age					OR: 13.7, 95% CI (3.0–44.8), $p = 0.001$		
Cardiovascular comorbidities					OR: 15.9, 95% CI (3.4–143.5), $p < 0.001$		
Congestive heart failure						HR: 1.28, 95% CI (1.13–1.46), $p < 0.0001$	HR: 2.15, 95% CI (1.71–2.69), $p < 0.0001$

PJI = prosthetic joint infection; SSI = surgical site infection; HR = hazard ratio; OR = odds ratio; CI = confidence interval; ASA = American Society of Anesthesiologists.

variables were associated with surgical site infections. These included admission from a healthcare facility, chronic obstructive pulmonary disease, a Charlson score of 3 or greater, the inability to bathe independently, and the inability to dress independently. Finally, in a retrospective case-control study, Lai et al. [9] examined the individual and cumulative effects of various medical comorbidities on the risk of developing PJI after hip or knee arthroplasty in 51 patients with 52 joint infections. Both diabetes mellitus and total number of medical conditions were associated with higher risk of infection.

Although these studies all provide valuable insights into the risk factors for mortality and PJI after TKA, they are limited by inadequate sample sizes (ranging from 51 to 9245 patients) to detect baseline risk factors for such rare outcomes as death and PJI and inclusion of patients from a single or small number of institutions. Our study builds on these previous findings by identifying the impact of specific baseline comorbid conditions on the relative risk of postoperative mortality and PJI in a large, nationally representative cohort of Medicare patients undergoing TKA. Additionally, our finding that hypercholesterolemia may be associated with a decreased risk of postoperative mortality is interesting in light of recent evidence from the Danish Hip Arthroplasty Registry that suggests the use of cholesterol-lowering agents (eg, statins) may be associated with a decreased risk of revision surgery after primary THA [18]. Although previous authors have identified diabetes and rheumatologic disease as predictors of PJI [9], we found that congestive heart failure, chronic pulmonary disease, preoperative anemia, and depression are also associated with an increased risk of PJI. Depression may also be associated with poor nutritional status, and one study suggests patients undergoing major joint arthroplasty who have preoperative anemia are more likely to receive allogeneic blood transfusions [2], which have been associated with an increased risk of postsurgical infection [14].

In summary, we identified the impact of specific baseline comorbid conditions on the relative risk of 90-day postoperative mortality and PJI after TKA in Medicare patients. Recent literature suggests medical management of diabetes may contribute to lowering the risk of complications after total joint arthroplasty procedures [13], and therefore we recommend optimizing the medical management of the conditions identified in this study before considering elective TKA in this elderly patient population. This information is important when counseling elderly patients regarding the risks associated with TKA. Furthermore, these variables should be included in risk adjustment models for public reporting of TKA outcomes.

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