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Original Article

Removal of an Infected Hip Arthroplasty Is a High-Risk Surgery: Putting Morbidity Into Context With Other Major Nonorthopedic Operations

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ABSTRACT

Background: Two-stage revision remains the most common approach to periprosthetic joint infection of total hip arthroplasty (THA) in the United States. The postoperative risks associated with removal of an infected prosthesis and placement of a spacer have not been thoroughly studied.
Methods: Patients who underwent THA implant removal and spacer placement for infection were identified in a large administrative database. Morbidity and mortality rates were assessed for the 90-day postoperative period and readmission rates were assessed at 30 days postoperatively. These outcomes were then compared with those after coronary artery bypass grafting, carotid endarterectomy, prostatectomy, pancreatoduodenectomy (Whipple procedure), and kidney transplant.
Results: Implant removal and spacer placement for THA periprosthetic joint infection (n = 10,386) had a 30-day readmission rate of 11.1% and 90-day mortality rate of 2.6%. Major complications were seen in 15.3% patients. Postoperative morbidity was often higher in these patients when compared with other procedures studied. Ninety-day mortality rates were significantly higher compared with carotid endarterectomy, prostatectomy, and kidney transplant (odds ratio [ORs] between 2.1 and 12.5; $P < .0001$). Readmission rates at 30 days were significantly higher than all other groups including coronary artery bypass grafting and Whipple (ORs between 1.4 and 8.2; $P < .0001$).
Conclusion: Removal of an infected THA with spacer placement is a high-risk surgery. This large study that includes over 10,000 patients helps quantify the risks of readmission, morbidity, and mortality. The rates of adverse outcomes are higher than those for many nonorthopedic operations typically considered to be major surgery.

One of the cornerstones of assessing surgical intervention is morbidity. Surgical interventions can have major impact on the well-being of individual patients as well as tremendous financial impact on society at large. Although any surgery has inherent impact on a patient's health, procedures of different magnitudes can have different associated risks for adverse outcomes. The underlying health status of the host that is associated with different procedures is also a major factor in postoperative morbidity. Defining the risks of surgical intervention on a particular patient population is of vital importance when it comes to appropriate clinical decision-making, risk assessment, and resource allocation.

Although it is generally understood that periprosthetic joint infection (PJI) is a devastating complication, little large scale data exist to quantify the morbidity of removing an infected implant as part of a 2-stage treatment. Recent data have suggested that life-expectancy is reduced in patients undergoing revision for a septic arthroplasty when compared with those with an aseptic diagnosis, which is likely a reflection of both host health status as well as the treatment itself [1]. One report of a relatively small series of patients undergoing 2-stage treatment of hip PJI found a 7% mortality rate between implant removal and reimplantation [2]. However, very few, if any, have investigated the morbidity after the first stage of a 2-stage revision arthroplasty procedure.

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The aim of this study was to investigate the morbidity of resection hip arthroplasty and spacer placement in patients with PJI. In addition, our goal was to place this morbidity in context by comparing this patient population with different groups of patients who underwent nonorthopedic procedures commonly considered to be major surgical undertakings known to put patients at risk for morbidity.

Materials and Methods

Database Cohorts

Medicare patient data from 2005 through 2012 were reviewed using the PearlDiver Technologies Patient Records Database (www.pearldiverinc.com, Fort Wayne, IN). The database contains the *International Classification of Diseases, Ninth Revision,* (*ICD-9*) diagnosis and procedure codes and the *Current Procedural Terminology* (*CPT*) codes. Access to the database was granted by PearlDiver Technologies for the purpose of academic research. The Medicare database was chosen owing to its size and prevalence of patients with the procedures being studied. The database was stored on a password-protected server maintained by PearlDiver. Our institutional review board approved an exemption for this research.

Inclusion criteria were Medicare patients who underwent removal of an infected hip prosthesis. Patients undergoing removal of a hip prosthesis were identified using the *CPT* code 27091 (removal of hip prosthesis; complicated, including total hip prosthesis, methylmethacrylate with or without insertion of spacer) or *ICD-9 Clinical Modification (ICD-9-CM)* procedure code 80.05 (arthrotomy for removal of prosthesis without replacement, hip) and *ICD-9-CM* procedure code 84.56 (insertion or replacement of [cement] spacer). All patients included in this study also had an *ICD-9* code that indicated infection (*ICD-9-CM* code 996.66, 996.67, 996.69, 998.59, and 711.05); patients without a diagnosis code consistent with infection were excluded from the analysis.

Comparison cohorts of patients who had undergone major nonorthopedic procedures were also identified. Patients who underwent a pancreatoduodenectomy (Whipple procedure) were identified using the *CPT* codes 48150, 48152, 48153, and 48154 and the *ICD-9-CM* procedure code 52.7. Patients who underwent kidney transplant were identified using the *CPT* codes 50360 and 50365 as well as the *ICD-9-CM* procedure code 55.69. Carotid endarterectomy (CEA) patients were identified using the *CPT* code 35301 or the *ICD-9-CM* procedure code 38.12 in conjunction with the *ICD-9-CM* diagnosis codes 433.10 or 433.11. Patients who underwent prostatectomy were identified using the *CPT* codes 55801, 55810, 55812, 55815, 55821, 55831, 55840, 55842, and 55845, and the *ICD-9-CM* procedure codes 60.3, 60.4, 60.5, 60.6, and 60.62. Finally, patients who underwent coronary artery bypass grafting (CABG) were identified using the *ICD-9-CM* procedure codes 36.1 and 36.10 through 36.19 as well as the *CPT* codes 33510-33514, 33516-33519, 33521-33523, and 33533-33536.

Outcomes

Patients in each cohort were queried for basic demographics including gender, age group (<65, 65-69, 70-74, 75-79, 80-84, and >85 years), obesity, and smoking status. Comorbid disease was also assessed in each cohort by documenting the prevalence of diabetes mellitus, obstructive sleep apnea, hyperlipidemia, hypertension, peripheral vascular disease, congestive heart failure, coronary artery disease, chronic kidney disease, lung disease, and liver disease. The average Charlson Comorbidity Index (CCI) and standard deviation for each cohort was calculated by the database.

Each cohort was then queried for postoperative complications after the surgical procedure using the *ICD-9* and *CPT* codes. Morbidity and inhospital mortality rates were assessed for the 90-day postoperative period, whereas readmission rates were assessed at 30 days postoperatively to avoid including potential planned readmissions for reimplantation. Complications included transfusion (*CPT* code 36430; *ICD-9* codes V58.2, 990.0, 990.2, and 990.4), pulmonary embolism (PE; *ICD-9* codes 415.1, 415.11, and 415.19), deep vein thrombosis (DVT; *ICD-9* codes 453.4, 453.40, 453.41, and 453.42), urinary tract infection (UTI; *ICD-9* codes 098.0, 098.1, 098.10, and 599.0), pneumonia (PNA; *ICD-9* codes 480.0-480.9, 481, and 482.0-482.9), myocardial infarction (MI; *ICD-9* codes 410.00-410.02, 410.10-410.12, 410.20-410.22, 410.30-410.32, 410.40-410.42, 410.50-410.52, 410.60-410.62, 410.70-410.72, 410.80-410.82, and 410.90-410.92), acute renal failure (ARF; *ICD-9* codes 584.5-584.9, 580.0-580.9, and 586), and cerebrovascular accident (CVA; *ICD-9* codes 430, 431, 432.0, 432.9, 433, 433.0, 433.00, 433.01, 433.1, 433.10, 433.11, 433.2, 433.20, 433.21, 433.3, 433.30, 433.31, 433.8, 433.80, 433.81, 433.9, 433.90, 433.91, 434, 434.0, 434.00, 434.01, 434.10, 434.11, 434.9, 434.90, and 434.91).

Statistical Analysis

A standard Pearson χ^2 analysis was used to compare postoperative complications and mortality. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. The Student *t* tests were used to compare length of stay between groups. For all statistical comparisons of postoperative complications, $P < .001$ was considered significant. Analyses were performed using SPSS Statistics for Windows (version 23; SPSS).

Results

There were 10,386 patients identified in the database between 2005 and 2012 who underwent removal of an infected hip prosthesis and met inclusion criteria. We also identified 930,352 patients who underwent CABG, 475,789 patients who underwent CEA, 179,329 patient who underwent prostatectomy, 38,446 patients who underwent Whipple, and 90,640 patients who underwent kidney transplant during this period. A comparison of each cohort's demographics and CCI are presented in Table 1. As expected, there were significant differences among the 6 different patient cohorts. It is worth noting that the study group of THA explant patients had a higher percentage of young patients <65 years of age (24.4%) compared with all other groups except kidney transplant. THA removal patients also had a significantly lower CCI than Whipple, kidney transplant, and CEA patients (all $P < .001$).

At 90 days after surgery, the documented mortality rate in patients undergoing THA removal and spacer placement was 2.6% (Fig. 1). The ORs of death after THA explant were higher than those after CEA (OR, 2.17; 95% CI, 1.92-2.46; $P < .0001$), prostatectomy (OR, 12.46; 95% CI, 10.64-14.58; $P < .0001$), and kidney transplant (OR, 2.69; 95% CI, 2.34-3.09; $P < .0001$). The ORs of death were higher than those of THA explant in patients after CABG (OR, 0.60; 95% CI, 0.53-0.68; $P < .0001$) and Whipple (OR, 0.45; 95% CI, 0.40-0.52; $P < .0001$).

The 30-day readmission rate was 11.1% in patients undergoing THA explant (Fig. 2). This was higher than all other groups including CABG (OR, 2.24; 95% CI, 2.11-2.38; $P < .0001$), CEA (OR, 3.78; 95% CI, 3.55-4.02; $P < .0001$), prostatectomy (OR, 8.15; 95% CI, 7.58-8.76; $P < .0001$), Whipple (OR, 1.48; 95% CI, 1.37-1.59; $P < .0001$), and kidney transplant (OR, 1.39; 95% CI, 1.30-1.48; $P < .0001$).

The 90-day incidence of transfusion in THA explant patients was 63% (Fig. 3). The ORs of transfusion were significantly higher than all other groups including CABG (OR, 5.11; 95% CI, 2.11-2.38; $P < .0001$), CEA (OR, 26.62; 95% CI, 25.54-27.75; $P < .0001$), prostatectomy (OR, 15.45; 95% CI, 14.80-16.12; $P < .0001$), Whipple