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Do Mortality and Complication Rates Differ Between Periprosthetic and Native Hip Fractures?

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ABSTRACT

Background: Epidemiological estimates indicate a rising incidence of periprosthetic hip fractures. While native hip fractures are known to be a highly morbid condition, a significant body of research has led to improved outcomes and decreased complications following these injuries. Comparatively, little research has evaluated the relative morbidity and mortality of periprosthetic hip fractures. The purpose of this study was to compare the morbidity and mortality of periprosthetic vs native hip fractures.

Methods: Using the National Surgical Quality Improvement Program (NSQIP) database, 523 periprosthetic hip fractures were matched to native hip fractures using propensity scores. The 30-day rates of complications were compared using McNemar's test. A multivariate regression was then used to determine independent risk factors for mortality following periprosthetic fracture.

Results: Mortality was similar between groups (periprosthetic: 2.7% vs native: 3.4%; $P = .49$). Periprosthetic fractures exhibited a greater rate of overall (63.1% vs 38.6%; $P < .001$) and minor complications (59.1% vs 34.4%; $P < .001$). There was an increased rate of return to the operating room (7.8% vs 3.1%; $P < .001$) and blood transfusion in the periprosthetic group (54.9% vs 30.2%; $P = .001$). Age greater than 85 (odds ratio 9.21) and dependent functional status (odds ratio 5.38) were both independent risk factors for mortality following periprosthetic fracture.

Conclusions: While native hip fractures are known to be highly morbid, our findings suggest that periprosthetic hip fractures have a similar mortality with significantly higher short-term morbidity. Future research is warranted to better understand risk factors and prevention strategies for complications in this subset of patients.

Total hip arthroplasty (THA) has been one of the most successful orthopedic procedures of the last century. Current estimates indicate rising utilization over the coming decades [1]. This increase in utilization will likely bring both younger more active and older osteoporotic patients, as well as an increasing burden of revision procedures; all three of these groups of patients are thought to have an increased risk of periprosthetic fracture [2]. These factors have left some authors to warn of an "impending epidemic of periprosthetic fractures of the hip." [3] Current registry data confirm a rising incidence of periprosthetic fractures, exemplified by the Swedish and Norwegian arthroplasty registries [4,5]. Similarly, the US data, from the National Inpatient Sample, would suggest periprosthetic fractures to be an increasingly common cause of revision, particularly in elderly THA patients [6].

With the aging population in the United States continuing to grow, recent estimates have demonstrated concerning increases in the projected rates of native hip fractures as well [7]. While a large body of literature has helped improve outcomes in these patients with the use of prompt multidisciplinary teams, fractures of the native hip remain highly morbid and a significant public health concern [8–10].

A litany of research has focused on the surgical treatment options and functional outcomes of complex periprosthetic fracture patients. However, comparatively little research has discussed the seemingly high morbidity and mortality of periprosthetic fractures. Given the

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similar demographics and comorbidities of native and periprosthetic hip fractures, these 2 groups present an interesting comparison. However, to our knowledge, only one single-center study to date has directly compared the mortality of these 2 groups of patients, demonstrating similar 1-year mortality rates [11].

Thus, the aim of our study was to utilize the National Surgical Quality Improvement Program Database to compare the short-term morbidity and mortality of periprosthetic hip fractures with native hip fractures. We further aimed to identify independent risk factors for mortality following periprosthetic hip fracture.

Methods

We conducted a retrospective cohort study using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database. The ACS-NSQIP collects 323 Health Insurance Portability and Accountability Act-compliant patient variables from 517 participating US hospitals [12]. Patients are prospectively identified, and information is gathered from operative reports, medical records, and patient interviews by trained clinical reviewers [12,13].Routine auditing by the program ensures high-quality data, with reported inter-rater disagreement below 2% for all variables. Data are collected through the 30th postoperative day, including after discharge.

The ACS-NSQIP database from 2005 to 2014 was queried to identify patients who underwent surgery for a hip fracture or a periprosthetic hip fracture. Hip fracture patients were initially selected by a postoperative diagnosis of hip fracture (International Classification of Diseases-9 codes 820.0-820.9). From these patients, those with primary Current Procedural Terminology codes 27,235 (percutaneous fixation), 27,125/27,236 (hemiarthroplasty), 27,130 (total joint arthroplasty), 27,244 (plate/screw fixation), and 27,245 (intramedullary implant) were included in the analysis. Periprosthetic hip fracture patients were identified using International Classification of Diseases-9 code 996.44 and the following Current Procedural Terminology codes: 27,125, 27,130, 27,132, 27,134, 27,138, 27,236, 27,248, 27,506, and 27,507. Patients with missing perioperative data were excluded from the analysis.

Patient characteristics such as age, sex, height, and weight are available in the database. Body mass index (BMI) was calculated from height and weight. Information about medical comorbidities was also collected from the ACS-NSQIP database. The American Society of Anesthesiologists (ASA) class $\geq$3 indicates severe systemic disease. History of pulmonary disease was defined as a history of dyspnea or severe chronic obstructive pulmonary disease. Diabetes was classified as insulin-dependent diabetes mellitus or non—insulin-dependent diabetes mellitus. Functional status was defined as the patient's ability to perform the activities of daily living (ADLs) within the 30 days before surgery, with the patient's best functional status during this period recorded. An independent patient is one who does not require assistance for any ADLs, while a partially dependent patient requires assistance for some ADLs, and a totally dependent patient requires assistance in completing all ADLs. Partially and totally dependent patients were grouped together for analysis. Anesthesia type was also available in the database and was classified as general or nongeneral (eg, neuraxial anesthesia) for this study. Operative time was defined as the minutes between the opening incision and the end of wound closure. Length of stay (LOS) was defined as the number of calendar days from operation to discharge. Operating room times and LOS were treated as continuous variables for analysis.

The ACS-NSQIP tracks patients for the occurrence of individual adverse events occurring within the first 30 postoperative days (including while the patient is in the hospital as well as after discharge). The occurrence of a serious adverse event was defined as the occurrence of any of the following: death, coma >24 hours, requirement for mechanical ventilation for more than 48 hours, unplanned intubation, stroke/cerebrovascular accident, thromboembolic event (deep venous thrombosis or pulmonary embolism), infectious complication (superficial surgical site infection, deep surgical site infection, organ/space infection, or sepsis), cardiac arrest, myocardial infarction, acute renal failure, return to the operating room, graft/prosthesis/flap failure, or peripheral nerve injury. Similarly, the occurrence of a minor adverse event was defined as wound dehiscence, blood transfusion, urinary tract infection, pneumonia, or progressive renal insufficiency. Any adverse event was defined as the occurrence of either a severe or minor adverse event. Readmission was defined as a binary variable that was positive when a patient had an unplanned readmission one or more times after the initial postoperative discharge. Readmission data are only available in the NSQIP database from the year 2011 and later, so patients that underwent surgery before 2011 were excluded from readmission analyses.

Statistical Analysis

Statistical analyses were conducted using Stata, version 13.1 (StataCorp, LP, College Station, Texas). Pearson's chi-square test was used to compare age, sex, ASA class, BMI, pulmonary disease, hypertension, smoking status, diabetes, anesthesia type, and functional status between patients who underwent hip fracture and periprosthetic hip fracture surgery.

To control for selection bias between the nonrandomized procedure groups, propensity scores were calculated from patient demographics and comorbidities. The propensity score is the conditional probability of receiving surgery for hip fracture vs periprosthetic hip fracture based on the observed patient demographics and comorbidities. Patients were matched one-to-one by propensity scores using nearest-neighbor matching. The propensity score has been extensively used in the literature for this purpose [14,15]. After matching, patient characteristics were compared between groups using Pearson's chi-squared test. Matching successfully reduced selection bias by eliminating significant differences in preoperative variables, as the propensity-matched P value was greater than .05 for all comparisons of patient characteristics.

McNemar's test was used to compare the rates of adverse outcomes that occurred with hip fracture and periprosthetic hip fracture surgery, using hip fracture cases as the reference. Continuous outcomes (operating room times and postoperative LOS) were compared between groups using linear regression. The level of significance was set at $P < .05$.

Independent risk factors for mortality following a periprosthetic fracture were identified using multivariate logistic regression, which controlled for potentially confounding patient variables. The multivariate model was constructed in a backward-stepwise fashion. The model initially included all independent variables and sequentially removed the variable with the highest P value until only variables with $P < .200$ remained. Variables with a P value between .050 and .200 remained in the model to control for potential confounding. The level of significance was set at $P < .05$ for all analyses. Owing to the number of comparisons made in this analysis, to decrease the probability of type I error, a Bonferroni correction was made: a result was therefore considered statistically significant when $P < .002$.

Results

Patient Demographics

In total 34,652 patients were evaluated in our initial analysis, including 34,129 native hip fractures and 523 periprosthetic hip