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Total Joint Arthroplasty in Nonagenarians: What Are the Risks?

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ABSTRACT

With recent increases in life expectancy in the United States, the number of nonagenarians (age 90–99 years) presenting for lower extremity joint arthroplasty (TJA) will likely rise. Utilizing the National Surgical Quality Improvement Program database, we compared 30-day outcomes of TJA between nonagenarians and controls (age <90 years). Nonagenarians had lower mean BMI, no difference in mean number of comorbidities, and shorter mean operation time. Compared to controls, nonagenarians had longer mean length-of-stay, higher readmission rate, and higher risk of postoperative adverse events. Given these findings, orthopaedic surgeons should be aware of the increased risks of TJA in nonagenarians, and should discuss these risks with potential surgical candidates during a shared decision-making process.

The elderly population in the United States continues to grow as the mean life expectancy increases secondary to advances in disease prevention and management. According to the National Center for Health Statistics, the nonagenarian population (age of 90–99 years) in the United States has nearly tripled over the past three decades, from 720,000 in 1980 to 1,900,000 in 2010 [1]. This demographic group is projected to continue growing for the foreseeable future, reaching an estimated 9,000,000 persons by the year 2050 [1]. With the dramatic increase in the size of this patient population, and their high risk of osteoarthritis [2], an increasing number of nonagenarians are expected to visit orthopaedic surgeons for lower extremity total joint arthroplasty (TJA) [2–4].

Prior studies of TJA in nonagenarians have shown good functional outcomes postoperatively [3,4]. However, despite the potential benefits, it is generally thought that these patients are at an increased risk of postoperative complications due to multiple medical comorbidities including chronic obstructive pulmonary disease, diabetes, and hypertension [2,5,6], which can delay preoperative optimization and increase the risk of complications postoperatively. Furthermore, elderly patients have limited physiological reserve to withstand surgical stress and have slower wound healing [7]. However, current studies of the nonagenarian population are limited by small sample sizes drawn from single-institutions [6,8–10].

Therefore, we attempted to address such limitations concerning this topic using a large, nationwide, multi-institution database from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP). We specifically assessed the following metrics for nonagenarians undergoing elective TJA compared to patients less than 90 years undergoing TJA: (1) demographics; (2) preoperative comorbidities; (3) operative related factors; (4) postoperative course, including readmission and length of stay; and (5) risk of postoperative adverse events within 30 days of surgery. The primary goal of our study was to assess the risk of postoperative complications among nonagenarians undergoing TJA. We hypothesized that nonagenarians would be at an increased risk of these postoperative complications.

Methods

Study Population

The NSQIP collects data on surgical encounters from more than 300 hospitals across the United States [11]. The database contains demographic and clinical variables for each patient, including Current Procedural Terminology (CPT) codes and 30-day postoperative outcomes. The data is devoid of personal identifiers and is freely available to researchers at participating institutions. Therefore, this study did not

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meet human subject research criteria and was given exempt status after review by our institutional review board.

Cases

The study population consisted of 58,126 patients who underwent elective lower extremity total joint arthroplasty between January 2011 and December 2012. Of this cohort, 347 (0.60%) were nonagenarians, with the remaining 57,779 patients serving as the comparison group. There were 22,784 patients (200 nonagenarians) who underwent total hip arthroplasty (CPT 27130), and 35,342 patients (147 nonagenarians) who underwent total knee arthroplasty (CPT 27447) during this time-period.

Demographics

Data were extracted on each patient's age (in years), gender, race (Caucasian, African-American, other, unknown), and body mass index (BMI) in kg/m^2. Age was categorized according to nonagenarian cutoffs (<90, ≥90 years). Body mass index was categorized according to standard ranges for normal weight (<25.0 kg/m^2), overweight (25.0–29.9 kg/m^2), class I obesity (30.0–34.9 kg/m^2), and class II/III obesity (≥35.0 kg/m^2).

Comorbidities were assessed using an adaptation of the Charlson Comorbidity Index for the ACS NSQIP data, as has been done previously [12–14]. Comorbidities (with point value in parentheses) included history of myocardial infarction (1), history of congestive heart failure (1), peripheral vascular disease, intermittent claudication or lower extremity rest pain (1), transient ischemic attack or cerebrovascular accident (1), chronic obstructive pulmonary disease (1), diabetes mellitus (1), hemiplegia (2), end-stage renal disease (2), ascites or esophageal varices (3), and metastatic cancer (6). A patient's Charlson score was determined as the sum of their comorbidity point values.

Preoperative and Intraoperative Exposures

We extracted data on each patient's procedure type (THA, TKA), functional status prior to surgery (independent, partially, or totally dependent), smoking status (nonsmoker, smoker), American Society of Anesthesiologists (ASA) score, anesthesia type (general, spinal or epidural, regional or local), and the length of surgery. The ASA score was analyzed as a continuous and categorical (<3, ≥3) variable. Length of surgery was defined as the total operation time in minutes, from incision to closure. Among the 347 nonagenarians, there were 4 patients with an operative time of 0 minutes, 1 patient with a time of 27 minutes, and 1 patient with a time of 533 minutes. We only considered patients with operation times between 30 and 270 minutes to avoid the confounding effect of outlier values on these variables.

Postoperative Course

We extracted data on each patient's hospital length of stay. Patients who had a postoperative length of stay greater than 30 days were not analyzed to avoid the confounding effect of outlier values. We also extracted data on each patient's discharge destinations (home, nursing facility) and readmissions within 30 days (no, yes).

Postoperative Adverse Events

The ACS NSQIP follows patients for 30 days postoperatively and provides data on 23 unique outcomes. Consistent with prior studies [13,14], we defined a "serious adverse event" as death, coma, failure to wean off of a ventilator, unplanned intubation, cerebrovascular accident, pulmonary embolism, cardiac arrest, myocardial infarction, acute renal failure, sepsis, septic shock, or return to the operating room. We defined a "minor adverse event" as wound disruption, superficial surgical site infection, deep surgical site infection, organ or space surgical site infection, urinary tract infection, pneumonia, transfusion, renal insufficiency, graft or prosthesis failure, peripheral nerve injury, or deep vein thrombosis. We defined "any adverse event" as having either a serious or a minor adverse event during the 30-day postoperative follow-up period.

Statistical Analysis

To compare differences in continuous variables between nonagenarians and other patients, we used means with independent sample t-tests. To compare differences of categorical variables, we used frequency tables with Fisher's Exact tests for binary variables and chi-squared tests for multi-level variables. To compare the risk of adverse events (any, serious, minor) between nonagenarians and other patients, we used logistic regression to calculate the odds ratio (OR) and 95% confidence interval (95% CI) of having an adverse event within 30 days of TJA. Sub-analyses separately assessed the risk of adverse events for THA and TKA. We also stratified our analyses by length of stay (<7 days, ≥7 days) and operative time (<2 hours, ≥2 hours). Models were controlled for gender, race, categorical body mass index, and Charlson comorbidity score. All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina). All P values were two-tailed, and $P < 0.05$ was interpreted as statistically significant.

Results

Demographics

Nonagenarians were more likely to be female (65 vs. 60%; p = 0.042) with a lower mean body mass index (25.6 vs. 31.7 kg/m^2; $P < 0.001$), and a lower proportion of patients were African American (3% vs. 6%) (Table 1). There was no significant difference in mean Charlson Comorbidity Scores (0.11 vs. 0.10 points; $P = 0.596$) (Table 1).

Preoperative and Intraoperative Exposures

Nonagenarians were more likely to undergo THA (58% vs. 39%) than TKA (42% vs. 61%; $P < 0.001$) (Table 2). Compared to controls, their preoperative functional status was more likely to be partially or totally dependent (13% vs. 2%; $P < 0.001$), they were less likely to be current

Table 1
Patient Demographics for Nonagenarians Compared to Other Patients Undergoing Total Joint Arthroplasty.

	Age (years)		
	<90	≥90	*P*
Gender, %			
Male	40	35	0.042
Female	60	65	
Race, %			
White	80	81	0.001
Black	6	3	
Other	3	1	
Unknown	12	16	
Body mass index (kg/m^2), mean	31.7	25.6	<0.001
Body mass index (kg/m^2), %			
<25.0	15	49	<0.001
25.0–29.9	31	36	
30.0–34.9	27	14	
≥35.0	27	1	
Charlson Comorbidity Score, mean	0.11	0.10	0.596
Charlson Comorbidity Score, %			
0	91	90	0.437
1	8	9	
2	1	0	
≥3	0	0	

• Abbreviations: % = percent of patients.
• Totals may not add to 100 due to rounding.