Journal of Orthopaedics 15 (2018) 671–675

Contents lists available at ScienceDirect

Journal of Orthopaedics

journal homepage: www.elsevier.com/locate/jor

Total shoulder arthroplasty in octogenarians: Is there a higher risk of adverse outcomes?

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ARTICLE INFO

Keywords:
Total shoulder arthroplasty
Shoulder arthroplasty
Octogenarian
Complications
Lengths of stay
Perioperative

ABSTRACT

This study used the National Surgical Quality Improvement Program to evaluate octogenarians who underwent total shoulder arthroplasty (TSA). Specifically, we evaluated: (1) patient demographics; (2) perioperative factors; and (3) 30-day postoperative complications. Compared to controls, the octogenarians had more females, white patients, lower BMIs, fewer smokers, less functionally independent, higher ASA scores, shorter operative times, and longer LOS. Octogenarians had greater odds for developing any (OR = 2.05; 95%CI, 1.70–2.46), any major (OR = 2.28; 95%CI, 1.66–3.13), and any minor (OR = 1.99; 95%CI, 1.63–2.45) complications. Perioperative risk management strategies for elective TSA in the elderly may help mitigate the increased perioperative risks associated with age.

1. Introduction

From 2000 to 2010, the number of Americans 80 years and older grew from 13.4 million to 16.7 million, representing a 25% increase.[1] As Americans live longer, they continue to access care as evidenced by an estimated 14% of the procedures performed in ambulatory surgical centers are done on those over 75.[2] Age alone is known to be a risk factor for perioperative morbidity and mortality, with one study reporting the 30-day mortality to be 51% in patients over 80 years across multiple surgical procedure types.[3] Increases in operative length in particular have also been associated with increased mortality in those over 80 years.[3] Special considerations already exist for the practice of surgical risk management in such patients, including careful preoperative cardiovascular risk assessment, selection of short-acting and regional anesthetic agents, and attempting to minimize operative length.[3–6] However, for specialized procedures such as total shoulder arthroplasty (TSA), these general recommendations might need to be further adjusted.

The number of TSA procedures performed in the United States has increased alongside the aging population in recent years, with one study finding two-thirds of TSA patients to be over 65 years of age.[7] Approximately 49 per 100,000 of those above 80 years of age undergo TSA, second only to patients aged 65–79 years.[8] Mortality and readmission rates have been suggested to be higher for patients over 75 years who undergo TSA compared to younger patients, with similar rates of revision surgery.[9] Additional data on disposition and lengths of stay (LOS) exist for these patients, but more specific data describing complications and perioperative patient characteristics are lacking.[8]

Therefore, the purpose of this study was to use a large prospectively collected national database to evaluate patients aged 80 years and older who underwent TSA to compare these patients to a cohort who were younger than 80 years. Specifically, we evaluated: (1) patient demographics; (2) perioperative factors such as anesthesia type, American Society of Anesthesiologists (ASA) score, operative time, lengths of stay (LOS); and (3) 30-day postoperative complications.

2. Materials and methods

2.1. Database

The present study used the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database, which is a validated, prospectively collected, risk-adjusted database that collects data on patients who undergo surgery from approximately 700 hospitals in the United States.[10–13] Surgical clinical reviewers, trained by the ACS, record perioperative data at each hospital, including demographics, laboratory values, comorbidities, diagnosis as defined by International Classification of Disease 9th and/or 10th Revisions (ICD-9,

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https://doi.org/10.1016/j.jor.2018.05.035
Received 24 February 2018; Accepted 6 May 2018
Available online 08 May 2018

ICD-10) codes, surgical procedure defined by Current Procedural Terminology (CPT) codes, and data related to discharge disposition, reoperations, readmissions, and mortality through 30 days postoperatively.

2.2. Study population

The NSQIP database was used to identify all patients who underwent TSA as defined by the CPT code 23472, from January 1, 2008 to December 31, 2015. A total of 10,353 patients were identified and were then stratified into two cohorts based on age, which resulted in 8802 patients less than 80 years and 1551 octogenarians who underwent TSA and were included in the study.

2.3. Patient demographics

Patient demographics included age, sex, race (white, black, other), body mass index (BMI), calculated from reported height and weight) categories, including less than 24.9 kg/m^2, 25 to 29.9 kg/m^2, 30 to 34.9 kg/m^2, 35 to 39.9 kg/m^2, and > 40 kg/m^2, smoking status, and functional status. In addition, using the available comorbidity data, a modified Charlson comorbidity score was calculated.[14] The modified Charlson score has been reported to be similar in efficacy when compared with the original Charlson score.[15,16] The following comorbidities were included and were assigned the following point values: chronic obstructive pulmonary disease (1 point), congestive heart failure (1 point), renal failure/end-stage renal disease (2 points), on a ventilator (2 points), ascites (3 points), and cancer (6 points); the scores were categorized as 0, 1, or ≥2.

2.4. Perioperative factors

The perioperative data collected included anesthesia type (general, regional or local, and other), American Society of Anesthesiologists (ASA) scores (categorized as greater than or equal to 3 or less than 3). Additionally, the operative times (in minutes) and the hospital LOS (in days) were extracted from the database.

2.5. Postoperative complications

The 30-day postoperative complications were stratified by any, major, and minor complications, as described by previous studies.[17,18] The major complications included stroke, cardiac arrest, myocardial infarction, pulmonary embolism, unplanned re-intubation, on ventilator for > 48 h, acute renal failure, sepsis, and septic shock. The minor complications included superficial incisional surgical site infection, deep incisional surgical site infection, organ space infection, wound dehiscence, pneumonia, urinary tract infection, deep vein thrombosis, renal insufficiency, and transfusion.

2.6. Data analysis

All statistical analyses were performed with SPSS version 23 (IBM Corporation, Armonk, New York). All tests were two-tailed and a p-value of less than 0.05 was used to determine statistical significance. Descriptive statistics were performed for all study variables. Patient demographics including gender, race, BMI, Charlson scores, smoking history, and functional status, as well as perioperative data, were compared with chi-square and Fisher's exact tests for categorical variables, and student's *t*-test was used for continuous variables. Then, logistic regression was used to calculate the odds ratios (OR) and 95% confidence intervals (95% CI) of any, major, and minor complications that occurred within 30 days postoperatively, while controlling for sex, race, BMI category, and Charlson/Deyo scores.

Table 1
Demographics of total shoulder arthroplasty patients.

Parameters	< 80 years	≥80 years	P-value
Number	8802	1551	n/a
Gender, % (n)			< 0.0001
Female	55 (4800)	66 (1028)	
Male	45 (3998)	34 (521)	
Race, % (n)			< 0.0001
White	85 (7477)	89 (1383)	
Black	5 (406)	2 (32)	
Other/Unknown	10 (919)	9 (136)	
BMI categories (kg/m^2), % (n)			< 0.0001
< 24.9 kg/m^2	15.7 (1381)	27.4 (423)	
25–29.9 kg/m^2	31.3 (2751)	40.9 (632)	
30–34.9 kg/m^2	26.9 (2366)	22.3 (344)	
35–39.9 kg/m^2	14.8 (1299)	6.4 (99)	
> 40 kg/m^2	11.2 (988)	3.1 (48)	
Charlson/Deyo score, % (n)			0.084
0	77.6 (6829)	78.5 (1218)	
1	20.2 (17,770)	20.1 (312)	
≥2	2.2 (196)	1.4 (21)	
Smoker, % (n)	11.8 (1037)	2.4 (37)	< 0.0001
Functional status, % (n)			< 0.0001
Independent	96.6 (8505)	93.7 (1454)	
Partially dependent	2.5 (224)	5.1 (79)	
Totally dependent	0.1 (8)	0.5 (7)	
Unknown	0.7 (65)	0.7 (11)	

BMI = body mass index.

3. Results

3.1. Demographics

The mean age of the octogenarian cohort was 83 years (range, 80–89 years), and for the less than 80 years cohort, the mean age was 67 years (range, 19–79 years). Compared to the less than 80 years cohort, the octogenarians had significantly more females (66 vs. 55%, $p < 0.0001$), were more likely to be white (89 vs. 85%, $p < 0.0001$), had lower BMIs (28.1 vs. 31.4 kg/m^2, $p < 0.0001$), were less likely to smoke (2.4 vs. 11.8%, $p < 0.0001$), and were less likely to be functionally independent (93.7 vs. 96.6%, $p < 0.0001$). Modified Charlson score distributions did not vary significantly between the two cohorts ($p = 0.084$) (Table 1).

3.2. Perioperative factors

Compared to the less than 80 years cohort, octogenarians had higher ASA scores ($p < 0.0001$), shorter operative times (108 vs. 115 min, $p < 0.0001$), and longer LOS (3 vs. 2 days, $p < 0.0001$) (Table 2).

3.3. Postoperative complications

Compared to less than 80 years cohort, octogenarians had a 105% higher risk for any complication (OR = 2.05; 95% CI, 1.70–2.46; $p < 0.0001$), 128% higher risk for any major complication (OR = 2.28; 95% CI, 1.66–3.13; $p < 0.0001$), and a 99% higher risk for any minor complication (OR = 1.99; 95% CI, 1.63–2.45; $p < 0.0001$) (Table 3). For the specific major complications, compared to the less than 80 years cohort, the octogenarians were more likely to be re-intubated (OR = 9.34; 95% CI, 3.56–24.79; $p < 0.0001$), on a ventilator for > 48 h (OR = 11.27; 95% CI, 2.83–44.82; $p = 0.001$), develop a pulmonary embolism (OR = 3.91; 95% CI, 1.87–8.19; $p < 0.0001$), acute renal failure (OR = 15.86; 95% CI, 2.29–109.88; $p = 0.005$), a stroke (OR = 3.95; 95% CI, 1.18–13.25; $p = 0.026$); a myocardial infarction (OR = 4.91; 95% CI, 1.93–12.52; $p = 0.001$), and septic shock (OR = 12.36; 95% CI, 2.29–66.75; $p = 0.003$) (Table 4). Also, for the specific minor complications, compared to the