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Analysis of perioperative complications in patients after total shoulder arthroplasty and reverse total shoulder arthroplasty

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Background: Data directly comparing the perioperative complication rates between total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) are limited.
Methods: The Nationwide Inpatient Sample database, which comprises data from a statistically representative sample of hospitals across the United States, was analyzed for the years 2010 and 2011. The *International Classification of Diseases, Ninth Revision* procedure codes differentiated the patients who received TSA (81.80) and RTSA (81.88). Demographic data, comorbidities, perioperative complications, and hospitalization data were compared.
Results: This retrospective analysis included 19,497 patients, with 14,031 patients in the TSA group and 5466 patients in the RTSA group. Patients who underwent RTSA were older ($P < .001$), were more likely to be female ($P < .001$), and had increased rates of fracture ($P < .001$). The RTSA group had significantly higher perioperative rates of mortality ($P = .004$), pneumonia ($P < .001$), deep venous thrombosis ($P < .001$), myocardial infarction ($P = .005$), urinary tract infection ($P < .001$), and blood transfusions ($P < .001$). In addition, the RTSA patients had longer hospital stays ($P < .001$) and higher hospital charges ($P < .001$). The rates of comorbidities were also higher in the patients who underwent RTSA. After adjustment for these differences in comorbidities and surgical indications with our multivariate analysis, RTSA was still independently associated with increased hospital charges (difference of $11,530; $P < .001$), longer hospitalization (difference of 0.24 day; $P < .001$), more blood transfusions (relative risk, 1.43; $P < .001$) and higher rates of pneumonia (relative risk, 1.61; $P = .04$) and deep venous thrombosis (relative risk, 2.24; $P = .01$).
Conclusion: We found that RTSA patients, compared with TSA patients, had significantly longer length of stay, higher hospital charges that are not completely attributable to increased implant costs alone, and increased rates of perioperative complications.
Level of evidence: Level III, Retrospective Cohort Design, Treatment Study.

Keywords: Reverse total shoulder arthroplasty; total shoulder arthroplasty; perioperative outcome; complication

The study was approved for exempt status by the University of Chicago Biological Sciences Division IRB. The IRB protocol number is IRB13-1065.

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In recent years, studies have demonstrated that shoulder arthroplasties are a reliable option for relieving shoulder pain and improving function in patients for whom nonoperative management for glenohumeral arthritis has failed.[13,17-19] This has led to increased growth rates of upper extremity arthroplasty that are comparable to the growth rates of total hip and knee arthroplasties.[4]

The results of total shoulder arthroplasty (TSA) in patients with an arthritic shoulder and combined rotator cuff insufficiency have been much less satisfactory.[5] Traditionally, a hemiarthroplasty of the shoulder with rotator cuff repair has been used for these patients. However, the results of hemiarthroplasties have not consistently provided adequate pain relief.[10,22] Thus, reverse total shoulder arthroplasty (RTSA) has now become an increasingly popular option for the arthritic and rotator cuff–deficient shoulders. Associated surgical complications have been reported in the literature for both TSA and RTSA as isolated groups. However, to our knowledge, a direct comparison of the immediate perioperative complication rates of RTSA with those of TSA has not been reported. We attempt to investigate the differences in patient characteristics and short-term complications between these 2 groups of patients who underwent a primary shoulder arthroplasty. We hypothesized that the RTSA group would comprise older patients, experience higher hospital costs, and have increased rates of perioperative complications.

Methods

Database

After obtaining approval from our Institutional Review Board, we analyzed the Nationwide Inpatient Sample (NIS) database from 2010 to 2011 for patients who underwent either a primary TSA or RTSA. The NIS, a publically available database that is part of the Healthcare Cost and Utilization Project, comprises data from a statistically representative sample of hospital inpatient admissions across the United States.[14] The recent years of this database consist of perioperative data on approximately 8 million inpatient admissions per year, which represent around 20% of all the hospital admissions in the United States. From the 2 most recent years (2010 and 2011) of inpatient data available, we identified all patients who underwent TSA as classified by the *International Classification of Diseases, Ninth Revision* (ICD-9) procedure code 81.80. We similarly identified all patients who underwent RTSA as classified by ICD-9 procedure code 81.88. The 2010 year of the NIS database represents the first year that a separate ICD-9 procedure code was used to differentiate RTSA from TSA. We excluded patients with ICD-9 diagnosis codes for revision arthroplasty, pathologic fracture, metastatic disease, and infection of the shoulder. We then compared demographic data, comorbidities, and perioperative complications and outcomes between the group of patients who underwent TSA and the group who underwent RTSA. The medical comorbidities that were documented in the database were directly extracted, whereas perioperative complications were determined through ICD-9 diagnosis codes recorded for the associated inpatient admission.

Demographic data

Demographic data that were available for review from the NIS database include age, gender, race, median household income (based on zip code of home address), primary payer source, hospital bed size, and teaching status of the hospital. A comparison of these demographic variables was performed between the TSA and RTSA groups.

Comorbidities

The prevalence of different comorbidities in the 2 groups of patients was also compared. Specifically, we compared observed rates of alcoholism, chronic anemia, congestive heart failure, chronic pulmonary disease, coagulopathy, depression, drug abuse, hypertension, hypothyroidism, liver disease, neurologic disorders, obesity, peripheral vascular disease, and chronic renal failure.

Indications for surgery and main outcome measures

We compared the percentage of patients who underwent surgery for osteoarthritis, rheumatoid arthritis, osteonecrosis, rotator cuff tear without arthritis, and fracture (or sequelae of fracture) between our patients who underwent TSA with those who underwent RTSA. The main perioperative medical complications that were compared included rates of pneumonia, deep venous thrombosis (DVT), pulmonary embolism, acute mental status changes, cerebrovascular accident, myocardial infarction, ileus, urinary tract infection, and death. Complications associated with surgery that were analyzed included percentage of patients diagnosed with postoperative hematoma, rates of blood transfusion, and proportion of patients requiring irrigation and débridement during their surgical admission. Other hospital-related outcome measures that we evaluated included length of stay, total hospitalization charges, and proportion of patients who were discharged to home (with or without home health care). Hospitalization costs associated with the 2010 hospitalizations were adjusted for inflation on the basis of the consumer price index with the 2011 year as the reference year.

Statistical analysis

Demographics, comorbidities, and complications and outcomes data were compared between the patients who underwent TSA and the patients who underwent RTSA by two sample independent t-test for all continuous variables and χ^2 tests for all categorical data. We wanted to have a higher sensitivity in identifying other potential risk factors associated with higher rates of complications. Thus, the differences of any preoperative variable with a P value $< .10$ in the univariate analyses between the RTSA and TSA groups were subsequently incorporated into a multivariate logistic regression analysis to adjust for potential confounders. The TSA group was used as the reference group in the multivariate analysis. A P value of .05 or less was considered to be a statistically significant difference. All calculations were performed with the SPSS version 17 software package (Chicago, IL, USA).