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Shoulder arthroplasty in the US Medicare population: a 1-year evaluation of surgical complications, hospital admissions, and revision surgery

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Background: The objective of this study was to describe patients receiving each shoulder arthroplasty procedure and to assess surgical complications, hospital admissions for surgical complications, and surgical revisions among Medicare beneficiaries undergoing shoulder arthroplasty.

Methods: Medicare patients receiving shoulder arthroplasty in the United States in 2011 were identified from Medicare administrative data and classified by surgery type: shoulder hemiarthroplasty (HA), anatomic total shoulder arthroplasty (TSA), or reverse shoulder arthroplasty (RSA). Surgical complications, hospital admissions, and revisions were identified during the year after the index arthroplasty procedure.

Results: There were 24,441 patients who met all inclusion criteria, and of those, 20.0% received HA, 42.5% received TSA, and 37.4% received RSA. Compared with RSA and TSA recipients, HA recipients tended to be older and sicker and were more likely to be Medicaid eligible. The rate of new surgical complications and related hospital admissions was greatest during the first 50 days after surgery but remained significant and stable throughout the remainder of the year. Rates of complications and related hospital admissions were greatest for HA recipients (17.4% and 6.6%, respectively), followed by RSA (14.2% and 5.1%) and TSA (9.4% and 4.0%).

Conclusions: The rate of adverse surgical outcomes after shoulder arthroplasty differed across populations that received HA, TSA, and RSA and across patients within each group by comorbidity burden. The finding that the rate of surgical complications and related hospital admissions remained meaningful during the entire year after surgery suggests that a postoperative follow-up period longer than the traditional 90 days may be warranted.

The use of shoulder arthroplasty in the United States is projected to continue to increase.[11-13,15,22,34] This trend is due in part to the aging population and the success of shoulder arthroplasty in minimizing pain and restoring shoulder function for patients with shoulder pain.[21] Traditionally, 2 shoulder arthroplasty procedures were used to treat patients with shoulder disability, the hemiarthroplasty (HA) and anatomic total shoulder arthroplasty (TSA) procedures. Since 2003, the reverse shoulder arthroplasty (RSA) has emerged as a third surgical option for patients with complex shoulder disease, further driving the increase in shoulder arthroplasty rates.[22,27] Originally intended and approved for the treatment of rotator cuff arthropathy, the indications for RSA have rapidly expanded to include treatment for massive irreparable rotator cuff tears (RCTs), arthroplasty revision, acute and delayed proximal humeral fractures,[10] and rheumatoid arthritis.[16,27]

The recent addition of a unique *International Classification of Diseases, Ninth Edition, Clinical Modification* (ICD-9-CM) procedure code in 2011 created the opportunity to distinguish RSA from TSA. Before this, there had been limited ability to evaluate surgical complications among HA, TSA, and RSA procedures in large claims databases. Surgical complications, ranging from minor to major complications that require reoperation, have been reported to vary widely across HA, TSA, and RSA.[9,29] However, most studies have been conducted within a single clinic or within select samples in local areas that may not reflect larger populations.[2,12,14,17,19,23,27-29,33,36,37]

The University of South Carolina Institutional Review Board approved this study: research proposal Pro00039050.

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Furthermore, previous studies were limited to only inpatient hospital data or 90-day postoperative follow-up, which may be inadequate to measure a broader array of complications. A recent publication from the Kaiser Permanente Shoulder Arthroplasty Registry assessed adverse outcomes after 4 shoulder arthroplasty procedures among Kaiser Permanente patients in California; however, study outcomes were limited to only 3 medical complications, revisions, and death.[14] Our study is the first to observe a large, national sample of Medicare shoulder arthroplasty patients during the year after surgery with a focus on surgical complications. In addition, no other work to date has described and compared the rates of surgical complications, hospital admissions, and revisions for each shoulder arthroplasty procedure in the Medicare population.

Therefore, the objective of this study was to describe the patients receiving each shoulder procedure and to assess surgical complications, hospital admission for surgical complications, and surgical revisions among all Medicare beneficiaries during the year after surgery. In addition, it is well known that medical comorbidities influence the outcomes of all forms of shoulder arthroplasty[1,4,5,18,26]; therefore, we also analyzed the association between baseline comorbidity burden and complication rates. Our study includes an evaluation of all Medicare administrative data providing information on all health care received in the year after HA, TSA, and RSA procedures. These results will define the difference in characteristics of patients receiving each procedure, the adverse outcomes associated with each operation, and the role of comorbidity burden on complications after surgery.

Materials and methods

This study used complete Medicare administrative claims data from the years 2010-2012 for all Medicare beneficiaries diagnosed with a shoulder condition in 2011 (N = 2,525,519). Medicare is the US federal health insurance program for Americans who are 65 years of age or older and provides health coverage to >49 million Americans, or 15% of the US population.[24] Most beneficiaries receive coverage because of age eligibility, although one-sixth of the Medicare population receives benefits because of disability status, such as end-stage renal failure.[35] Medicare administrative data include extensive information about individual Medicare beneficiaries enrolled in traditional fee-for-service Medicare as well as claims for health care services provided to them and submitted to Medicare on their behalf. The use of comprehensive Medicare administrative data enabled patient health care utilization to be tracked across inpatient and outpatient providers.

From these data, individual patients with any record of receiving a HA, TSA, or RSA procedure in 2011 were identified using Medicare Part A inpatient claims. The index date of shoulder arthroplasty was defined for each beneficiary as the date of first shoulder arthroplasty in 2011. Additional inclusion criteria were applied to ensure complete data included the following: continuous enrollment in fee-for-service Medicare Part A and Part B from 365 days before to 365 days after the index arthroplasty and no enrollment in Medicare Part C during the study period; aged 66 years on the surgery date; and survival for the 365 days after the index arthroplasty. The minimum age criterion of 66 years was used to ensure enrollment in the Medicare system for a year before the index surgery. As this study is focusing on surgical complications for new shoulder arthroplasty, patients with a shoulder arthroplasty or upper extremity joint arthroplasty revision in the 365 days before their index arthroplasty in 2011 or a diagnosis of a mechanical complication of an internal orthopedic device implant or graft on their index shoulder arthroplasty were excluded from the study. Patients with >1 type of arthroplasty procedure indicated on the index surgery date were also excluded. The complete sample inclusion process with sample size is provided in the Appendix.

The type of arthroplasty procedure that patients received was identified using ICD-9-CM procedure codes listed on inpatient hospital records and included HA (81.81), TSA (81.80), and RSA (81.88). Inpatient hospital records and ICD-9-CM diagnosis codes were used to assess surgical indications for shoulder arthroplasty. All diagnosis positions on the index inpatient hospital record for surgery were used. Shoulder-related diagnoses were categorized into 5 groups based on a diagnosis algorithm and included osteoarthritis, fracture/dislocation, arthropathy with RCT, rheumatoid arthritis, and aseptic necrosis.[12]

In the year after the index shoulder arthroplasty, all claims with at least 1 diagnosis of a surgical complication or arthroplasty revision were identified. For each patient, we calculated the days from 1 day after hospital admission for the index shoulder arthroplasty to the identified complication. Using this information, short-term and 1-year postsurgical complications, hospital admissions for a surgical complication, and revisions rates were measured cumulatively and presented for the periods of 30, 60, 90, 180, and 365 days after the admission date for arthroplasty. Surgical complication groups of interest were determined by published guidance[29] and clinical input from clinical research collaborators, which included the following:

1. Postoperative infection or infection and inflammatory reaction due to internal prosthetic device implant and graft
2. Fracture of scapula
3. Mechanical complication of internal orthopedic device or other complications due to internal prosthetic device (unspecified mechanical complication of an internal orthopedic device, dislocation of prosthetic joint, mechanical loosening of prosthetic joint, mechanical loosening of prosthetic joint, broken prosthetic joint implant, periprosthetic fracture around prosthetic joint, periprosthetic osteolysis, articular bearing surface wear of prosthetic joint, and other complications due to other internal orthopedic or prosthetic device, implant, and graft)
4. Nerve injury or injury to peripheral nerves of shoulder girdle and upper limb
5. Hematoma
6. Instability and dislocation

Hospital admission for a surgical complication was defined as an inpatient hospital record with a diagnosis of 1 of the aforementioned surgical complications or a complication requiring revision. Revision surgery was defined as a Medicare claim with a Healthcare Common Procedure Coding System or ICD-9-CM procedure code for upper extremity joint arthroplasty revision or removal of implant. All details regarding specific codes and algorithms used to define study concepts are available in the Appendix.

Demographic characteristics of the patients were measured by cross-referencing the 2011 Beneficiary Summary Files from Medicare. Specific patient-level variables included age, sex, race, and dual eligibility status. Previous shoulder-related health care utilization was used to describe the shoulder health of the arthroplasty population among procedure types. Shoulder-related utilization in the year before the index shoulder arthroplasty was analyzed using all Medicare administrative claims from the 365 days before the index shoulder arthroplasty in 2011. Measured shoulder-related utilization included arthroscopy, open reduction–internal fixation, and rotator cuff repair. General patient health at index surgery was measured using the Charlson Comorbidity Index (CCI). The CCI is a validated measure of burden of disease.[6,7,25] Comorbidities are weighted from 1 to 6 for mortality risk and disease severity and then summed to form the total CCI score.[6,7,25] Complication rates were stratified by CCI scores to analyze the association between baseline comorbidity burden and surgical complications after shoulder arthroplasty. Rates of complications, admission for a surgical com-

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