J Shoulder Elbow Surg (2016) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Comorbidity effects on shoulder arthroplasty costs analysis of a nationwide private payer insurance data set

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Background: The purpose of this study was to evaluate the effect of common medical comorbidities on the reimbursements of different shoulder arthroplasty procedures.
Methods: We conducted a retrospective query of a single private payer insurance claims database using PearlDiver (Warsaw, IN, USA) from 2010 to 2014. Our search included the *Current Procedural Terminology* codes and *International Classification of Diseases, Ninth Revision* codes for total shoulder arthroplasty (TSA), hemiarthroplasty, and reverse shoulder arthroplasty (RSA). Medical comorbidities were also searched for through *International Classification of Diseases* codes. The comorbidities selected for analysis were obesity, morbid obesity, hypertension, smoking, diabetes mellitus, hyperlipidemia, atrial fibrillation, chronic obstructive pulmonary disease, cirrhosis, depression, and chronic kidney disease (excluding end-stage renal disease). The reimbursement charges of the day of surgery, 90-day global period, and 90-day period excluding the initial surgical day of each comorbidity were analyzed and compared. Statistical analysis was conducted through analyses of variance or Kruskal-Wallis test.
Results: Comorbidities did not have a significant effect on same-day reimbursements but instead caused a significant effect on the subsequent 89-day (interval) and 90-day reimbursements in the TSA and RSA cohorts. For TSA and RSA, the highest reimbursement costs during the 90-day period after surgery were seen with the diagnosis of hepatitis C, followed by atrial fibrillation and later chronic obstructive pulmonary disease. For hemiarthroplasty, the same was true in the following order: hepatitis C, cirrhosis, and atrial fibrillation.
Conclusion: Shoulder arthroplasty reimbursements are significantly affected by comorbidities at time intervals following the initial surgical day.
Level of evidence: Level IV; Large Database Analysis; Economics Study

Keywords: Shoulder arthroplasty; reverse shoulder arthroplasty; economic analysis; total; reverse; hemiarthroplasty

Institutional Review Board approval was not required as this was a retrospective review of a large database without the use of private patient information.

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Shoulder arthroplasty is a commonly performed procedure in the United States, and recent studies have demonstrated that this trend is still on the rise.[13,17-20] Reasons for this increase include broader indication for use in fracture care,[9] growing number of patients with degenerative joint disease,[8]

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http://dx.doi.org/10.1016/j.jse.2016.11.044

and confidence in the satisfactory outcomes that these procedures achieve.[16]

With the recent emphasis on value-based care, greater attention is being directed to understanding the costs associated with surgery as well as the drivers of those costs.[2] It has been repeatedly demonstrated that medical comorbidities influence the outcomes of all forms of shoulder arthroplasty: total shoulder arthroplasty (TSA), hemiarthroplasty (HA), and reverse shoulder arthroplasty (RSA).[1-3] The increased costs associated with various comorbidities, however, are not well understood. There is thus a need for clinicians to better understand the economic aspects of a patient's comorbidities and the effects on the cost of care. The purpose of this study was to examine the effect of common medical comorbidities on the initial-day, subsequent 89-day interval period, and 90-day reimbursement costs of shoulder arthroplasty procedures.

Materials and methods

We conducted a retrospective review of the Humana private payers insurance database claims through the PearlDiver supercomputer (Warsaw, IN, USA). All patients undergoing shoulder arthroplasty between 2010 and 2014 were identified by *Current Procedural Terminology* codes and stratified according to arthroplasty type into TSA, HA, and RSA groups. *International Classification of Diseases, Ninth Revision* and *Current Procedural Terminology* codes were used to identify medical comorbidities, including obesity, morbid obesity, hypertension, smoker status, diabetes mellitus, hyperlipidemia, atrial fibrillation, chronic obstructive pulmonary disease (COPD), cirrhosis, hepatitis C, depression, and chronic kidney disease (excluding end-stage renal disease) within the cohort (Table I). Costs were determined on the basis of reimbursement data from the insurance company to the payees, which includes and is not limited to costs of hospitalization, surgical procedure, physical therapy, diagnostic tests, and other charges that the patient might have incurred throughout the 90-day period. Reimbursements have been previously used as markers of costs in cost analysis studies and provide readers the opportunity to observe how payees are currently being reimbursed.[12] By analyzing reimbursements, surgeons, hospitals, and policy makers can observe what payers are actually compensating for in the care provided rather than an inflated estimate of cost elicited by charges. Use of reimbursement as a proxy for cost defines the financial burden to the payer. The same-day, the 89-day interval period, and the 90-day reimbursement costs of each procedure were evaluated on the basis of claims reported from 2010 to 2014.

The Charlson Comorbidity Index (CCI)[10] was extracted from the database and calculated for patients stratified by comorbidity and arthroplasty type, as previously described.[22] The CCI was calculated on the day of surgery as well as 90 days after the procedure. Correlations with same-day and 90-day reimbursement costs were evaluated.

Statistics

To compare differences in reimbursement cost between procedure type and comorbidity, analysis of variance for normally distributed data or Kruskal-Wallis comparison for non-normally distributed data was used. Annual mean reimbursements were used for this analysis. Correlations were performed with the use of linear correlations on SPSS version 20 (IBM, Armonk, NY, USA), and an α value of $< .05$ was considered statistically significant.

Results

Between 2010 and 2014, a total of 23,879 patients were identified. This included 13,622 TSA, 5668 RSA, and 4589 HA patients.

Total shoulder arthroplasty

Among patients undergoing TSA, the average initial-day reimbursement cost was $13,233 (standard deviation [SD], $728; range, $12,153-16,405) and did not vary significantly among patients with various comorbidities (Kruskal-Wallis, $P = .698$) (Table II).

Table I *International Classification of Diseases* codes used for data extraction

Entity	Code
Total shoulder arthroplasty	ICD-9 81.80, CPT 23472
Reverse shoulder arthroplasty	ICD-9 81.88
Hemiarthroplasty	ICD-9 81.81, CPT 23470
Hepatitis C	ICD-9 07051, 07054, 07070
Obesity	ICD-9 27800
Morbid obesity	ICD-9 27801
Hypertension	ICD-9 4019, 7962
Smoking	ICD-9 3051
Diabetes mellitus	ICD-9 25000, 25001, 25002, 25003
Hyperlipidemia	ICD-9 2720, 2722, 2729, 2721
Atrial fibrillation	ICD-9 42731
Chronic obstructive pulmonary disease	ICD-9 4910, 4911, 49120, 49121, 49122
Cirrhosis	ICD-9 5712, 5715, 5718
Depression	ICD-9 2962, 2963, 311
Chronic kidney disease (excluding end-stage renal disease)	ICD-9 D-5851, 5852, 5853, 5854, 5855, 5859

ICD-9, International Classification of Diseases, Ninth Revision; CPT, Current Procedural Terminology.