Reasons for Readmission Following Primary Total Shoulder Arthroplasty

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Take-Home Points

- Shoulder arthroplasty is an increasingly commonly performed procedure for shoulder arthritis and other conditions.
- Unplanned readmission in the 30 days after shoulder arthroplasty occurred in about 1 of 40 cases.
- Increasing age was associated with readmission, particularly age >80 years.
- Other risk factors for readmission were male sex, anemia, and dependent functional status.
- The most common reasons for readmission were pneumonia, dislocation, pulmonary embolism, and surgical site infection.

Total shoulder arthroplasty (TSA) is performed with increasing frequency in the United States and is considered to be cost-effective.[1-4] Following the procedure, patients generally achieve shoulder function and pain relief.[5-8] Despite the success of the procedure, the growing literature on TSA has also reported rates of complications between 3.6% and 25% of the treated patients.[9-16]

In recent years, an increasing interest has focused on the rates and risk factors for unplanned hospital readmissions; these variables may not only reflect the quality of patient care but also result in considerable costs to the healthcare system. For instance, among Medicare patients, readmissions within 30 days of discharge occur in almost 20% of cases, costing $17.4 billion per year.[17] Readmission rates increasingly factor into hospital performance metrics and reimbursement, including the Hospital Readmissions Reduction Program of the Patient Protection and Affordable Care Act that reduces Centers for Medicare and Medicaid Services payments to hospitals with high 30-day readmission rates.[18]

To date, only a few studies have evaluated readmission following TSA, with 30- to 90-day readmission rates ranging from 4.5% to 7.3%.[19-23] These studies comprised single institution series[20,22] and analyses of administrative databases.[19,21,23] Most studies have shown that readmission occurs more often for medical than surgical reasons, with surgical reasons most commonly including infection and dislocation.[19-23] However, only limited analyses have been conducted regarding risk factors for readmission.[21,23] To date and to our knowledge, no study has investigated reasons for readmission following TSA using nationwide data.

This study aims to determine the rates, risk factors, and reasons for hospital readmission following primary TSA in the United States using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database.

Methods

Data Source

The NSQIP database was utilized to address the study purpose. NSQIP is a nationwide prospective surgical registry established by the American College of Surgeons and reports data from academic and community hospitals across the United States.[24] Patients undertaking surgery at these centers are followed by the surgical clinical reviewers at the participating NSQIP sites prospectively for 30 days following the procedure to record complications including readmission. Preoperative and surgical data, such as demographics, medical comorbid diseases, and operative time, are also included. Previous studies have analyzed the complications of various orthopedic surgeries using the NSQIP data.[14,16,25-30]

Data Collection

We retrospectively identified from NSQIP the patients who underwent primary TSA (anatomic or reverse) in 2013 to 2014. The timeframe 2013 to 2014 was used because NSQIP only began recording reasons for readmission in 2013. The inclusion criteria were as follows: *Current Procedural Terminology* (*CPT*) code for TSA (23472); preoperative diagnosis according to the *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes 714.0, 715.11, 715.31, 715.91, 715.21, 715.89, 716.xx 718.xx, 719.xx, 726.x, 727.xx, and 733.41 (where x is a wild card digit); and no missing demographic, comorbidity, or outcome data. Anatomic and reverse TSA were analyzed together because they share the same *CPT* code, and the NSQIP database prevents searching by the *ICD-9* procedure code.

The rate of unplanned readmission to the hospital within 30 postoperative days was characterized. The reasons for readmission in this 30-day period were only available in 2013 and were determined using the *ICD-9* diagnosis codes. Patient demographics were recorded for use in identifying potential risk factors for readmission; the demographic data included sex, age, smoking status, body mass index (BMI), and comorbidities, including end-

stage renal disease, dyspnea on exertion, congestive heart failure, diabetes mellitus, hypertension, and chronic obstructive pulmonary disease (COPD).

Statistical Analysis

Statistical analyses were performed using Stata version 13.1 (StataCorp). First, using bivariate and multivariate regression, demographic and comorbidity factors were tested for independent association with readmission to the hospital within 30 days of surgery. Second, among the readmitted patients, the reasons for readmission were tabulated. Of note, the reasons for readmission were only documented for the procedures performed in 2013. All tests were 2-tailed and conducted at an α level of 0.05.

Results

A total of 3627 TSA patients were identified. The mean age (± standard deviation) was 69.4 ± 9.5 years, 55.8% of patients were female, and mean BMI was 30.1 ± 7.0 years. **Table 1** provides the additional demographic data. Of the 3627 included patients, 93 (2.56%) were readmitted within 30 days of surgery. The 95% confidence interval for the estimated rate of readmission reached 2.05% to 3.08%.

In the bivariate analyses (**Table 2**), the following factors were positively associated readmission: older age (60-69 years, relative risk [RR] = 1.6; 70-79 years, RR = 2.2; ≥80 years, RR = 3.3; *P* = .011), dependent functional status (RR = 2.9, *P* = .008), and anemia (RR = 2.2, *P* < .001).

In the multivariate analyses (**Table 3**), the following factors were independent risk factors for readmission: older age (60-69 years, RR = 1.6; 70-79 years, RR = 2.3; ≥80 years, RR = 3.1; *P* =.027), male sex (RR = 1.6, *P* = .025), anemia (RR = 1.9, *P* = .005), and dependent functional status (RR = 2.8, *P* = .012). Interestingly, readmission showed no independent association with diabetes, dyspnea on exertion, BMI, COPD, hypertension, or current smoking status (*P* > .05 for each).

The reasons for readmission were available for 84 of the 93 readmitted patients. The most common reasons for readmission included pneumonia (14 cases, 16.7%), dislocation (7 cases, 8.3%), pulmonary embolism (7 cases, 8.3%), and surgical site infection (6 cases, 7.1%) (**Table 4**).

Discussion

Our analysis of 3042 TSAs from the NSQIP database suggests that unplanned readmission to the hospital occurs following about 1 in 40 cases of TSA. The study also suggests that the most common reasons for readmission encompass pneumonia, dislocation, pulmonary embolism, and surgical site infection. Old age, male sex, anemia, and dependent functional status serve as risk factors for readmission, and patients with such factors should be counseled and monitored accordingly.

In recent years, an increasing emphasis has centered on reducing rates of hospital readmission, with programs such as the Hospital Readmissions Reduction Program of the Affordable Care Act cutting reimbursements for hospitals with high 30-day readmission rates.[17,18] To date, only a few studies have evaluated the reasons for readmission and readmission rates for TSA.[19-23] Initial reports consisted of single-institution TSA registry reviews. For example, Mahoney and colleagues[20] retrospectively evaluated shoulder arthroplasty procedures at their institution to document the readmission rates, finding a 5.9% readmission rate at 30 days. Readmission occurred

more frequently in the first 30 days following discharge than in the 30- to 90-day period, with the most common reasons for readmission including medical complications, infection, and dislocation. Streubel and colleagues[22] evaluated reoperation rates from their institution's TSA registry, finding a 0.6% reoperation rate for primary TSA at 30 days and 1.5% for revision TSA. Instability and infection were the most common indications for reoperation. Our findings confirm these single-institution results and demonstrate their application to a nationwide sample of TSA, not just to high-volume academic centers. We similarly observed that dislocation, surgical site infection, and medical complications (mostly pneumonia and pulmonary embolism) were common causes of readmission, and that the 30-day readmission rate was about 1 in 40.

Several authors have since used statewide databases to analyze and determine risk factors for readmission following TSA. Lyman and colleagues[19] used the New York State Database to show that higher hospital TSA surgical volume was associated with a lower rate of readmission when age and comorbidities were controlled for in a multivariate model. Old age was also associated with an increased readmission rate in their multivariate analysis, but comorbidities (as measured by the Charlson comorbidity index) presented a nonsignificant associative trend. These authors opted not to determine specific causes of readmission. Schairer and colleagues[21] used State Inpatient Databases from 7 states, finding a 90-day readmission rate of 7.3%, 82% of which were due to medical complications and 18% of which were due to surgical complications (mostly infection and dislocation). Their multivariate regression revealed that male sex, reverse TSA, Medicaid insurance, patients discharged to inpatient rehabilitation or nursing facilities, medical comorbidities, and low-volume TSA hospitals were associated with readmission. Zhang and colleagues[23] used the same source to show that the 90-day readmission rate reached 14% for surgically treated proximal humerus fractures and higher for patients who underwent open reduction internal fixation, were female, were African American, were discharged to a nursing facility, possessed Medicaid insurance, or experienced medical comorbidities. Most recently, Basques and colleagues[31] analyzed 1505 TSA cases from 2011 and 2012 in the NSQIP database, finding a 3.3% rate of readmission, with heart disease and hypertension as risk factors for readmission. Although the limitations of the NSQIP database prevented us from analyzing surgeon and hospital TSA volume or reverse vs anatomic TSA, our results confirm that the findings from statewide database studies apply to the United States nationwide NSQIP database. Old patient age, male sex, and medical comorbidities (anemia and dependent functional status) are independent risk factors for TSA readmission. We identified pneumonia, dislocation, pulmonary embolism, and surgical site infection as the most common reasons for readmission.

This study features several limitations that should be considered when interpreting the results. Anatomic and reverse TSA share a *CPT* code and were not separated using NSQIP data. A number of studies have reported that reverse TSA may place patients at higher risk for readmission;[20,21] however, confounding by other patient factors could play a role in this finding. The 30-day timeframe for readmission is another potential limitation; however, this timeframe is frequently used in other studies and is the relevant timeframe for the reduced reimbursement penalties from the Hospital Readmissions Reduction Program of the Affordable Care Act.[18] Furthermore, the NSQIP database contains no information on surgeon or hospital TSA volume, which is a result of safeguards for patient and provider privacy. Additionally, readmission data were only available for 2011 to 2013, with causes of readmission only present in 2013. Although provided with such current information, we cannot analyze readmission trends over time, such as in response to the Affordable Care Act of 2010. Finally, although NSQIP surgical clinical reviewers strive to identify readmissions to other hospitals during their reviews of outpatient medical records, proportions of these readmissions are possibly missed. Therefore, our 30-day readmission rate may slightly underestimate the true rate.

Despite these limitations, the NSQIP database offers a unique opportunity to examine risk factors and reasons for readmission following TSA. The prior literature on readmission following TSA stemmed either from limited samples or administrative data, which feature known limitations.[32] By utilizing a large, prospective, non-

administrative, nationwide sample, our findings are probably both more reliable and generalizable to the country as a whole.

Conclusion

Unplanned readmission occurs following about 1 in 40 cases of TSA. The most common causes of readmission include pneumonia, dislocation, pulmonary embolism, and surgical site infection. Patients with old age, male sex, anemia, and dependent functional status are at a higher risk for readmission and should be counseled and monitored accordingly.

This paper will be judged for the Resident Writer's Award.

Key Info

Figures/Tables

Figures / Tables:

Table 1. Patient Population

	Number	Percent
Total	3627	100.0%
Age		
18-59	539	14.9%
60-69	1235	34.1%
70-79	1317	36.3%
≥80	536	14.8%
Sex		
Male	1603	44.2%
Female	2024	55.8%
Body mass index		
Normal (<25 kg/m^2)	650	17.9%
Overweight (25-30 kg/m^2)	1147	31.6%
Obese (≥30 kg/m^2)	1830	50.5%
Functional status		
Independent	3544	97.7%
Dependent	83	2.3%
Diabetes mellitus		
No	3022	83.3%
Yes	605	16.7%
Dyspnea on exertion		

No	3393	93.6%	
Yes	234	6.5%	
Hypertension			
No	1192	32.9%	
Yes	2435	67.1%	
COPD			
No	3384	93.3%	
Yes	243	6.7%	
Current smoker			
No	3249	89.6%	
Yes	378	10.4%	
Anemia			
No	3051	84.1%	
Yes	576	15.9%	

Abbreviation: COPD, chronic obstructive pulmonary disease.

Table 2. Bivariate Analysis of Risk Factors for Readmission

	Rate	RR	95% CI	P-value
Age				0.011
18-59	1.30%	Ref.	-	
60-69	2.02%	1.6	0.7-3.6	
70-79	2.89%	2.2	1.0-4.9	
≥80	4.29%	3.3	1.4-7.6	
Sex				0.099
Female	2.17%	Ref.	-	
Male	3.06%	1.4	0.9-2.1	
Body mass index				0.764
Normal (<25 kg/m^2)	2.92%	Ref.	-	
Overweight (25-30 kg/m^2)	2.35%	0.8	0.5-1.4	
Obese (≥30 kg/m^2)	2.57%	0.9	0.5-1.5	
Functional status				0.008
Independent	2.45%	Ref.	-	
Dependent	7.23%	2.9	1.3-6.5	
Diabetes mellitus				0.483
No	2.48%	Ref.	-	
Yes	2.98%	1.2	0.7-2.0	
Dyspnea on exertion				0.393
No	2.51%	Ref.	-	
Yes	3.42%	1.4	0.7-2.8	
Hypertension				0.145
No	2.01%	Ref.	-	
Yes	2.83%	1.4	0.9-2.2	
COPD				0.457
No	2.51%	Ref.	-	
Yes	3.29%	1.3	0.6-2.7	

Current smoker				0.116
No	2.71%	Ref.	-	
Yes	1.32%	0.5	0.2-1.2	
Anemia				<0.001
No	2.16%	Ref.	-	
Yes	4.69%	2.2	1.4-3.4	

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; RR, relative risk.

Table 3. Independent Risk Factors for Readmission on Multivariate Analysis

	Rate	RR	95% CI	*P*-value
Age				0.027
18-59	1.30%	Ref	-	
60-69	2.02%	1.6	0.7-3.6	
70-79	2.89%	2.3	1.0-5.1	
≥80	4.29%	3.1	1.3-7.4	
Sex				0.025
Female	2.17%	Ref.	-	
Male	3.06%	1.6	1.1-2.4	
Anemia				0.005
No	2.16%	Ref	-	
Yes	4.69%	1.9	1.2-3.0	
Functional status				0.012
Independent	2.45%	Ref	-	
Dependent	7.23%	2.8	1.3-6.2	

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; RR, relative risk.

Table 4. Reasons for Readmission

	Number	Percent
Pneumonia	14	16.7%
Dislocation	7	8.3%
Pulmonary embolism	7	8.3%
Surgical site infection	6	7.1%
Atrial fibrillation	4	4.8%
Hematoma	4	4.8%
Altered mental status	3	3.6%
Chest pain	3	3.6%
Renal insufficiency/kidney failure	3	3.6%
Urinary tract infection	3	3.6%
Acute gastric or duodenal ulcer	2	2.4%
Dermatitis/other allergic reaction	2	2.4%
Orthostatic hypotension/syncope	2	2.4%
Pain	2	2.4%
Respiratory distress	2	2.4%
Sepsis	2	2.4%

Urinary retention	2	2.4%
Acute cholecystitis	1	1.2%
Cerebrovascular accident	1	1.2%
Constipation	1	1.2%
Contusion of shoulder	1	1.2%
Deep venous thrombosis requiring therapy	1	1.2%
Gastrointestinal hemorrhage	1	1.2%
Gout	1	1.2%
Hepatic encephalopathy	1	1.2%
Intestinal infection	1	1.2%
Narcotic overdose	1	1.2%
Nausea/vomiting	1	1.2%
Proximal humerus fracture	1	1.2%
Rotator cuff tear	1	1.2%
Seroma	1	1.2%
Unspecified disease of pericardium	1	1.2%
Weakness	1	1.2%

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Multimedia

Product Guide

Product Guide

- STRATAFIX™ Symmetric PDS™ Plus Knotless Tissue Control Device
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- BioComposite SwiveLock C, with White/Black TigerTape™ Loop

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