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Investigating immediate postoperative medical complication risks relative to in-hospital length of stay after total shoulder arthroplasty

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Background: The purpose of this study was to investigate the association between in-hospital length of stay (LOS) and postoperative complication rates within 30 days of total shoulder arthroplasty (TSA).
Methods: All patients who underwent either anatomic or reverse TSA between 2015 and 2019 were queried from the American College of Surgeons National Surgical Quality Improvement database. The study population was stratified into three cohorts as follows: LOS 0 (same-day discharge), LOS 1 (next-day discharge), and LOS 2–3 (LOS of 2-3 days). Patient demographics and comorbidities were compared between cohorts using bivariate analysis. Multivariate logistic regression analysis was conducted to investigate the relationship between LOS and postoperative complications.
Results: In comparison to the LOS 0 day cohort, LOS 2–3 day cohort had a greater likelihood of developing overall complication (OR, 2.598; $P < .001$), major complication (OR, 1.885; $P < .001$), minor complication (OR: 3.939; $P < .001$), respiratory complication (OR: 12.979; $P = .011$), postoperative anemia requiring transfusion (OR, 23.338; $P < .001$), non-home discharge (OR, 10.430; $P < .001$), and hospital readmission (OR, 1.700; $P = .012$). Similarly, in comparison to the LOS 1 cohort, LOS 2-3 cohort had a greater likelihood of developing overall complication (OR: 2.111; $P < .001$), major complication (OR, 1.423; $P < .001$), minor complication (OR, 3.626; $P < .001$), respiratory complication (OR, 2.057; $P < .001$), sepsis or septic shock (OR: 2.795; $P = .008$), urinary tract infection (OR, 1.524; $P = .031$), postoperative anemia requiring transfusion (OR, 10.792; $P < .001$), non-home discharge (OR: 10.179; $P < .001$), hospital readmission (OR, 1.395; $P < .001$), and return to the operating room (OR. 1.394; $P = .014$). There was no significant difference in the risk of developing postoperative complications between LOS 0 day and LOS 1 day cohort. On baseline, the LOS 1 and LOS 2-3 day cohort had a higher proportion of patients with the following demographics and comorbidities compared to LOS 0 day cohort: advanced age, higher body mass index, female gender, positive smoking status, insulin-dependent diabetes, noninsulin-dependent diabetes, dyspnea at rest and moderate exertion, partially dependent functional status, an American Society of Anesthesiologists classification of 3 or higher, a history of severe chronic obstructive pulmonary disease, a history of congestive heart failure, the use of hypertension medication, disseminated cancer, wound infection, the use of steroids, and a history of bleeding disorder.
Conclusion: Patients who were discharged on the same and next day following TSA demonstrated a reduced probability of experiencing respiratory complications, infections, postoperative anemia requiring transfusion, non-home discharge, and readmission in comparison to those with a LOS of 2-3 days. There was no difference in postoperative complications between same and nextday discharged patients. Patients who underwent outpatient arthroplasty were healthier at baseline compared to those who underwent inpatient arthroplasty.

Total shoulder arthroplasty (TSA) has become an increasingly popular and effective treatment for degenerative shoulder conditions. Over 66,000 patients underwent TSA in the United States in 2011 alone.[30] TSA volume more than doubled between 2005 and 2013.[8] The growing prevalence of shoulder pathology and the

Institutional review board approval was not required for this study.

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expanding indications for surgery suggest that the utilization of TSA will continue to increase in the future.[5] There have been continual improvements in surgical techniques and implant design. Moreover, the implantation of aggressive perioperative management protocols has led to shorter postoperative hospital length of stay (LOS).[2]

Shortening postoperative LOS can enhance patient satisfaction and reduce health care costs.[9,23] While the costs associated with TSA are typically lower than the costs associated with hip and knee arthroplasties, it remains substantial. It was recently estimated to be over $40,000.[32] The mean postoperative LOS following TSA was recently reported to be 2 days.[7] However, TSA with same-day discharge is gaining popularity for select patients. The COVID-19 pandemic has further served as a catalyst for shorter hospital stays and same-day discharge following TSA.[24]

Previous studies investigating the relationship between same-day discharge and postoperative complications following TSA have reported conflicting results. Two retrospective cohort studies reported no significant difference in complication rates between outpatient and inpatient TSA.[4,17] However, a case-control study by Harris et al[14] demonstrated a significantly higher readmission rate in the outpatient TSA cohort compared to the inpatient cohort. Conversely, a separate case-control study by Duchman et al[10] found that inpatient TSA patients had higher complication rates compared to their outpatient counterparts. These four studies were all limited by low sample sizes and data that was over a decade old. Similar studies of total hip arthroplasty and total knee arthroplasty have indicated that same-day discharge is associated with higher odds of cardiac and pulmonary complications when compared with next-day discharge.[19]

The aim of this study was to investigate in-hospital LOS and postoperative complications in patients undergoing anatomic or reverse TSA. We hypothesized that same- or next-day discharge after TSA is associated with decreased postoperative complications through reduced exposure to hospital-acquired infections, thereby potentially reducing associated inflammation and the development of metabolic abnormalities. We also hypothesized that patients who underwent outpatient arthroplasty were likely to be healthier at baseline compared to those who underwent inpatient arthroplasty.

Methods

All patients who underwent TSA between 2015 and 2019 were queried from the American College of Surgeons National Surgical Quality Improvement (NSQIP) database. As the NSQIP database is fully deidentified, this study was exempt from review and approval by our University's Institutional Review Board. Patient information included in the database is gathered from over 600 health care facilities throughout the United States obtained through various means such as interviews, outpatient visits, and examination of patient records.[13]

Current Procedural Terminology (CPT) code 23472 was used to identify 22,542 patients who underwent TSA from 2015 to 2019. CPT code 23472 includes both reverse and anatomic TSAs. Patients who were missing postoperative LOS data were excluded from the current study. Patients with LOS of 4 days or longer were also excluded from the current study, as it has already been established that those patients have a a higher complication rate. The resulting study population was stratified into three cohorts based on LOS calculated in calendar days as follows: LOS 0 (same-day discharge), LOS 1 (next-day discharge), and LOS 2–3 (LOS of 2-3 days).

Demographic data collected from the database included the following: race, gender, body mass index (BMI), age, smoking status, functional status, American Society of Anesthesiologists (ASA) physical status classification class, steroid use, preoperative laboratory values, preoperative comorbidities, and operative variables. Rates of major and minor complications occurring within 30 days postoperatively were also collected. Major complications included cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, stroke or cerebrovascular accident, unplanned intubation, deep vein thrombosis, pulmonary embolism, requirement of mechanical ventilation for >48 hours, acute renal failure, sepsis, septic shock, reoperation, readmission, mortality, deep incisional surgical site infection, and organ/space surgical site infection. Minor complications included progressive renal insufficiency, urinary tract infection (UTI), pneumonia, postoperative anemia requiring transfusion within 72 hours after surgery, and superficial incisional surgical site infection. Respiratory complications included pneumonia, unplanned intubation, pulmonary embolism, and being on a ventilator for more than 48 hours postoperatively.

SPSS Software version 26.0 (IBM Corp., Armonk, NY, USA) was used to perform statistical analyses for this investigation. Bivariate analysis was used to compare patient demographic characteristics, comorbidities, and surgical characteristics between cohorts. Multivariate logistic regression analysis was then conducted, with adjustments made for all significantly associated variables, such as patient demographics, preoperative comorbidities, and operative variables, to investigate the association between postoperative LOS and postoperative complications. The calculated odds ratios (ORs) were reported with a 95% confidence interval. The level of statistical significance was set at $P < .05$.

Table I
Length of stay (LOS) cohorts.

LOS cohorts	N = 21,094 (%)
LOS 0 (same-d discharge)	1628 (7.7)
LOS 1 (next-d discharge)	12,827 (60.8)
LOS 2–3 (traditional LOS of 2-3 d)	6639 (31.5)

Results

A total of 21,315 patients undergoing TSA between 2015 and 2019 were included in the study after the exclusion criteria. Among those patients, 1639 (7.7%) had a LOS of 0 day, 12,930 (60.7%) had a LOS of 1 day, and 6746 (31.6%) had a LOS of 2-3 days (Table I).

The LOS of 2-3 days cohort had a higher proportion of patients with certain demographics and comorbidities when compared to the LOS of 0 and LOS of 1 day cohorts. These demographics and comorbidities included advanced age, female gender, non-White race, positive smoking status, insulin-dependent diabetes, noninsulin-dependent diabetes, dyspnea at rest and moderate exertion, partially dependent functional status, an ASA classification of 3 or higher, a history of severe chronic obstructive pulmonary disease (COPD), a history of congestive heart failure (CHF), the use of hypertension medication, disseminated cancer, wound infection, the use of steroids, a history of bleeding disorder, and preoperative blood loss or anemia requiring transfusion. The LOS of 2-3 days cohort had a longer total operation time when compared to the shorter LOS cohorts. Additionally, the LOS of 1 day cohort had a higher proportion of patients with certain demographics and comorbidities when compared to the LOS of 0 day cohort. These demographics and comorbidities included advanced age, higher BMI, female gender, positive smoking status, insulin-dependent diabetes, noninsulin-dependent diabetes, dyspnea at rest and moderate exertion, partially dependent functional status, an ASA classification of 3 or higher, a history of severe COPD, a history of

Table II
Comparison of patient demographics, medical comorbidities, and operative characteristics between LOS cohorts.

Outcome	LOS 0 (same-day discharge)	LOS 1 (next-day discharge)	LOS 2-3 (traditional LOS of 2-3 day)	*P*
Overall number	1628	12,827	6639	
Age (y)	67.26 ± 9.82	68.44 ± 9.20	70.55 ± 9.58	**<.001**
BMI (kg/m^2)	29.94 ± 5.95	31.29 ± 6.58	31.42 ± 7.18	.294
	n (%)	n (%)	n (%)	
Female	739 (45.4)	6395 (49.9)	4368 (65.8)	**<.001**
Smoker	138 (8.5)	1377 (10.7)	729 (11.0)	**.011**
Race				**<.001**
Black or African American	68 (4.2)	506 (3.9)	410 (6.2)	
Asian	35 (2.1)	74 (0.6)	33 (0.5)	
White	1359 (83.5)	11,075 (86.3)	5354 (80.6)	
American Indian or Alaska Native	9 (0.6)	45 (0.4)	40 (0.6)	
Native Hawaiian or Pacific Islander	4 (0.2)	17 (0.1)	5 (0.1)	
Unknown	153 (9.4)	1110 (8.7)	797 (12.0)	
Anesthesia				**<.001**
Other or Unknown	154 (9.5)	288 (2.2)	139 (2.1)	
General	1470 (90.3)	12,529 (97.7)	6485 (97.7)	
Regional	4 (0.2)	10 (0.1)	15 (0.2)	
Diabetes				**<.001**
Insulin-dependent	56 (3.4)	501 (3.9)	444 (6.7)	
Nondiabetic	1422(87.3)	10,724 (83.6)	5317 (80.1)	
Noninsulin dependent	150 (9.2)	1602 (12.5)	878 (13.2)	
Dyspnea				**<.001**
At rest	2 (0.1)	28 (0.2)	33 (0.5)	
Moderate exertion	31 (1.9)	698 (5.4)	547 (8.2)	
None	1595 (98.0)	12,101 (94.3)	6059 (91.3)	
Functional status				**<.001**
Independent	1595 (98.0)	12,580 (98.1)	6383 (96.1)	
Partially dependent	1 (0.1)	125 (1.0)	198 (3.0)	
Totally dependent	1 (0.1)	6 (0.0)	8 (0.1)	
Unknown	31 (1.9)	116 (0.9)	50 (0.8)	
ASA classification				**<.001**
1 or 2	933 (57.3)	6014 (46.9)	2344 (35.3)	
3, 4, or 5	693 (42.6)	6798 (53.0)	4288 (64.5)	
None assigned	2 (0.1)	15 (0.1)	7 (0.1)	
Use of a ventilator	0 (0.0)	0 (0.0)	0 (0.0)	—
History of severe COPD	47 (2.9)	724 (5.6)	584 (8.8)	**<.001**
Ascites	0 (0.0)	0 (0.0)	3 (0.0)	**.038**
History of CHF	2 (0.1)	50 (0.4)	63 (0.9)	**<.001**
Use of hypertension medication	915 (56.2)	8451 (65.9)	4592 (69.2)	**<.001**
Disseminated cancer	0 (0.0)	21 (0.2)	21 (0.3)	**.013**
Wound infection	1 (0.1)	24 (0.2)	36 (0.5)	**<.001**
Use of corticosteroids	47 (2.9)	575 (4.5)	385 (5.8)	**<.001**
Weight loss	2 (0.1)	19 (0.1)	15 (0.2)	.408
Bleeding disorder	26 (1.6)	256 (2.0)	166 (2.5)	**.021**
Transfusion	0 (0.0)	6 (0.0)	8 (0.1)	.093
Previous sepsis	7 (0.4)	34 (0.3)	32 (0.5)	.110
Total operation time	104.30 ± 38.52	104.35 ± 39.49	113.26 ± 47.26	**<.001**

LOS, length of stay; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists; *COPD*, chronic obstructive pulmonary disease; *CHF*, congestive heart failure.
Bold values indicate statistically significant values ($P < .05$).

CHF, the use of hypertension medication, disseminated cancer, wound infection, the use of steroids, and a history of bleeding disorder (Table II).

An increasing rate of overall complications was observed as the LOS increased from LOS of 0 day (2.9%) to a LOS of 1 day (3.8%) and to a LOS of 2-3 days (8.3%). A similar pattern was seen for major complications (2.1%, 3.1%, and 4.6%), minor complications (1.0%, 1.1%, and 4.4%), respiratory complications (0.1%, 0.5%, and 1.0%), sepsis or septic shock (0.0%, 0.1%, and 0.3%), postoperative anemia requiring transfusion (0.1%, 0.3%, and 3.0%), non-home discharge (1.4%, 1.7%, and 17.8%), hospital readmission (1.7%, 2.2%, and 3.4%), and return to the operating room (0.9%, 1.1%, and 1.5%) (Table III).

Univariate logistic regression analysis showed that in comparison to the LOS 0 day cohort, LOS 1 day cohort had a greater likelihood of developing major complication (OR, 1.457; $P = .035$) and respiratory complication (OR, 7.390; $P = .047$). Similarly, in comparison to the LOS 0 day cohort, LOS 2–3 day cohort had a greater likelihood of developing overall complication (OR, 3.032; $P < .001$), major complication (OR, 2.214; $P < .001$), minor complication (OR, 4.685; $P < .001$), respiratory complication (OR, 16.087; $P < .001$), postoperative anemia requiring transfusion (OR, 25.383; $P < .001$), non-home discharge (OR, 15.068; $P < .001$), and hospital readmission (OR, 2.109; $P < .001$). Lastly, in comparison to the LOS 1 day cohort, LOS 2–3 day cohort had a greater likelihood of developing overall complication (OR, 2.265; $P < .001$), major complication (OR, 1.519; $P < .001$), minor complication (OR, 4.011; $P < .001$), cardiac complication (OR, 1.935; $P = .033$), respiratory complication (OR, 2.177; $P < .001$), sepsis or septic shock (OR, 2.742; $P = .008$), UTI (OR, 1.803; $P = .002$), postoperative anemia requiring transfusion (OR, 12.104; $P < .001$), non-home discharge (OR, 12.261; $P < .001$), hospital readmission (OR, 1.548; $P < .001$), and return to the operating room (OR, 1.352; $P = .022$) (Table IV).

After controlling for all associated patient demographics and comorbidities, adjusted multivariate logistic regression analysis showed that in comparison to the LOS 0 day cohort, LOS 2–3 day cohort had a greater likelihood of developing overall complication (OR, 2.598; $P < .001$), major complication (OR, 1.885; $P < .001$),

Table III
Comparison of complication rates following shoulder arthroplasty between LOS cohorts.

Complication	LOS 0 (same-day discharge), %	LOS 1 (next-day discharge), %	LOS 2-3 (traditional LOS of 2-3 day), %	*P*
Overall complication	47 (2.9)	491 (3.8)	549 (8.3)	**<.001**
Major complication	35 (2.1)	398 (3.1)	308 (4.6)	**<.001**
Minor complication	16 (1.0)	147 (1.1)	295 (4.4)	**<.001**
Cardiac arrest or MI	2 (0.1)	21 (0.2)	21 (0.3)	.063
Renal complication	2 (0.1)	13 (0.1)	7 (0.1)	.968
Respiratory complication	1 (0.1)	58 (0.5)	65 (1.0)	**<.001**
Stroke/CVA	0 (0.0)	6 (0.0)	4 (0.1)	.605
Sepsis or septic shock	0 (0.0)	12 (0.1)	17 (0.3)	**.004**
Wound infection	6 (0.4)	57 (0.4)	32 (0.5)	.818
Wound dehiscence	0 (0.0)	3 (0.0)	5 (0.1)	.151
Urinary tract infection	8 (0.5)	57 (0.4)	53 (0.8)	**.007**
Postoperative transfusion	2 (0.1)	33 (0.3)	201 (3.0)	**<.001**
Mortality	1 (0.1)	14 (0.1)	12 (0.2)	.306
Non-home discharge	23 (1.4)	222 (1.7)	1179 (17.8)	**<.001**
Hospital readmission	27 (1.7)	288 (2.2)	228 (3.4)	**<.001**
Return to the operating room	15 (0.9)	142 (1.1)	99 (1.5)	**.036**

LOS, length of stay; *MI*, myocardial infarction; *CVA*, cerebrovascular accident.
Bold values indicate statistically significant values ($P < .05$).

Table IV
Univariate analysis investigating the association between risk of complications following shoulder arthroplasty and LOS cohort classification.

Complication	LOS 1 cohort vs LOS 0 cohort			LOS 2,3 cohort vs LOS 0 cohort			LOS 2,3 cohort vs LOS 1 cohort		
	Odds ratio	95% CI	*P*	Odds ratio	95% CI	*P*	Odds ratio	95% CI	*P*
Overall complication	1.339	0.988-1.814	.060	3.032	2.240-4.106	**<.001**	2.265	1.998-2.568	**<.001**
Major complication	1.457	1.028-2.067	**.035**	2.214	1.554-3.154	**<.001**	1.519	1.305-1.768	**<.001**
Minor complication	1.168	0.695-1.962	.557	4.685	2.824-7.771	**<.001**	4.011	3.283-4.900	**<.001**
Cardiac arrest or MI	1.333	0.312-5.691	.698	2.580	0.604-11.013	.201	1.935	1.056-3.546	**.033**
Renal Complication	0.825	0.186-3.658	.800	0.858	0.178-4.135	.849	1.040	0.415-2.609	.933
Respiratory complication	7.390	1.023-53.390	**.047**	16.087	2.231-116.016	**.006**	2.177	1.526-3.105	**<.001**
Stroke/CVA	0.000	0.000-0.000	.988	0.000	0.000-0.000	.988	1.288	0.363-4.567	.695
Sepsis or septic shock	0.000	0.000-0.000	.988	0.000	0.000-0.000	.988	2.742	1.309-5.744	**.008**
Wound infection	1.207	0.519-2.803	.662	1.309	0.547-3.137	.545	1.085	0.703-1.675	.712
Wound dehiscence	0.000	0.000-0.000	.988	0.000	0.000-0.000	.987	3.222	0.770-13.485	.109
Urinary tract infection	0.904	0.430-1.898	.789	1.630	0.773-3.434	.199	1.803	1.239-2.624	**.002**
Postoperative transfusion	2.097	0.503-8.747	.310	25.383	6.298-102.300	**<.001**	12.104	8.366-17.512	**<.001**
Mortality	1.778	0.234-13.528	.578	2.946	0.383-22.674	.299	1.657	0.766-3.585	.199
Non-home discharge	1.229	0.798-1.894	.350	15.068	9.937-22.851	**<.001**	12.261	10.586-14.200	**<.001**
Hospital readmission	1.362	0.915-2.028	.128	2.109	1.410-3.154	**<.001**	1.548	1.298-1.847	**<.001**
Return to the operating room	1.204	0.705-2.055	.497	1.628	0.943-2.809	.080	1.352	1.044-1.751	**.022**

LOS, length of stay; *MI*, myocardial infarction; *CVA*, cerebrovascular accident; *CI*, confidence interval.
Bold *P* values indicate statistical significance with $P < .05$.

minor complication (OR, 3.939; $P < .001$), respiratory complication (OR, 12.979; $P = .011$), postoperative anemia requiring transfusion (OR, 23.338; $P < .001$), non-home discharge (OR, 10.430; $P < .001$), and hospital readmission (OR, 1.700; $P < .012$). Similarly, in comparison to the LOS 1 day cohort, LOS 2−3 day cohort had a greater likelihood of developing overall complication (OR, 2.111; $P < .001$), major complication (OR, 1.423; $P < .001$), minor complication (OR, 3.626; $P < .001$), respiratory complication (OR, 2.057; $P < .001$), sepsis or septic shock (OR, 2.795; $P = .008$), UTI (OR, 1.524; $P = .031$), postoperative anemia requiring transfusion (OR, 10.792; $P < .001$), non-home discharge (OR, 10.179; $P < .001$), hospital readmission (OR, 1.395; $P < .001$), and return to the operating room (OR, 1.394; $P = .014$). There was no significant difference in the risk of developing postoperative complications between LOS 0 day and LOS 1 day cohort (Table V).

Discussion

This study used a national database to identify an association between in-hospital LOS and postoperative complications following TSA. Patients discharged on the same day, or postop day 1, had a lower risk of developing complications compared to those who had a LOS of 2-3 days. Patients with a LOS 2-3 days had a higher likelihood of developing overall complications, major complications, minor complications, respiratory complication, postoperative anemia requiring transfusion, non-home discharge, and hospital readmission compared to both same- and next-day discharge patients. Moreover, patients with a LOS of 2-3 days also had a higher risk of developing sepsis or septic shock, UTI, and returning to operating room compared to those who were discharged the next day. There was no significant difference in the complication rate for patients discharged same day and postop day 1. Patients who underwent outpatient arthroplasty were healthier at baseline compared to those who underwent inpatient arthroplasty.

Shorter lengths of stay are becoming more feasible with the implementation of surgical improvements and careful patient selection.[2] An examination of postoperative complications associated with shorter hospital stays could aid in evaluating the clinical implications of early discharge. Such information can help health care professionals determine the most suitable LOS for each patient while considering the patient's individual risk profile and other pertinent factors. In contrast to previous studies, the present study includes a large sample size and is adjusted for patient demographics, preoperative comorbidities, and operative variables.

Table V
Multivariate analysis investigating the association between risk of complications following shoulder arthroplasty and LOS cohort classification.

Complication	LOS 1 cohort vs LOS 0 cohort			LOS 2,3 cohort vs LOS 0 cohort			LOS 2,3 cohort vs LOS 1 cohort		
	Odds ratio	95% CI	*P*	Odds ratio	95% CI	*P*	Odds ratio	95% CI	*P*
Overall complication	1.231	0.905-1.673	.185	2.598	1.908-3.538	**<.001**	2.111	1.857-2.399	**<.001**
Major complication	1.324	0.930-1.885	.119	1.885	1.314-2.704	**<.001**	1.423	1.219-1.663	**<.001**
Minor Complication	1.087	0.643-1.836	.757	3.939	2.353-6.594	**<.001**	3.626	2.958-4.444	**<.001**
Cardiac arrest or MI	1.163	0.268-5.054	.840	1.854	0.421-8.159	.414	1.594	0.858-2.960	.140
Renal complication	0.511	0.113-2.315	.383	0.462	0.091-2.330	.349	0.904	0.349-2.344	.836
Respiratory complication	6.310	0.871-45.711	.068	12.979	1.789-94.158	**.011**	2.057	1.433-2.953	**<.001**
Stroke/CVA	0.000	0.000-0.000	.988	0.000	0.000-0.000	.988	0.973	0.263-3.601	.967
Sepsis or septic shock	0.000	0.000-0.000	.988	0.000	0.000-0.000	.988	2.795	1.310-5.965	**.008**
Wound infection	1.219	0.521-2.853	.649	1.497	0.614-3.651	.375	1.228	0.786-1.919	.367
Wound dehiscence	0.000	0.000-0.000	.988	0.000	0.000-0.000	.987	3.830	0.889-16.501	.072
Urinary tract infection	0.722	0.341-1.529	.395	1.100	0.514-2.356	.806	1.524	1.039-2.236	**.031**
Postoperative transfusion	2.163	0.515-9.080	.292	23.338	5.735-94.979	**<.001**	10.792	7.465-15.600	**<.001**
Mortality	1.493	0.195-11.416	.700	1.874	0.237-14.841	.552	1.256	0.570-2.767	.572
Non-home discharge	1.025	0.665-1.578	.912	10.430	6.869-15.838	**<.001**	10.179	8.785-11.793	**<.001**
Hospital readmission	1.219	0.815-1.822	.336	1.700	1.126-2.565	**.012**	1.395	1.164-1.671	**<.001**
Return to the operating room	1.189	0.692-2.042	.531	1.657	0.947-2.899	.077	1.394	1.070-1.815	**.014**

LOS, length of stay; *MI*, myocardial infarction; *CVA*, cerebrovascular accident; *CI*, confidence interval.
Bold *P* values indicate statistical significance with $P < .05$.

The present study controlled for all statistically associated preoperative conditions including those identified in the literature as predisposing factors for respiratory complications after shoulder arthroplasty. This includes male gender, age, functional status, and ASA classification class[20] in addition to history of dyspnea and COPD. Our analysis revealed that a LOS of 2-3 days was an independent risk factor for respiratory complications. There could be various reasons for this finding, one of which may be attributed to an increased risk of venous thromboembolism (VTE) after surgery. Hospitalization and immobility associated with a longer LOS are well-known risk factors for VTE.[6] Lung et al,[21] used NSQIP Program database data and found that shoulder arthroplasty patients with longer LOS were much more likely to have VTE compared to those discharged sooner. Another study by Young et al[33] demonstrated that the risk of thrombosis after shoulder arthroplasty increases with reduced mobility associated with longer hospital stay.

Extended hospital stays can lead to increased exposure to nosocomial organisms. This is a potential reason for the increased incidence of respiratory complications, such as pneumonia. One study demonstrated that patients with longer hospital stays have a significantly higher rate of acquiring pneumonia compared to those with shorter stays.[18] Similarly, data from this study show patients with LOS of 2-3 days had increased risk of developing UTI and sepsis or septic shock. This finding is supported by the literature, which indicates that patients with a longer LOS are more likely to contract hospital-acquired infections, including UTI.[22,25] One study found that one of the risk factors for early readmission after anatomic or reverse TSA is UTI,[31] which is in line with our findings that patients with LOS of 2-3 days had a greater risk of readmission compared to those discharged on the same or following day. Overall, these findings suggest that, in addition to appropriate infection control measures, prompt discharge after surgery may help to minimize the risk of complications and improve patient outcomes.

This study has also revealed that patients with a LOS of 2−3 days after surgery had a greater risk of requiring a postoperative transfusion. This finding is consistent with prior studies that have shown an association between postoperative blood transfusion and prolonged hospital stays in patients undergoing total hip arthroplasty.[28] Moreover, research has also linked blood transfusions to a significantly higher incidence of respiratory tract and wound infections.[12]

Proper risk stratification of potential surgical candidates is a crucial aspect of performing outpatient TSA. The findings of this study may be attributed to a better understanding of the risks and benefits of outpatient TSA, as well as improved patient selection, patient education, and postsurgical multimodal pain management strategies.[1,3,4] In fact, patients in the LOS 0 day cohorts were younger and significantly healthier with fewer comorbidities than LOS of 1 day and LOS of 2−3 day cohorts. Specifically, those patients demonstrated a lower BMI, a better functional status, a lower ASA classification status, and were less likely to present with diabetes, dyspnea, a positive smoking status, corticosteroid use, disseminated cancer, wound infection, as well as a history of COPD, CHF, or bleeding disorders. Additionally, univariate analysis indicated that patients undergoing outpatient TSA had a reduced likelihood of complications compared to those in the LOS 1 day and LOS 2−3 day cohorts. This underscores the capacity of orthopedic surgeons to accurately identify suitable candidates for outpatient arthroplasty, leading to a lower and acceptable complication rate. Moreover, patients with a LOS of 2-3 days had higher rates of complications, even after adjusting for all the aforementioned comorbidities as well as patient demographics. This suggests that the prolonged hospital stay itself is a modifiable risk factor that contributes to poor patient outcomes. Given that more than 50% of patients undergoing arthroplasty with major complications do not have any predisposing risk factors,[27] it is essential for orthopedic surgeons to carefully consider the risks associated with an increased LOS. By optimizing patient selection and minimizing LOS, health care professionals can improve patient outcomes and reduce the burden of surgical complications.

There were several key limitations related to data collection and study design. First, as the cohorts were formed retrospectively, causality cannot be established in this study. Although this study controlled for all identified significantly associated variables with the multivariate logistic regression analysis, the postulation that a LOS of 2-3 days is a risk factor for complications would require that this LOS be voluntary, planned, or standard of care. Second, the timeframe of data collection in the American College of Surgeons NSQIP database is another limitation, as it only records surgical complications that occur within 30 days of surgery. As a result, this study overlooks any long-term postoperative complications that may affect a significant proportion of the patient population undergoing TSA. Moreover, the database might not have captured any complications that emerged after patients were discharged and

returned home. Third, patient classification was based on their LOS, which was determined retrospectively using calendar days. To improve the accuracy of patient classification and enable more detailed comparisons of readmission and complication rates, future prospective research studies may be needed. Finally, the utilization of CPT code 23472 could not distinguish between anatomic and reverse TSA. Nonetheless, two investigations have reported comparable rates of complications for both procedures.[15,26] Despite the limitations, this study is unique in its utilization of a large national database to compare the outcomes of outpatient and inpatient TSA. By identifying a cohort with a lower risk of complications, health care professionals may be able to decide on patient discharge more appropriately. In addition, the literature has demonstrated that the NSQIP database is more reliable than other national databases in terms of data consistency, completeness, and accuracy.[11,16,29]

Conclusion

Patients who were discharged on the same and next day following TSA demonstrated a reduced probability of experiencing respiratory complications, infections, postoperative anemia requiring transfusion, non-home discharge, and readmission in comparison to those with a LOS of 2-3 days. There was no difference in postoperative complications between same- and next-day discharged patients. Patients who underwent outpatient arthroplasty were healthier at baseline compared to those who underwent inpatient arthroplasty.

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