Clin Orthop Relat Res (2014) 472:1589–1596
DOI 10.1007/s11999-013-3400-1

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

CLINICAL RESEARCH

# Does Preoperative American Society of Anesthesiologists Score Relate to Complications After Total Shoulder Arthroplasty?

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Received: 16 July 2013 / Accepted: 19 November 2013 / Published online: 10 December 2013


## Abstract

*Background* For hip and knee arthroplasties, an American Society of Anesthesiologists (ASA) score greater than 2 is associated with an increased risk of medical and surgical complications. No study, to our knowledge, has evaluated this relationship for total shoulder arthroplasty (TSA) or reverse total shoulder arthroplasty (reverse TSA).

*Questions/purposes* We aimed to assess the relationship between the ASA score and (1) surgical complications, (2) medical complications, and (3) hospitalization length after TSA, reverse TSA, and revision arthroplasty.

*Methods* We retrospectively analyzed all patients who had undergone TSAs, reverse TSAs, or revision arthroplasties by the senior author (EGM) from November 1999 through July 2011 who had at least 6 months' followup. Of the 485 procedures, 452 (93.2%) met the inclusion criteria. Data were collected on patient demographics, comorbidities, hospitalization length, and short-term ($\leq$ 6 months) medical and surgical complications. Logistic regression analysis modeled the risk of having postoperative complications develop as a function of the ASA score.

*Results* Patients with an ASA score greater than 2 had a greater risk of having a surgical complication develop ($p < 0.001$; OR, 2.27; 95% CI, 1.36–3.70) and three times the risk of prosthesis failure (ie, component dislocation, component loosening, and hardware failure) ($p < 0.001$; OR, 3.23; 95% CI, 1.54–6.67). Higher ASA scores were associated with prolonged length of hospitalization (effect size 0.46, $p < 0.001$), but not medical complications.

*Conclusions* ASA score is associated with surgical, but not medical, complications after TSA and reverse TSA. The ASA score could be used for risk assessment and preoperative counseling.

*Level of Evidence* Level III, therapeutic study. See the Instructions for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution has approved or waived approval for the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

**Electronic supplementary material** The online version of this article (doi:10.1007/s11999-013-3400-1) contains supplementary material, which is available to authorized users.

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## Introduction

Total shoulder arthroplasty (TSA) has been shown to be a highly effective treatment for arthritis that is refractory to nonoperative treatment [12, 14]. It relieves pain and improves ROM and function in most patients [12]. In 2003, a second type of TSA (called a reverse prosthesis or reverse total shoulder arthroplasty [reverse TSA]) was approved by the FDA for patients who had intractable shoulder pain because of arthritis and who lacked an intact rotator cuff [55]. Despite the technical challenges it initially presented to surgeons, the short-term (8–10 years) results of reverse TSA have been encouraging [24, 37, 55], and the success of the reverse TSA prosthesis has been shown to contribute to the large increase in the number of shoulder replacement procedures performed annually in the United States [14, 27]. Although TSAs and reverse TSAs are done safely in most patients, some patients have medical or surgical complications develop that can lead to poor functional results and unanticipated hospital costs [3, 5, 47, 53]. Although wide ranges have been reported for the frequency of complications with TSAs and reverse TSAs, the latter generally have complication rates that are higher, and sometimes several times higher, than the former [1, 3, 5, 6, 51, 52, 54, 56].

The American Society of Anesthesiologists (ASA) physical status classification system was developed in 1941, and was further modified in 1963, to provide a concise summary of the patient's overall health status and to assess the risk of intraoperative and postoperative complications [8, 19]. High ASA scores have been shown to be associated with an increased risk of medical complications [30, 36], prosthesis dislocation [2, 23, 26, 28], infection [4, 9, 25, 27, 33, 41, 43, 45, 50, 57], prolonged hospital stay [6, 17, 29], and discharge to a rehabilitation service [15] after hip and knee arthroplasties.

To our knowledge, the relationship of the ASA score to these variables after TSA has not been reported. Therefore, the purpose of our study was to assess the relationship between the ASA score and (1) surgical complications, including prosthesis failure (defined as component dislocation, component loosening, or hardware failure), (2) medical complications, and (3) hospital length of stay stratified by TSA, reverse TSA, and revision procedures.

## Patients and Methods

Institutional review board approval was obtained for this study. The retrospective cohort included all patients who had a TSA or reverse TSA as a primary or revision procedure by the senior author (EGM) from November 1999 through July 2011; patients undergoing primary hemiarthroplasty for fracture were excluded. Of the 485 procedures, 33 were excluded: 17 because there was no ASA score recorded preoperatively and 16 because the patients had less than the minimum 6-month followup secondary to death (one) or loss to followup (15). Of the 16 patients, nine were seen in the clinic for a 3-month postoperative visit; no medical or surgical complications were reported at that time. Per study protocol, multiple attempts were made to contact the 16 patients, but eight no longer had current contact information, one had died within 6 months of surgery (sepsis secondary to an infected reverse TSA), and seven had died on average more than 5 years after surgery. The cause of death according to public records was cancer (two), complications from Alzheimer's disease (one), and unknown etiology (four). We retrospectively analyzed the remaining 452 arthroplasties (93.2% of the original cohort), which included 225 TSAs (Stryker® Total Solar Shoulder System, Stryker Corporation, Mahwah, NJ, USA) 176 reverse TSAs (Tornier Aequalis® Reversed Shoulder Prosthesis, Bloomington, MN, USA; DJO Global Reverse® Shoulder Prosthesis (RSP®), Austin, TX, USA), and 51 revision operations (11 revisions of hemiarthroplasties to TSAs and 40 revisions of hemiarthroplasties or TSAs to reverse TSAs) to determine the relationship between the ASA score and postoperative medical and surgical complications. Patient data were extracted from the clinic charts of the senior author (EGM), the electronic patient record, and the institution's hospital medical record.

### Patient Characteristics

There were statistically significant differences among the three surgical groups (TSA, reverse TSA, and revision) with respect to sex, age, ASA score, BMI, number of medications, and SF-36 physical component score (Table 1). The distribution of indications for surgery was statistically different across the three surgical groups ($p < 0.001$) with more TSAs than reverse TSAs done for osteoarthritis (Table 1).

The primary outcomes for this study were (1) medical complications, (2) surgical complications, and (3) length of hospital stay. To exclude any complications unrelated to the more immediate postoperative period, we included only complications that occurred during the first 6 months after surgery. The medical complications of interest included all recorded postoperative medical complications, which were: deep venous thrombosis, pulmonary embolus, urinary tract infection, delirium, pneumonia, acute renal failure, cardiac arrhythmia, tachycardia, gout episode, and adverse medication reaction. There were no episodes of acute coronary syndrome (defined as non-ST elevation myocardial infarction, ST elevation myocardial infarction, and unstable angina), cerebrovascular accident, transient ischemic attack, or gastrointestinal bleeding in our cohort.

**Table 1.** Patient demographic and diagnostic characteristics

| Characteristic | Surgery group | | | p value* |
|---|---|---|---|---|
| | Total shoulder arthroplasty (n = 225) | Reverse total shoulder arthroplasty (n = 176) | Revision† (n = 51) | |
| Women (%) | 99 (44.2) | 105 (63.3) | 32 (64.0) | < 0.001 |
| Age, mean (SD) | 63.9 (10.4) | 67.3 (12.2) | 63.9 (10.7) | 0.008 |
| Charlson Comorbidity Index score (SD) | 1.3 (2.0) | 1.3 (1.7) | 1.2 (1.5) | 0.900 |
| ASA | | | | 0.001 |
| 1 | 5 (2.2%) | 4 (2.4%) | 0 (0) | |
| 2 | 155 (69.2%) | 80 (47.6%) | 33 (64.7%) | |
| 3 | 64 (28.6%) | 82 (48.8%) | 18 (35.3%) | |
| 4 | 0 (0) | 2 (1.2%) | 0 (0) | |
| BMI, mean (SD) | 28.8 (4.9) | 29.8 (6.8) | 31.6 (7.1) | 0.008 |
| Allergies, median (interquartile range) | 0 (0,1) | 0 (0,1) | 0.5 (0,1) | 0.736 |
| Medications, median (interquartile range) | 5 (3,8) | 7 (4,10) | 5 (2,7) | < 0.001 |
| SF-36 | | | | |
| Physical component score (SD) | 38.2 (8.6) | 34.4 (9.3) | 35.1 (9.1) | < 0.001 |
| Mental component score (SD) | 49.4 (11.9) | 46.9 (11.7) | 49.8 (10.4) | 0.065 |
| Length of stay, mean (SD) | 2.46 (0.90) | 3.23 (2.01) | 3.37 (1.81) | < 0.001 |
| Diagnosis, number (%) | | | | < 0.001 |
| Osteoarthritis | 206 (91.6) | 75 (42.6) | 1 (2.0) | |
| Failed arthroplasty | 0 | 5 (2.8) | 32 (62.7) | |
| Cuff arthropathy | 0 | 50 (28.2) | 1 (2.0) | |
| Infection | 0 | 7 (4.0) | 10 (19.6) | |
| Instability | 1 (0.4) | 5 (2.8) | 5 (9.8) | |
| Rheumatoid arthritis | 3 (1.3) | 12 (6.8) | 1 (2.0) | |
| Osteonecrosis | 11 (4.9) | 3 (1.7) | 0 | |
| Fracture | 1 (0.4) | 6 (3.4) | 0 | |
| Cuff tear with pseudoparalysis | 1 (0.4) | 5 (2.8) | 1 (2.0) | |
| Traumatic arthritis/arthritis of dislocation | 0 | 8 (4.5) | 0 | |

* p value refers to global test of difference across the groups defined by surgery type; † revision group includes revision to total shoulder arthroplasty (n = 11) and revision to reverse total shoulder arthroplasty (n = 40); ASA = American Society of Anesthesiologists score.

Surgical complications of interest were nerve injury, perioperative fracture, superficial and deep wound infection, and prosthesis failure. We used the following definitions for surgical complications. Nerve damage was any neurologic deficit confirmed by electromyographic testing that was localized at the cord level or below, making it unlikely that the injuries were secondary to the interscalene block, which typically is done at a higher level in the brachial plexus. Perioperative fractures included all humeral and acromial fractures that occurred intraoperatively and during the first 6 months after surgery. Fractures occurring secondary to trauma were excluded. A superficial wound infection was defined as wound redness and warmth treated with antibiotics with or without surgical débridement. A deep wound infection was defined as a positive culture from fluid obtained through fluoroscopic aspiration and that was treated with antibiotics with or without surgical débridement. Prosthesis failure included component dislocation, component loosening, and hardware failure. Component loosening was defined as radiographic migration, subluxation, or dislocation of the glenoid and/or humeral component. Component dislocation was defined as glenohumeral component dislocation requiring a reduction or a revision procedure. Hardware failure was defined as fracture of the fixation screws or baseplate failure of a reverse TSA prosthesis.

The ASA physical status classification consists of six classes to assess preoperative medical status (Table 2) [19, 35, 38]. The ASA score was assigned by the anesthesiologist preoperatively and recorded in the patient's chart. Because of the small number of participants with ASA score 1 (n = 9) and ASA score 4 (n = 2), we collapsed patients with ASA scores of 1 and 2 into one group and patients with ASA scores of 3 and 4 into one group. We characterized each patient record regarding preoperative ASA score (treated as an ordinal variable) and the

**Table 2.** American Society of Anesthesiologists physical status classification

| Physical status | Description |
|---|---|
| 1 | A normal healthy patient |
| 2 | A patient with mild systemic disease |
| 3 | A patient with severe systemic disease |
| 4 | A patient with severe systemic disease that is a constant threat to life |
| 5 | A moribund patient who is not expected to survive without the operation |
| 6 | A declared brain-dead patient whose organs are being removed for donor purposes |

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occurrence of an outcome of interest (treated as a binary variable). Risk of the occurrence of an outcome of interest (such as medical complication) was modeled as a function of preoperative ASA score group using logistic regression. There are some potentially confounding variables (eg, age) that could contribute to the outcome (ie, medical complications), and the strength of this model was its ability to incorporate these covariates of interest and help control for their influence on the outcome. Another outcome of interest was the relationship between the ASA score group and prolonged length of stay in the hospital. To assess for this factor, a Student's t-test was used to compare mean length of stay across ASA score groups.

To examine the influence of type of surgery on the relationship between preoperative ASA score group and the occurrence of an outcome of interest, we stratified the patient population by surgical type into three mutually exclusive groups (TSA, reverse TSA, and revision procedures) and our logistic regression models were expanded to include type of surgery ($p < 0.05$).

## Results

### Surgical Complications

Surgical complications were stratified by type of surgery and ASA group (Table 3) (Appendix 1. Supplemental material is available with the online version of CORR®). Patients undergoing TSA or reverse TSA had lower odds of having a surgical complication develop postoperatively compared with patients undergoing revision surgery (Table 4). Patients in the TSA and reverse TSA groups had ¼ to ⅓ the odds of having numbness, nerve injury, or infection develop compared with patients in the revision group. Patients in the TSA group had 1/5 the odds of having component failure compared with patients in the revision group. Patients with an ASA score of 3 or 4 had an increased likelihood of having a surgical complication develop postoperatively compared with patients with an ASA score of 1 or 2 ($p = 0.001$; OR, 2.27; 95% CI, 1.36–3.70). Patients with an ASA score of 1 to 2 had a lower likelihood of numbness or nerve injury than patients with an ASA score of 3 to 4 ($p = 0.020$; OR, 0.377; 95% CI, 0.165–0.860) (Table 4). Patients in the TSA and reverse TSA groups had a lower likelihood of numbness or nerve injury than patients in the revision group ($p = 0.009$; OR, 0.251; 95% CI, 0.094–0.673; and OR, 0.234; 95% CI, 0.080–0.680, respectively). There were no differences between ASA groups ($p = 0.224$) or across the surgical groups ($p = 0.787$) with respect to perioperative fracture. Patients in the TSA and reverse TSA groups had a lower likelihood of infection than patients in the revision group ($p = -0.001$; OR, 0.241; 95% CI, 0.094–0.618; and OR, 0.327; 95% CI, 0.127–0.841, respectively), but there was no difference between the ASA score groups in the incidence of postoperative infection ($p = 0.883$). Patients in the ASA Class 1 to 2 score group had a lower likelihood of component failure than patients in the ASA Class 3 to 4 score group ($p = 0.002$; OR, 0.313; 95% CI, 0.150–0.654). Patients in the TSA group had a lower likelihood of component failure than patients in the revision group ($p = 0.006$; OR, 0.199; 95% CI, 0.071–0.559).

### Medical Complications

There were no differences between the two ASA groups ($p = 0.644$) or across surgical groups ($p = 0.326$) in the likelihood of having a medical complication develop postoperatively.

### Length of Stay

There was an association between ASA score and length of hospital stay (effect size, 0.46; $p < 0.001$) with patients in the ASA Class 3 to 4 group having an increased likelihood of a longer hospitalization (mean, 3.3 days; range, 2–11 days) than patients in the ASA Class 1 to 2 group (mean, 2.6 days; range, 2–21 days).

## Discussion

Although the ASA score originally was designed to assess a patient's risk for undergoing general anesthesia [19, 57] rather than to assess the patient's perioperative risk of

**Table 3.** Medical and surgical complications by surgery and ASA groups

| Diagnosis | Surgery group | | | ASA group | |
|---|---|---|---|---|---|
| | Total shoulder arthroplasty (n = 225) | Reverse total shoulder arthroplasty (n = 176) | Revision (n = 51) | ASA Classes 1–2 (n = 277) | ASA Classes 3–4 (n = 166) |
| Medical complications | | | | | |
| Deep vein thrombosis | 2 (0.01) | 2 (0.01) | 1 (0.02) | 2 (0.01) | 3 (0.02) |
| Pulmonary embolism | 1 (< 0.01) | 1 (< 0.01) | 1 (0.02) | 2 (0.01) | 1 (< 0.01) |
| Urinary tract infection | 3 (0.01) | 2 (0.01) | 1 (0.02) | 3 (0.01) | 3 (0.02) |
| Delirium | 3 (0.01) | 5 (0.03) | 0 | 4 (0.01) | 4 (0.02) |
| Pneumonia | 1 (< 0.01) | 3 (0.02) | 0 | 3 (0.01) | 1 (< 0.01) |
| Kidney failure | 4 (0.02) | 0 | 0 | 2 (0.01) | 2 (0.01) |
| Arrhythmia | 0 | 6 (0.03) | 1 (0.02) | 4 (0.01) | 3 (0.02) |
| Tachycardia | 8 (0.04) | 10 (0.06) | 3 (0.06) | 16 (0.06) | 5 (0.03) |
| Gout | 1 (< 0.01) | 2 (0.01) | 0 | 3 (0.01) | 0 |
| Drug reaction | 2 (0.01) | 3 (0.02) | 3 (0.06) | 6 (0.02) | 2 (0.01) |
| Surgical complications | | | | | |
| Numbness/nerve injury | 10 (4.5) | 7 (4.2) | 8 (15.7) | 10 (3.6) | 15 (9.0) |
| Perioperative fracture | 0 | 12 (6.6) | 2 (3.9) | 6 (2.2) | 7 (4.2) |
| Infection | 11 (4.9) | 12 (6.6) | 9 (17.7) | 19 (6.7) | 12 (7.2) |
| Component failure | 8 (3.6) | 18 (10.1) | 8 (15.7) | 12 (4.3) | 21 (12.7) |

ASA = American Society of Anesthesiologists.

**Table 4.** Multivariate analysis of likelihood of complication with incidence

| Group | Likelihood of the following complications | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Numbness/nerve injury | | Perioperative fracture | | Infection | | Component failure | |
| | OR (95% CI) | % | OR (95% CI) | % | OR (95% CI) | % | OR (95% CI) | % |
| Surgical group | | | | | | | | |
| Total shoulder arthroplasty (n = 225) | 0.25 (0.09, 0.67)* | 4.5 | Undefined | 0 | 0.24 (0.09, 0.62)* | 4.9 | 0.20 (0.07, 0.56)* | 3.6 |
| Reverse total shoulder arthroplasty (n = 176) | 0.23 (0.08, 0.68)* | 4.2 | 1.72 (0.37, 8.01) | 6.6 | 0.33 (0.13, 0.84)* | 6.6 | 0.61 (0.25, 1.50) | 10.1 |
| Revision† (n = 51) | Reference | 15.7 | Reference | 3.9 | Reference | 17.7 | Reference | 15.7 |
| ASA score group | | | | | | | | |
| 1–2 (n = 281) | 0.38 (0.17, 0.85)* | 3.6 | 0.50 (0.17, 1.52) | 2.2 | 0.95 (0.45, 2.00) | 6.7 | 0.31 (0.15, 0.65)* | 4.3 |
| 3–4 (n = 171) | Reference | 9.0 | Reference | 4.2 | Reference | 7.2 | Reference | 12.7 |

* Statistically significant; † includes revision to total shoulder arthroplasty (n = 11) and revision to reverse total shoulder arthroplasty (n = 40); OR = odds ratio; ASA = American Society of Anesthesiologists.

morbidity, the ASA status has been shown to correlate well with medical and surgical complications after THAs and TKAs [2, 4, 9, 15, 30, 33, 36, 41, 45, 50]. However, to our knowledge, no studies have been published regarding the relationship of the ASA scores to complications after shoulder arthroplasty. Our aim was to assess the relationship between the ASA score and (1) surgical complications, (2) medical complications, and (3) hospital length of stay as stratified by TSA, reverse TSA, and revision procedures.

There are several factors to consider in the interpretation of our data. First, many factors influence the short-term medical and surgical complication rates after shoulder arthroplasty. Although we collected data on numerous potentially confounding variables (including patient age, sex, BMI, and comorbid conditions), which we then could incorporate into our logistic regression analysis, we cannot rule out the possibility that other predictors, not measured, may have influenced the complication rates. For example, our model could not take into account the changes in operative technique and implant design that occurred during the 12-year period (1999–2011) of our study and their effect on the complication rate. However, many clinically relevant factors, such as implant selection, patient selection, surgical technique, and postoperative protocol, were inherently controlled for in our study design because our study reflects the practice of one surgeon in a tertiary medical center.

Second, it is possible that one or more of the 16 patients lost to followup before 6 months had medical or surgical complications develop that were treated elsewhere. This is unlikely because nine of the 16 patients were evaluated at 3 months postoperatively, at which point they had no medical or surgical complications. Furthermore, this limitation does not affect our findings regarding the relationship between the ASA score and complications because there was no differential loss to followup between ASA score groups. Similarly, there were 17 patients who were excluded who did not have an ASA score recorded in the medical chart. It is possible that their inclusion might have changed the results.

Although the distribution of ASA scores in our TSA and reverse TSA groups may have influenced our results (Table 1), this limitation is offset mostly by the distribution of ASA scores in our revision group, the group in which we would expect the highest complication rate.

The number and range of complications that are included in the statistical analysis affect our results, and a different constellation of complications might produce different results than those reported here. Similarly, our complication rate may reflect the referral practice of the senior author (EGM), and the findings may not be extrapolated accurately to other surgical practices. However, our study involved a direct chart review that allowed us to detect all reported complications on patients; the literature shows that this method is more accurate than relying solely on hospital discharge data and billing procedure codes [11, 16, 21, 22, 34, 45]. Although the current literature lacks a uniform classification of postoperative complications in total joint arthroplasties, the events defined as postoperative complications in our study are mostly consistent with those defined in previous studies [6, 13, 20, 40, 44].

Another limitation of our study is the inherently subjective nature of the ASA score, which typically is determined preoperatively by the anesthesiologist. Although the anesthesiologist was not controlled in our study, because of its retrospective nature, the anesthesiologists who determined each patient's ASA score reported their findings at the time of surgery as part of normal clinical routine and not as part of our study. Studies of interrater consistency of the ASA score have observed its inconsistency [18, 32] and imprecision [31, 38]. As previously suggested [19], this poor interobserver reliability most likely is the result of difficulty in distinguishing a patient with normal health (ASA Class 1) from one with mild systemic disease (ASA Class 2) rather than discriminating between a relatively healthy patient (ASA Classes 1 and 2) and one with severe, even life-threatening, systemic disease (ASA Classes 3 and 4). Therefore, because our analysis classified the patients into a high ASA score group (ASA Class 3 or 4) and a low ASA score group (ASA Class 1 and 2), this limitation had a minimal, if any, effect on our results. However, the results might be different if there were more patients in each ASA level, and further study with larger numbers of patients will be necessary to determine the risks for every ASA level.

We showed that increasing ASA scores were associated with a higher number of postoperative surgical complications. Because, to our knowledge, there are no other published studies examining the relationship between the ASA score and these variables for shoulder arthroplasty, we compared our findings with those reported for hip and knee arthroplasties. The ASA status has been shown to correlate well with surgical morbidity [8, 10, 29, 35, 42], and multiple studies have identified a significant relationship between the ASA score and surgical complications after hip or knee arthroplasty [2, 23, 26, 28]. One study showed that patients with a high ASA score had a 10-fold increase in dislocation risk after THA [23], and subsequent studies confirmed the association between increased ASA scores and increased likelihood of prosthesis failure (defined as dislocation) in THA [26, 28]. Most recently, Hooper et al. [19] reported that patients with an ASA score of 3 had an increased risk of early revision after THA compared with patients who had an ASA score of 1 or 2. Our study is the first to suggest that this previously identified relationship between the ASA score and prosthesis failure in THA also holds true in shoulder arthroplasty. It is intriguing to consider why the ASA score has value in predicting the risk of prosthesis dislocation. It has been suggested that patients with high ASA scores are less able to observe shoulder or hip precautions after surgery because of impaired cognitive and/or physical abilities [26].

Although our study showed a relationship between the ASA score and surgical complications, there was no association between the ASA score and medical complications. This finding may reflect the fact that patients with higher ASA scores are identified as high-risk patients, which allows the medical team to take necessary precautions to prevent medical complications. Studies investigating the ability of the ASA score to predict the risk for medical complications after total joint arthroplasty of the lower extremity have produced mixed results: some have reported an association [8, 29, 35, 36, 39, 48, 49], whereas others failed to find such a relationship [17, 53]. The inconsistency in these findings may be because the literature, like our study, is retrospective and lacks sufficient power to accurately determine the effect of the ASA score on postoperative medical complications and infection. A post hoc power analysis revealed that we would need 7420 patients in each ASA group to show statistical significance for medical complications.

Higher ASA scores (ie, an ASA score of 3 or 4) also were associated with prolonged hospital stay in this patient cohort. This finding is supported by previous studies that have shown that patients with a high ASA score are more likely to require a prolonged hospitalization or intensive care unit stay [7, 8, 17, 29], have higher rates of discharge to rehabilitation or skilled nursing facilities [15], and incur increased hospital costs [46, 53]. The causes of this increased length of stay are speculative but may be the result of intraoperative factors, such as length of surgery, red blood cell transfusions [7], or baseline functional status [17].

Our study suggests that the ASA score may be useful for predicting surgical postoperative complications in patients undergoing shoulder arthroplasty and offers clinicians important information when discussing outcomes with patients before surgery. More research is needed to investigate the relationship between the ASA score and other clinically relevant outcome measures, such as functional outcome, ROM, pain relief, and patient satisfaction, after TSA. Furthermore, the association between increasing ASA scores and prolonged hospitalization substantiates the suggestion that the ASA score may have a role in predicting hospital costs and negotiating reimbursement rates [8, 29, 46, 53]. We believe, based on our study, that a prospective study of the use of the ASA score in stratifying patients for risk assessment is warranted.

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