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Identifying appropriate candidates for ambulatory outpatient shoulder arthroplasty: validation of a patient selection algorithm

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Background: Outpatient total shoulder arthroplasty (TSA) is increasing in frequency, but the selection of patients who are appropriate outpatient joint candidates remains challenging. We propose an algorithm for selecting outpatient TSA candidates, with validation by a cohort of patients from an ambulatory surgery center (ASC).

Methods: We identified 61 patients who had primary anatomic and reverse TSA. The selection algorithm, which stratifies patients referable to their age and cardiopulmonary comorbidities, was used to choose patients for outpatient surgery. Complications, including cardiopulmonary, thromboembolic, and postoperative wound problems, were recorded.

Results: All 61 patients were discharged from the ASC on the day of surgery. There were no cardiopulmonary events requiring intervention or hospital admission. One patient (2%) required a secondary operation, 3 patients (5%) experienced acute surgical complications, 3 patients (5%) had transient postoperative nausea, and 4 patients (7%) had additional complications within the 90-day episode of care.

Conclusions: This study is the first to propose a patient selection method for outpatient TSA. Using this algorithm for patient selection produced a low rate of perioperative complications and no hospital admissions. We suggest this algorithm provides an evidence-based method for the standardization of outpatient TSA candidate selection.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Total shoulder arthroplasty; outpatient; patient selection; complications; algorithm; validation

Outpatient total joint arthroplasty (TJA) of the shoulder (TSA), hip (THA), and knee (TKA) are becoming more common as a response to increased focus on low-cost, high-quality health care by government and regulatory agencies. There is a growing body of literature documenting the safety and cost savings associated with outpatient TJA, with some centers reporting large series of patients with equivalent or lower complication rates compared with inpatient

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cohorts.[10,14,15,19] TSA has been slower to transition to the outpatient setting, but recent reports showed complication and readmission rates favorable to outpatient hip and knee arthroplasty.[6,7] TSA has been shown to be a safe, reliable treatment for degenerative conditions of the shoulder, producing predictably good results in appropriate candidates.

Although reports have emerged demonstrating that TSA can be performed safely in the outpatient setting, selecting patients who are suited for outpatient TSA remains challenging.[2,4] Basques et al[2] reported that patients undergoing outpatient TSA are generally younger and in better health than their inpatient peers, but no patient selection algorithm was described in their study of a Medicare database.

Nevertheless, common comorbid conditions, such as coronary artery disease, heart failure, chronic obstructive pulmonary disease, and diabetes, are generally understood to increase the risk of perioperative complications in TJA. Using this knowledge to select individual outpatient TSA candidates is more difficult, which is one of the reasons clinicians may be reluctant to transition to the outpatient setting. In the absence of a risk stratification scheme specific to arthroplasty, many physicians use the American Society of Anesthesiologists (ASA) Physical Status Classification System to help identify inpatient and outpatient TJA candidates. This system groups patients into broad categories but evidence supporting its use for TJA and, specifically, ambulatory outpatient TJA is lacking.

As outpatient TSA gains broader acceptance, the demand for a more objective, evidence-based method of patient selection will likely increase. The proposed selection algorithm presented here for identifying patients who are suitable for outpatient TSA was used to select a consecutive cohort of patients who had anatomic or reverse TSA at a free-standing ASC, and complications and adverse events were reviewed to validate its use.

Materials and methods

A prospectively maintained institutional database was used to identify patients who underwent ambulatory outpatient anatomic or reverse TSA at a single freestanding surgery center. The primary surgeon (T.W.T.) is a partner in the single-specialty orthopedic group that owns and manages the surgery center. Included were 61 consecutive patients, 49 with anatomic TSAs and 12 with reverse TSAs. Revision shoulder arthroplasties were excluded.

All patients were identified as outpatient candidates through the use of the patient selection algorithm (Fig. 1), which was formulated in conjunction with the lead anesthesiologist at the ASC. As the algorithm was designed, its purpose was to stratify patients based on patient characteristics believed to be most important for avoiding perioperative anesthetic-related complications. Decision points were based on data from shoulder, hip, and knee arthroplasty literature, but use of these points in a selection process has not previously been described.[11,16,17] Patient age and preoperative anemia were the first 2 decision points. Then, pulmonary (sleep apnea, morbid obesity, and chronic obstructive pulmonary disease) and cardiac

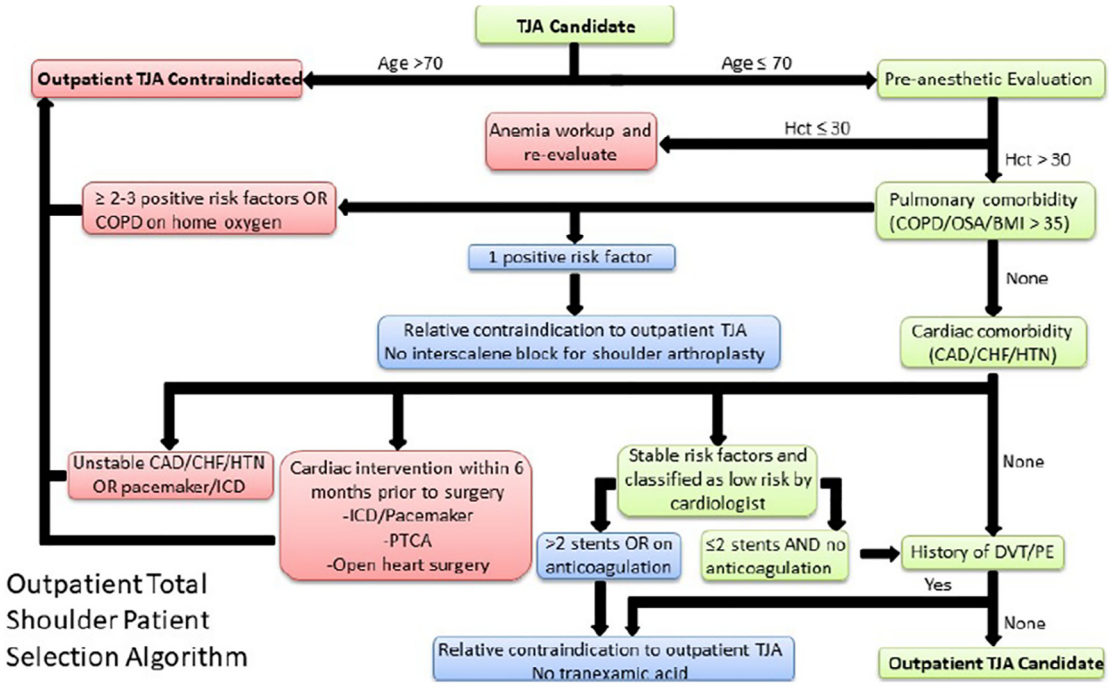

Figure 1 Algorithm for selection of patients for outpatient total shoulder arthroplasty. *TJA*, total joint arthroplasty; *COPD*, chronic obstructive pulmonary disease; *OSA*, obstructive sleep apnea; *BMI*, body mass index; *CAD*, coronary artery disease; *CHF*, congestive heart failure; *HTN*, hypertension; *ICD*, implantable cardioverter-defibrillator; *DVT*, deep venous thrombosis; *PE*, pulmonary embolism.

(coronary artery disease, hypertension, and congestive heart failure) conditions were evaluated. The final decision points were a history of thromboembolic disease and the use of anticoagulation.

After the algorithm was formulated and approved by all members of the surgical and anesthesia teams, it was implemented as a part of the customary preanesthetic evaluation. As a part of this evaluation, patients met preoperatively with the anesthesia staff for medical optimization. Final approval for outpatient TSA was made according to protocol by the staff anesthesiologist.

Operative technique and postoperative protocol

All procedures were done with the patient in the beach chair position through a standard deltopectoral approach with subscapularis tenotomy under muscular paralysis. Single doses of vancomycin and cefazolin were given preoperatively, and no postoperative antibiotics were administered before discharge.

A multimodal approach was used to control pain perioperatively, with patients receiving a combination of celecoxib, long-acting and short-acting oxycodone, and gabapentin by mouth preoperatively and postoperatively. An intraoperative periarticular injection also was used, including liposomal bupivacaine, bupivacaine with epinephrine, and ketorolac in the deltoid, pectoralis major, and soft tissues in the surgical field. Previous work at our institution has shown that this injection technique can provide similar pain relief at lower cost and with fewer complications than an indwelling interscalene catheter.[21] No patient in this study received an interscalene block, and no immediate postoperative radiographs were obtained. Drains were not used.

All patients were examined in the postanesthesia care unit postoperatively, and patients who could void spontaneously, whose pain was controlled on an oral regimen, and who could ambulate independently were discharged home. A surgery center staff member contacted each patient by phone the day after discharge to address any concerns, and a telephone "hotline" was made available for patients to contact an orthopedic surgeon after business hours and on weekends.

Patients were instructed in sling immobilization and taught how to perform Codman exercises at home for 2 weeks. Formal physical therapy was initiated at the first postoperative visit. The postoperative rehabilitation for anatomic and reverse TSA was standardized by protocol and involved sling immobilization with passive range of motion exercises for the first 6 weeks. From 6 to 12 weeks, the patients were allowed gentle active range of motion, with free use of the arm after 12 weeks.

Record review

A retrospective record review identified patient age, sex, operative side, procedure, ASA score, and body mass index (BMI). Also documented were unanticipated intraoperative events, postoperative nausea, emesis, hemorrhage, urinary retention, readmission, and reoperation. For the purposes of the study, infection, acute blood loss anemia, transfusion, wound complications, hospital admission, and reoperation were considered acute surgical complications. Nonsurgical/cardiopulmonary complications were defined as mortality, arrhythmia, blood pressure volatility, syncope, thromboembolic events, pneumonia, renal failure, and any other substantial deviation from the typical postoperative course not attributable to the direct effects of surgery.

Results

Of the 61 patients, 39 (64%) were men, the average BMI was 31 kg/m^2 (range, 21-49 kg/m^2), and the average age at the time of surgery was 58 years (range, 37-69 years). The ASA Physical Status Classification was class II in 39 patients (64%), class III in 20 (32%), and class I in 2 (Table I). Of the TSA cohort, the diagnosis was primary osteoarthritis in 41, inflammatory arthritis in 3, capsulorraphy arthropathy in 2, posttraumatic arthritis in 1, and osteonecrosis in 1. Of the RTSA cohort, the diagnosis was rotator cuff arthropathy in 7, primary osteoarthritis with glenoid bone loss in 4, and proximal humeral fracture in 1.

All 61 patients were discharged from the ASC on the day of surgery. There were no cardiopulmonary events requiring intervention or hospital admission. Acute complications developed in 3 patients (5%; Table II). One patient developed bleeding in the postanesthesia recovery area that resolved

Table I Patient demographics

Variable	Patients (n = 61)
Age, yr	58 (37-69)
Sex	
Male	39
Female	22
BMI, kg/m^2	31 (21-49)
ASA classification	
I	2
II	39
III	20

BMI, body mass index; *ASA*, American Society of Anesthesiologists. Data are presented as mean (range) or as number of patients.

Table II Complications

Event	No. (%) (n = 61)	Outcome
Reoperation within 90 days	1 (1.6)	Hematoma evacuation
Readmission within 90 days	0	
Total complications	7 (11.5)	
Infection	0	
Cardiopulmonary events	0	
Hematoma	1 (1.6)	Evacuation
Perioperative anesthesia complications	2 (3.3)	
Transient postoperative bradycardia		Uneventful recovery
Acute hypotension		Surgery aborted
Arthrofibrosis	2 (3.3)	Additional physiotherapy
Anterior subluxation	1 (1.6)	No treatment
Subscapularis rupture	1 (1.6)	No treatment

with compression but later required delayed evacuation of a hematoma. Nonsurgical complications included a patient who had acute postoperative bradycardia that resolved, and the patient was discharged home, and 1 patient who became acutely hypotensive with induction of anesthesia, causing surgery to be aborted. The latter patient underwent uncomplicated shoulder arthroplasty in the hospital environment 1 month later with a 23-hour observation stay and routine discharge.

Transient postoperative nausea without emesis occurred in 3 patients (5%), all of which resolved with oral symptomatic treatment with ondansetron. Additional complications occurred in 4 patients (7%) within the 90-day episode of care: 2 developed arthrofibrosis, 1 had mild anterior subluxation on follow-up radiographs, and 1 patient sustained a subscapularis rupture in a fall but declined further surgical intervention (Table II).

Discussion

TJR, including TSA, continues to rise in popularity. Recent reports have estimated that the demand for TSA is increasing at a rate of approximately 10% per year, with even higher rates in patients aged older than 55 years.[6,13,18] This increased demand is likely multifactorial, with studies citing an increased familiarity with the procedure among training centers, expanding indications, and increased patient access to care.[18,20] As the popularity of shoulder arthroplasty increases, regulatory pressure for high-quality, cost-effective care will likely increase as well. Following the trends set by knee and hip arthroplasty, decreasing the length of stay after surgery and even transitioning TSA to the outpatient setting for selected patients represent viable means for cost reduction without compromise of patient safety, satisfaction, or outcomes.[1,15]

Multiple studies have suggested that TJA can be safely performed as an outpatient procedure with good outcomes and low complication rates. A recent large series describing 549 patients who had outpatient THA found very low rates of admission and perioperative complications.[14] This same study emphasized the importance of patient selection, citing control of medical comorbidities as part of their selection process. A recent randomized trial of 112 inpatient THAs compared with 108 outpatient THAs found no difference in complication or readmission rates and comparable contact with the treating physician's office at 4 weeks.[10] The authors suggested that patients with revision or bilateral THA, age older than 75 years, BMI of more than 40 kg/m^2, history of cardiopulmonary disease, and chronic opioid use were unsuitable for inclusion in their study. In addition to supporting the viability of outpatient TJA, these studies suggest agreement that certain characteristics are important in patient selection for outpatient arthroplasty.

Although research has examined outpatient TKA and THA in depth, there is less information regarding TSA. Recent studies suggest that TSA can be performed safely and that many of the risk factors identified in the hip and knee literature similarly increase complication rates in TSA.[4,11,17] These studies also show that physicians transitioning to an ambulatory TSA practice are selecting younger patients without certain comorbidities, even though evidence-based guidelines for patient selection do not exist. A recent analysis of the United States Standard Analytical File compared patient characteristics and perioperative events between 119,854 inpatient TSAs and 3493 outpatient TSAs.[2] A significantly lower rate of complications was found in the outpatient group, which also had lower rates of obesity and medical comorbidities. This clearly is in agreement with our algorithm, which drives patient selection toward those with fewer cardiopulmonary comorbidities.

The algorithm (Fig. 1), which we believe provides a standardized method to improve this selection process, has a number of decision points that are based on comorbidities indicating patients who would be at unacceptably increased risk with outpatient TSA. These decisions points are supported by data from the hip, knee, and shoulder arthroplasty literature, but to our knowledge no other selection algorithm of this nature has been described for outpatient shoulder arthroplasty.[11,16,17]

Age and preoperative anemia are the first 2 branch points in the algorithm, followed by pulmonary and cardiac comorbidities and history of thromboembolic disease. The literature suggests that all of these characteristics are associated with increased perioperative risk.[5,8,12,22] According to our algorithm, however, a patient can still be a candidate for outpatient TSA even with a single pulmonary comorbidity or stable cardiovascular risk factors. This may explain why some patients with a BMI exceeding 35 kg/m^2 in the absence of chronic obstructive pulmonary disease or obstructive sleep apnea, or both, were still able to safely undergo ambulatory outpatient TSA. The algorithm also allows the clinician to identify patients who are not ideal outpatient candidates but may still undergo ambulatory TSA with appropriate preoperative optimization and acknowledgement of risk. It is still important to note that patients excluded from outpatient TSA by the algorithm may still be considered for surgery in the inpatient setting.

The risk of complications after TSA has been reported to range from approximately 3% to 9%, depending on study design.[7-9] Even with the broad definitions used in this study, the complication rate in our cohort of outpatient shoulder arthroplasties (11.5%) is comparable to those previously reported in the literature, suggesting that candidates identified by our algorithm can undergo outpatient TSA surgery with very low complication and admission rates.

Outpatient TSA is not a currently approved procedure for patients insured by government payors, although TKA is nearing approval. In contrast, patients with commercial payors are not restricted from ambulatory TSA, and physicians interested in this practice may find it beneficial to negotiate bundled payments or insurance carve-outs to facilitate program implementation.

The limitations of the study include those imposed by its retrospective design and the lack of a comparison group of patients who were chosen for outpatient surgery without the use of the algorithm. However, the paramount importance of patient safety prevented use of a comparison group because we did not believe we could ethically select patients without these strict criteria. Similarly, a power analysis was not done for this study because the incidence of episode-of-care complications after outpatient TSA is low,[4] suggesting that the number needed to treat to show differences between competing algorithms would be quite large. However, this study does represent the largest series in the literature to date describing the safety profile and patient selection method for ambulatory outpatient TSA.

Further, our cohort of patients underwent their procedures at a high-volume ASC, all performed by a single surgeon and, thus, that experience may not generalize well to other settings. Also, there are common comorbid conditions that are not included in the algorithm, resulting in some remaining subjectivity during the patient selection process.

Finally, 24 hours of antibiotic prophylaxis is not used as part of our outpatient total joint replacement program. Many centers recommend this practice, but we note that Centers for Disease Control and Prevention guidelines recommend against it[3] and that to date, we have documented no infections after outpatient shoulder arthroplasty with this protocol. Future studies with larger numbers of patients and comparison cohorts are needed to further validate the selection algorithm.

Conclusions

This algorithm represents a new approach to the selection and risk stratification of outpatient TSA patients. Our results show a low level of perioperative complications and no hospital admissions, suggesting that our algorithm can provide an evidence-based method of patient selection for physicians considering transition to an outpatient TSA practice.

Disclaimer

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