JSES Open Access 2 (2018) 13–17

Contents lists available at ScienceDirect

JSES Open Access

journal homepage: www.elsevier.com/locate/jses

Safety and patient satisfaction of outpatient shoulder arthroplasty

Timothy S. Leroux, MD [a], William A. Zuke, BA [b], Bryan M. Saltzman, MD [b], Beatrice Go, BS [b], Nikhil N. Verma, MD [b], Anthony A. Romeo, MD [b], Jason Hurst, MD [c], Brian Forsythe, MD [b,*]

[a] University Health Network, Toronto, ON, Canada
[b] Midwest Orthopaedics at Rush, Rush University Medical Center, Chicago, IL, USA
[c] Joint Implant Surgeons, Inc., New Albany, OH, USA

ARTICLE INFO

Keywords:
Ambulatory surgery
Outpatient arthroplasty
Shoulder arthroplasty
Outpatient surgery
Reverse shoulder arthroplasty
Total shoulder replacement
Reverse total shoulder replacement

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

Background: There is increasing interest in outpatient shoulder arthroplasty (SA); however, the clinical evidence behind this practice is sparse. The purpose of this study was to assess the safety of outpatient SA performed in an ambulatory surgery center and to determine patient factors that are associated with increased risk for perioperative complications or dissatisfaction.

Methods: Patient demographics and operative variables were collected retrospectively for patients undergoing outpatient SA at 2 ambulatory surgery centers with a minimum follow-up of 90 days. Patients completed a postsurgery questionnaire about their experience, satisfaction, pain control, and health care use.

Results: Forty-one anatomic total SAs (n = 32) and reverse SAs (n = 9) with a mean follow-up of 60 weeks (16.4 weeks-3 years) were included. The mean age, body mass index, Charlson Comorbidity Index, and American Society of Anesthesiologists class were 60.6 ± 4.8 years, 31.8 ± 6.6, 2.9 ± 1.9, and 2.3 ± 0.6, respectively. Three (7.3%) minor complications occurred within 90 days of the SA, none before first follow-up. Two patients stayed in the ambulatory surgery center 23-hour observation unit. Thirty-five patients (85.4%) completed the questionnaire, of whom 97.0% (n = 32) were satisfied with the outpatient procedure. Two patients had difficulties with postoperative pain control and were taking chronic narcotic medication before surgery.

Conclusion: Outpatient SA in an ambulatory surgery center is safe with high patient satisfaction and low rates of perioperative complications. Although larger cohorts are required to adequately determine which patients will be appropriate candidates for an outpatient SA, our findings do suggest that patients with a history of preoperative narcotic use may have difficulties or dissatisfaction with outpatient SA.

Total shoulder arthroplasty (TSA) is an excellent operation to address pain relief and to provide functional improvement for patients limited by glenohumeral arthritis who have failed to respond to conservative measures.[18] The number of TSAs performed in the United States is growing rapidly,[9,17] and patient demand is increasing substantially in the last 4 decades, with an average increase in volume of TSA of 9.4% per year.[1,9] In an age of cost-conscious health care, this has substantial implications for overall health care expenditures, including a focused attempt by health care providers to minimize costs while maintaining safety and efficacy. In particular, policymakers and hospitals are frequently looking at length of stay (LOS) after surgery as an area of focus for improvement, with recent interest in outpatient TSA.[21] According to an insurance-based database, outpatient TSA results in a $3614 cost reduction compared with matched inpatients.[7]

In the hip and knee arthroplasty literature, numerous studies have evaluated the success of outpatient procedures (LOS of 0 days) and have suggested specific eligibility criteria and perioperative analgesia protocols to permit success.[3,8,13,20,23,28-30] However, ambulatory shoulder arthroplasty (SA) is in its relative infancy, and publications delineating the results of this practice are lacking or involve only a small cohort of patients.[6] The purpose of this study was to retrospectively evaluate the safety and satisfaction of outpatient SA at 2 separate ambulatory surgery centers. Specifically, our intention was to report demographic variables of those patients selected by the senior surgeon to undergo ambulatory surgery; readmissions, complications, and unscheduled postoperative clinical visits within 90 days of the procedure; and results from an administered questionnaire meant to assess readiness for

Institutional Review Board approval was obtained at Rush University Medical Center under the ORA No. 16062708-IRB01.

* Corresponding author: Brian Forsythe, MD, Midwest Orthopaedics at Rush, 1611 W Harrison St, Suite 300, Chicago, IL 60612, USA.
E-mail address: forsythe.research@rushortho.com (B. Forsythe).

https://doi.org/10.1016/j.jses.2017.11.002

discharge and satisfaction with the overall experience. Our hypothesis was that outpatient SA would be offered to healthier and younger patients, that it demonstrated safety with a low complication profile, and that patients would generally be satisfied with their experience.

Methods

We conducted a retrospective chart review and telephone questionnaire of patients who underwent an outpatient primary anatomic TSA or reverse TSA (RTSA) at 2 ambulatory surgery centers from August 2013 to July 2016. The ambulatory surgery centers have the capacity for 23-hour observation, are physician owned, and are managed by a national surgery center corporation. Exclusions included revision procedures, hemiarthroplasties, and SA performed for fracture. After exclusion criteria were applied, consecutive patients were included. We obtained consent by telephone, at which time patients were also asked a series of questions about their experience with outpatient SA. We believe a telephone interview is sufficient for the purpose of safety and satisfaction as opposed to direct examination. In addition, to decrease the likelihood of missing early postoperative complications, patients with at least 90 days of follow-up were included. The chart review portion of this study examined all available documents in the medical record, including demographic information, past medical history, past surgical history, medication history, intraoperative anesthesia records, and postanesthesia care unit (PACU) records.

The senior authors selected patients for outpatient procedures on the basis of past medical history and active comorbidities. The following were exclusion criteria for outpatient procedures: renal disease, chronic obstructive pulmonary disease, active thromboembolic disease, active or untreated coronary artery disease, and untreated sleep apnea. A prior coronary or cerebrovascular event, if treated and stable, was not an absolute exclusion criterion. Active and untreated disease, however, was a strict exclusion criterion for outpatient SA. Furthermore, medical specialists cleared all patients for the outpatient procedures. Perioperatively, an anesthetist administered an ultrasound-guided, single-injection interscalene block augmented with epinephrine and dexamethasone to all patients, and general anesthesia was used for all patients intraoperatively. Two senior authors (B.F. and J.H.) performed all outpatient SAs at 2 separate ambulatory surgery centers. All used the deltopectoral interval and followed the implant-specific technique guidelines. One surgeon routinely administered tranexamic acid (TXA) perioperatively (n = 21) by intravenous or topical routes, whereas the other surgeon did not use TXA (n = 20). Patients with a history of a stent, stroke, transient ischemic attack, deep venous thrombosis, pulmonary embolism, or color blindness received topical TXA. In addition, all patients received standardized postoperative pain management (Table I). Before proceeding with an outpatient TSA, confirmation of an available, reliable caregiver in the home was a requisite.

Table I
Postoperative pain medication protocol by senior surgeons

Surgeon 1	Oxycodone/acetaminophen (5/325-mg tablets), 1-2 tablets every 4 hours as needed (60 tablets, with 2 possible refills) Transition to hydrocodone/acetaminophen (5/325 mg) 1-2 tablets every 6 hours as needed (30 tablets)
Surgeon 2	Oxycodone (5-mg tablets), 1-2 tablets every 6 hours as needed (75 tablets); acetaminophen, 650 mg every 6 hours; Dilaudid (2 mg), 1-2 tablets every 4 hours for breakthrough pain (10 tablets) Transition to hydrocodone/acetaminophen (5/325 mg) as needed (75 tablets)

Table II
Patient demographic information

Average combined follow-up	60.3 weeks
Average clinic follow-up	25.5 weeks
Average telephone follow-up	63.5 weeks
Age	60.6 ± 4.8 years
Gender	
Male	46.3 (19)
Female	53.7 (22)
BMI	31.8 ± 6.6
Charlson Comorbidity Index	2.9 ± 1.9
ASA class	2.3 ± 0.6
Comorbidities	
Hypertension	60.0 (25)
Diabetes mellitus	10.0 (4)
Depression	28.6 (12)
Tobacco	
Current use	4.9 (2)
Previous use	24.4 (10)
Preoperative narcotic use	17.1 (7)

BMI, body mass index; *ASA*, American Society of Anesthesiologists.
Data are presented as % (number) or mean ± standard deviation.

Results

A total of 41 outpatient primary anatomic TSA procedures (32) or RTSA procedures (9) were reviewed from August 2013 to July 2016. Of all the SAs performed at the 2 ambulatory surgery centers, only 2 patients (5%) were excluded from this study. One patient was excluded for a hemiarthroplasty revised to a TSA and another for an RTSA for a proximal humerus fracture. Comparison of the patient demographics and surgical data of these anatomic TSAs and RTSAs revealed no significant differences (Appendix). The mean age of the patients was 60.6 ± 4.8 years (range, 46.1-68.5 years); 46.3% (n = 19) were male. The mean body mass index (BMI) was 31.9 ± 6.6; 24 (58.5%) patients had a BMI >30; 14 (34.1%) patients had a BMI >35. The mean Charlson Comorbidity Index was 2.9 ± 1.9, and the mean American Society of Anesthesiologists (ASA) class was 2.3 ± 0.6. The mean follow-up was 60.3 weeks (25.5 weeks in clinic and 63.5 weeks by telephone) (Table II); 35 of the 41 (85.4%) patients were able to complete a phone questionnaire between September 2016 and November 2016.

Indications, surgical time, and recovery time in the PACU before discharge can be found in Table III. There were no intraoperative complications. One surgeon used TXA routinely and the other surgeon did not, but the differences in blood loss at the 2 centers (with TXA, mean of 103 ± 53 mL; without TXA, mean of 84.3 ± 52 mL) were not significant ($P = .21$). Two patients originally destined for

Table III
Surgical details per case

Indication	
Glenohumeral arthritis	82.9 (34)
Rotator cuff arthropathy	14.6 (6)
Avascular necrosis	2.4 (1)
Procedure	
TSA	78.0 (32)
RTSA	23.8 (9)
Implant	
Biomet Comprehensive	51.2 (21)
Tornier	36.6 (15)
Arthrex Univers II	12.1 (5)
Surgery time	101.1 ± 24.7 minutes
PACU time	
No observation patients	144.5 ± 49.3 minutes
All patients	212.5 ± 253.2 minutes
Estimated blood loss	97.6 ± 54.4 mL

TSA, total shoulder arthroplasty; *RTSA*, reverse total shoulder arthroplasty; *PACU*, postanesthesia care unit.
Data are presented as % (number) or mean ± standard deviation.

same-day discharge required overnight observation in the 23-hour observation unit at the ambulatory surgery center. One of these patients decided to stay overnight for the convenience of the caregiver, despite being medically cleared for home discharge. The second patient developed hypoxia postoperatively, and the surgeon made the decision for overnight observation.

After discharge home, no patients saw an additional health care provider for complaints related to the SA before the first postoperative visit, which was a mean of 10 ± 3 days after the index outpatient SA. Overall, there were 3 postoperative complications (7.3%): 1 patient was sent to an urgent care facility at the first postoperative visit (10 days postoperatively) for an erythematous papular rash on the involved upper extremity; a second patient presented with superficial phlebitis at the first postoperative visit, resolving with conservative treatment; and the third patient developed a hematoma at the medial aspect of the incision 17 days after operation, which resolved after 1 month and required no surgical intervention.

A total of 35 of 41 patients (85.4%) completed the telephone questionnaire. For consistency, 1 individual administered all questionnaires. Regarding readiness for discharge, 94.3% (n = 33) felt ready, whereas 5.7% (n = 2) felt that they needed to stay overnight. When the patients were asked if they would have the procedure again as an outpatient, the same 2 patients (5.7%) who did not feel ready for discharge stated they would not. Interestingly, these 2 patients were taking narcotics preoperatively and postoperatively for chronic pain because of an unrelated medical condition. One patient took morphine 60 mg every 8 hours; the other patient took oxycodone 7.5 mg every 6 hours. Of note, 6 other patients were taking narcotics preoperatively related to pain associated with the shoulder arthritis but discontinued narcotics in the postoperative period. Overall, 81.8% (n = 27) said their SA experience as an outpatient was excellent, and 84.9% (n = 28) were very satisfied with the SA performed on an outpatient basis. The complete responses to the questionnaire are listed in Table IV.

Table IV
Questionnaire responses

After the procedure, did you feel ready to leave when you were discharged?	
Yes	94.3 (33)
No	5.7 (2)
Was your pain well controlled the first night after the procedure?	
Yes	94.3 (33)
No	5.7 (2)
Did you seek medical attention at any time after you were discharged?	
Yes	5.7 (2)
No	94.3 (33)
How long were you taking pain medication for your shoulder after the procedure?	
	9.0 ± 15.3days*
Are you currently taking pain medication for your shoulder?	
Yes	5.7 (2)
No	94.3 (33)
Would you have this operation again?	
Yes	100 (35)
No	0.0 (0)
How would you describe your experience with your outpatient TSA?	
Excellent	81.8 (27)†
Good	15.2 (5)
Average	3.0 (1)
Fair	0.0 (0)
Poor	0.0 (0)
How satisfied are you with the TSA performed as an outpatient procedure?	
Very satisfied	84.9 (28)†
Satisfied	12.1 (4)
Adequate	3.0 (1)
Unsatisfied	0.0 (0)
Very unsatisfied	0.0 (0)
If you had another TSA, would you have it done as an outpatient or an inpatient?	
Outpatient	94.3 (33)
Inpatient	5.6 (2)

TSA, total shoulder arthroplasty.
Data are presented as % (number) or mean ± standard deviation.
* Patients removed from calculation who were currently taking pain medication chronically for other conditions. Includes 1 outlier of 90 days.
† Patients who stayed overnight after the operation were excluded from answering these questions; n = 33.

Discussion

Overall, this study demonstrates that outpatient SA is safe and results in a high degree of patient satisfaction. Across the entire cohort, no patients required medical attention between discharge and the first postoperative visit at a mean of 10 days, although one patient required attention at an urgent care facility after the first postoperative visit. In addition, only 1 patient (2.4%) was held at the ambulatory surgery center for overnight observation for a medical reason, and 2 patients were dissatisfied with their experience and would not have a future SA done in the outpatient setting. In reviewing the medical records for these 2 individuals, both were noted to be using narcotics preoperatively for unrelated conditions, and both were the only patients who did not cease narcotic use postoperatively. Not only do these findings stem from the largest clinical study on outpatient SA to date, they offer support for SA to be done in the outpatient setting and provide insight into how chronic preoperative narcotic use may potentially influence patient satisfaction after SA in the outpatient setting.

Recent literature suggests that the average inpatient TSA results in a duration of stay of 2.2 days.[10] This is an obvious point in the TSA process that can be modified with the potential for substantial health care cost savings. However, this must be accomplished without compromising patient safety to maintain the effects of the intervention and to avoid morbidity that may lead to readmissions or repeated intervention that would otherwise counteract the initial cost savings. Ambulatory total hip arthroplasty and total knee arthroplasty have been performed for more than a decade now, and there is an appreciable track record to suggest that appropriately selected patients do not have any increased risks for complications or readmission compared with their inpatient surgery counterparts.[5,19]

The literature is far less extensive when evaluating ambulatory SA, however. Leroux et al recently published a population-based study comparing adverse event and readmission rates between outpatient and inpatient TSA.[22] Their results suggested that an appropriately selected patient could safely undergo outpatient TSA with an expected risk profile that is comparable to standard inpatient TSA, but with lower costs. In their analysis, the 30-day adverse event rate in the outpatient and inpatient TSA cohorts was 2.31% and 7.89%, respectively, with readmission rates of 1.74% and 2.93%, respectively. They acknowledge that there was a bias toward performing outpatient TSA in younger, healthier male patients. This reflects the importance of proper selection of patients for outpatient arthroplasty procedures as being integral to successful outcomes. The senior surgeons chose patients who were relatively young (mean age, 60.6 years) and healthy (mean ASA grade, 2.3; mean Charlson Comorbidity Index, 2.9), reflecting the available data suggesting that active comorbid cardiac disease, renal failure, chronic pulmonary disease, ASA class >3, and increasing chronologic age are independent predictors of length of hospital stay, readmission, or mortality after elective TSA in any setting.[24,25,33,34]

A recent study by Brolin et al compared the 90-day complications and rates of readmission after outpatient TSA with a matched

inpatient cohort.[6] Their analysis of 30 outpatient TSAs did not reveal any significant differences in readmissions or number of complications compared with the inpatient cohort. Similar to our study, no hospital admissions from the ambulatory surgery center occurred. Although their study included only anatomic TSAs, our study has further demonstrated the safety of anatomic TSAs in addition to RTSAs in the outpatient setting. Furthermore, telephone follow-up in this study demonstrated a high patient satisfaction with this procedure performed on an outpatient basis.

Adequate pain control perioperatively may have contributed to the high satisfaction and patient comfort with discharge on the day of surgery. The anesthesia literature has demonstrated success with outpatient SA in terms of postoperative analgesia, nausea and vomiting, and patient satisfaction using either continuous or single-injection interscalene brachial plexus blocks; authors have noted high satisfaction scores and low pain scores at 24 hours and 7 days postoperatively using this means of anesthesia.[11,16,31] All of our patients received interscalene blocks at the time of surgery, and thus our recommendation would similarly propose this means of local anesthesia for all patients who undergo outpatient TSA.

The 2 patients (5.7%) who would rather have a future TSA as an inpatient procedure were the only patients who felt their pain was not well controlled overnight. Interestingly, these 2 patients were taking narcotics for unrelated medical conditions and continued use postoperatively. Six other patients in this cohort were taking narcotics for the index shoulder at the time of surgery but ceased shortly thereafter. Recent investigations of narcotic consumption in spine surgery and total joint arthroplasty show an association with increased complications and LOS.[4,32,36] Although the association of narcotic use with complications and LOS after SA has not been assessed to date, preoperative narcotic use is associated with worse outcomes in both anatomic TSA and RTSA.[26,27] It would be expected for this relationship with complications and LOS to exist with SA, especially in considering outpatient procedures. Even though this cohort is relatively small, we recommend being cognizant of chronic narcotic use when considering patients for an outpatient SA as their pain may not be adequately controlled. Use of additional pain management, such as patient-controlled catheter systems, may be beneficial in this subset of patients.

Recent data suggest that no association exists between BMI and 30-day complications after primary TSA surgery,[18] although this was not specific to ambulatory surgery. Our average BMI of 31.9 (obesity class I)[35] with a maximum patient BMI of 47.4 would seem to corroborate these findings with outpatient TSA, as these patients did not experience any adverse events. However, future study is needed to determine complication rates with an adequate cohort of patients as we were likely underpowered in this regard. Obesity has been shown to correlate with increased surgical times, however, and operative time >174 minutes has been demonstrated as an independent predictor for the development of a major local complication after elective TSA.[18,33] In our cohort of patients, the mean operative time was 101 minutes (range, 63-165 minutes), which is well below the suggested threshold for concern from the literature and suggestive that factors related to the speed and comfort level of the surgeon may play a role in determining which patients of greater BMI are appropriate for outpatient vs. inpatient SA. A more in-depth analysis of obesity and outpatient SA is necessary from a larger sample, but our data provide an initial proposition that BMI should not be a contraindication to outpatient SA surgery.

Additional to note is the importance of the relatively low intraoperative blood loss (mean, 97.6 mL) with these included patients. Anthony et al reported from a database study of TSA that the most common complication was bleeding resulting in transfusion, representing 4.26% of this patient population.[2] Moreover, a single-center, single-surgeon study reported a transfusion rate of 38% in primary, noncomplex SA.[15] Given the morbidity associated with transfusion,[14] intraoperative hemostasis is an important component to a successful ambulatory SA practice. Similar to total knee arthroplasty and total hip arthroplasty, TXA has been shown to reduce blood loss without additional complications in SA.[12] Although no difference in blood loss was found between the 2 cohorts in our study, the sample size likely underpowers this study to detect a difference in blood loss for the use of TXA. Thus, routine TXA may be a potential avenue to reduce complications in the outpatient setting.

Successful outpatient SA requires adequate staff planning and communication among caregivers. After proper selection of patients for safe outpatient SA, adequate time should be allowed for recovery before discharge. In this study, the time in the PACU was 144.5 ± 49.3 minutes, and the average time at discharge was 1:46 PM. With the high satisfaction, the authors thus recommend scheduling outpatient SAs as morning cases to ensure recovery for early afternoon discharge.

Our study is not without limitations. First, it is a retrospective collection of data. The sample size is small, although with the literature relatively devoid of case series on this topic, our cohort provides a relatively sizable contribution to the overall SA and health care expenditure literature. In addition, there is some heterogeneity in the patient population—in the pathologic process, procedure, and implant choice, all of which were evaluated as a single cohort as the small cohort size limited subgroup analysis stratified by these individual variables. The results are provided at an average follow-up of 60.3 ± 45.2 weeks, which is a relatively short follow-up after an arthroplasty procedure but effectively provides patient safety with outpatient SA well beyond the initial perioperative window and thus serves the intended purpose for this study. In a similar vein, future evaluation of such outcomes will be an effective complement to this study. Finally, a selection bias exists in the patients who underwent outpatient SA in our cohort as they were predominantly young and relatively healthy, which again is inherent to the clinical importance of proper selection of patients. As such, future efforts are necessary to determine more definitively which patients are at greatest and least risk for complications or readmissions after ambulatory SA.

Conclusion

Outpatient SA in an ambulatory surgery center is safe, with high patient satisfaction and low rate of perioperative complications. Although larger cohorts are required to adequately determine which patients will be appropriate candidates for an outpatient SA, our findings do suggest that patients with a history of chronic narcotic pain medication use may have difficulties or dissatisfaction with outpatient SA.

Disclaimer

Anthony A. Romeo receives research support from and is a paid consultant for Arthrex.

Nikhil N. Verma receives research support from Arthrex.

Jason Hurst receives research support from and is a paid consultant for Zimmer Biomet.

The other authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jses.2017.11.002.

References

1. Adams JE, Sperling JW, Hoskin TL, Melton LJ, Cofield RH. Shoulder arthroplasty in Olmsted County, Minnesota, 1976-2000: a population-based study. J Shoulder Elbow Surg 2006;15:50-5. http://dx.doi.org/10.1016/j.jse.2005.04.009
2. Anthony CA, Westermann RW, Gao Y, Pugely AJ, Wolf BR, Hettrich CM. What are risk factors for 30-day morbidity and transfusion in total shoulder arthroplasty? A review of 1922 cases. Clin Orthop Relat Res 2014;473:2099-105. http://dx.doi.org/10.1007/s11999-014-4107-7
3. Argenson JN, Husted H, Lombardi A Jr, Booth RE, Thienpont E. Global forum: an international perspective on outpatient surgical procedures for adult hip and knee reconstruction. J Bone Joint Surg Am 2016;98:e55. http://dx.doi.org/10.2106/jbjs.15.00998
4. Armaghani SJ, Lee DS, Bible JE, Shau DN, Kay H, Zhang C, et al. Increased preoperative narcotic use and its association with postoperative complications and length of hospital stay in patients undergoing spine surgery. Clin Spine Surg 2016;29:E93-8. http://dx.doi.org/10.1097/bsd.0000000000000109
5. Aynardi M, Post Z, Ong A, Orozco F, Sukin DC. Outpatient surgery as a means of cost reduction in total hip arthroplasty: a case-control study. HSS J 2014;10:252-5. http://dx.doi.org/10.1007/s11420-014-9401-0
6. Brolin TJ, Mulligan RP, Azar FM, Throckmorton TW. Neer Award 2016: outpatient total shoulder arthroplasty in an ambulatory surgery center is a safe alternative to inpatient total shoulder arthroplasty in a hospital: a matched cohort study. J Shoulder Elbow Surg 2017;26:204-8. http://dx.doi.org/10.1016/j.jse.2016.07.011
7. Cancienne JM, Brockmeier SF, Gulotta LV, Dines DM, Werner BC. Ambulatory total shoulder arthroplasty: a comprehensive analysis of current trends, complications, readmissions, and costs. J Bone Joint Surg Am 2017;99:629-37. http://dx.doi.org/10.2106/jbjs.16.00287
8. Courtney PM, Rozell JC, Melnic CM, Lee G-C. Who should not undergo short stay hip and knee arthroplasty? Risk factors associated with major medical complications following primary total joint arthroplasty. J Arthroplasty 2015;30:1-4. http://dx.doi.org/10.1016/j.arth.2015.01.056
9. Day JS, Lau E, Ong KL, Williams GR, Ramsey ML, Kurtz SM. Prevalence and projections of total shoulder and elbow arthroplasty in the United States to 2015. J Shoulder Elbow Surg 2010;19:1115-20. http://dx.doi.org/10.1016/j.jse.2010.02.009
10. Dunn JC, Lanzi J, Kusnezov N, Bader J, Waterman BR, Belmont PJ. Predictors of length of stay after elective total shoulder arthroplasty in the United States. J Shoulder Elbow Surg 2015;24:754-9. http://dx.doi.org/10.1016/j.jse.2014.11.042
11. Gallay SH, Lobo JJA, Baker J, Smith K, Patel K. Development of a regional model of care for ambulatory total shoulder arthroplasty: a pilot study. Clin Orthop Relat Res 2008;466:563-72. http://dx.doi.org/10.1007/s11999-007-0083-5
12. Gillespie R, Shishani Y, Joseph S, Streit JJ, Gobezie R. Neer Award 2015: a randomized, prospective evaluation on the effectiveness of tranexamic acid in reducing blood loss after total shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:1679-84. http://dx.doi.org/10.1016/j.jse.2015.07.029
13. Goyal N, Chen AF, Padgett SE, Tan TL, Kheir MM, Hopper RH, et al. Otto Aufranc Award: a multicenter, randomized study of outpatient versus inpatient total hip arthroplasty. Clin Orthop Relat Res 2016;475:364-72. http://dx.doi.org/10.1007/s11999-016-4915-z
14. Grier AJ, Bala A, Penrose CT, Seyler TM, Bolognesi MP, Garrigues GE. Analysis of complication rates following perioperative transfusion in shoulder arthroplasty. J Shoulder Elbow Surg 2017;26:1203-9. http://dx.doi.org/10.1016/j.jse.2016.11.039
15. Gruson KI, Accousti KJ, Parsons BO, Pillai G, Flatow EL. Transfusion after shoulder arthroplasty: an analysis of rates and risk factors. J Shoulder Elbow Surg 2009;18:225-30. http://dx.doi.org/10.1016/j.jse.2008.08.005
16. Ilfeld BM, Wright TW, Enneking FK, Mace JA, Shuster JJ, Spadoni EH, et al. Total shoulder arthroplasty as an outpatient procedure using ambulatory perineural local anesthetic infusion: a pilot feasibility study. Anesth Analg 2005;101:1319-22. http://dx.doi.org/10.1213/01.ane.0000180199.52383.ce
17. Jain NB, Higgins LD, Guller U, Pietrobon R, Katz JN. Trends in the epidemiology of total shoulder arthroplasty in the United States from 1990-2000. Arthritis Rheum 2006;55:591-7. http://dx.doi.org/10.1002/art.22102
18. Jiang JJ, Somogyi JR, Patel PB, Koh JL, Dirschl DR, Shi LL. Obesity is not associated with increased short-term complications after primary total shoulder arthroplasty. Clin Orthop Relat Res 2015;474:787-95. http://dx.doi.org/10.1007/s11999-015-4584-3
19. Kort NP, Bemelmans YFL, Schotanus MGM. Outpatient surgery for unicompartmental knee arthroplasty is effective and safe. Knee Surg Sports Traumatol Arthrosc 2017;25:2659-67. http://dx.doi.org/10.1007/s00167-015-3680-y.
20. Kort NP, Bemelmans YFL, van der Kuy PHM, Jansen J, Schotanus MGM. Patient selection criteria for outpatient joint arthroplasty. Knee Surg Sports Traumatol Arthrosc 2016;;25:2668-75. http://dx.doi.org/10.1007/s00167-016-4140-z.
21. Krell RW, Girotti ME, Dimick JB. Extended length of stay after surgery: complications, inefficient practice, or sick patients? JAMA Surg 2014;149:815. http://dx.doi.org/10.1001/jamasurg.2014.629
22. Leroux TS, Basques BA, Frank RM, Griffin JW, Nicholson GP, Cole BJ, et al. Outpatient total shoulder arthroplasty: a population-based study comparing adverse event and readmission rates to inpatient total shoulder arthroplasty. J Shoulder Elbow Surg 2016;25:1780-6. http://dx.doi.org/10.1016/j.jse.2016.04.006
23. Lovecchio F, Alvi H, Sahota S, Beal M, Manning D. Is outpatient arthroplasty as safe as fast-track inpatient arthroplasty? A propensity score matched analysis. J Arthroplasty 2016;31:197-201. http://dx.doi.org/10.1016/j.arth.2016.05.037
24. McCormick F, Nwachukwu B, Kiriakopoulos ES, Schairer W, Provencher M, Levy J. In-hospital mortality risk for total shoulder arthroplasty: a comprehensive review of the Medicare database from 2005 to 2011. Int J Shoulder Surg 2015;9:110. http://dx.doi.org/10.4103/0973-6042.167938
25. Menendez ME, Baker DK, Fryberger CT, Ponce BA. Predictors of extended length of stay after elective shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:1527-33. http://dx.doi.org/10.1016/j.jse.2015.02.014
26. Morris BJ, Laughlin MS, Elkousy HA, Gartsman GM, Edwards TB. Preoperative opioid use and outcomes after reverse shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:11-6. http://dx.doi.org/10.1016/j.jse.2014.05.002
27. Morris BJ, Sciascia AD, Jacobs CA, Edwards TB. Preoperative opioid use associated with worse outcomes after anatomic shoulder arthroplasty. J Shoulder Elbow Surg 2016;25:619-23. http://dx.doi.org/10.1016/j.jse.2015.09.017
28. Parcells BW, Giacobbe D, Macknet D, Smith A, Schottenfeld M, Harwood DA, et al. Total joint arthroplasty in a stand-alone ambulatory surgical center: short-term outcomes. Orthopedics 2016;39:223-8. http://dx.doi.org/10.3928/01477447-20160419-06
29. Parvizi J. CORR Insights: Otto Aufranc Award: a multicenter, randomized study of outpatient versus inpatient total hip arthroplasty. Clin Orthop Relat Res 2017;475:373-4. http://dx.doi.org/10.1007/s11999-016-4985-y
30. Schotanus MGM, Bemelmans YFL, Grimm B, Heyligers IC, Kort NP. Physical activity after outpatient surgery and enhanced recovery for total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2017;25:3366-71. http://dx.doi.org/10.1007/s00167-016-4256-1
31. Shah A, Nielsen K, Braga L, Pietrobon R, Klein S, Steele S. Interscalene brachial plexus block for outpatient shoulder arthroplasty: postoperative analgesia, patient satisfaction and complications. Indian J Orthop 2007;41:230-6. http://dx.doi.org/10.4103/0019-5413.33688
32. Sing DC, Barry JJ, Cheah JW, Vail TP, Hansen EN. Long-acting opioid use independently predicts perioperative complication in total joint arthroplasty. J Arthroplasty 2016;31:170-4, e171. http://dx.doi.org/10.1016/j.arth.2016.02.068
33. Waterman BR, Dunn JC, Bader J, Urrea L, Schoenfeld AJ, Belmont PJ. Thirty-day morbidity and mortality after elective total shoulder arthroplasty: patient-based and surgical risk factors. J Shoulder Elbow Surg 2015;24:24-30. http://dx.doi.org/10.1016/j.jse.2014.05.016
34. Westermann R, Anthony CA, Duchman K, Gao Y, Pugely A, Hettrich C, et al. Infection following anterior cruciate ligament reconstruction: an analysis of 6,389 cases. J Knee Surg 2016;30:535-43. http://dx.doi.org/10.1055/s-0036-1593617
35. World Health Organization global database on body mass index. <http://apps.who.int/bmi/index.jsp?introPage=intro_3html>; [accessed September 6, 2016].
36. Zywiel MG, Stroh DA, Lee SY, Bonutti PM, Mont MA. Chronic opioid use prior to total knee arthroplasty. J Bone Joint Surg Am 2011;93:1988-93. http://dx.doi.org/10.2106/JBJS.J.01473