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Outpatient Shoulder Arthroplasty—A Systematic Review

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Abstract

Objective: Recent reports have shown that outpatient shoulder arthroplasty (SA) may be a safe alternative to inpatient management in appropriately selected patients. The purpose was to review the literature reporting on outpatient SA.

Methods: A systematic review of publications on outpatient SA was performed. Included publications discussed patients who were discharged on the same calendar day or within 23 hours from surgery. Articles were categorized by discussions on complications, readmissions, and safety, patient selection, pain management strategies, cost effectiveness, and patient and surgeon satisfaction.

Results: Twenty-six articles were included. Patients undergoing outpatient SA were younger and with a lower BMI than those undergoing inpatient SA. Larger database studies reported more medical complications for patients undergoing inpatient compared to outpatient SA. Articles on pain management strategies discussed both single shot and continuous interscalene blocks with similar outcomes. Both patients and surgeons reported high levels of satisfaction following outpatient SA, and cost analysis studies demonstrated significant cost savings for outpatient SA.

Conclusion: In appropriately selected patients, outpatient SA can be a safe, cost-saving alternative to inpatient care and may lead to high satisfaction of both patients and physicians, though further studies are needed to clarify appropriate utilization of outpatient SA.

Keywords

ambulatory, arthroplasty, cuff tear arthropathy, outpatient, replacement, shoulder

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Introduction

Shoulder arthroplasty (SA) is a well-established and effective treatment for patients with glenohumeral joint arthritis. As the world's population ages, both demand for and utilization of shoulder arthroplasty has increased. In 2008, there were approximately 47,000 shoulder arthroplasties performed in the United States.[1] As innovation in SA improves and the indications for treatment expand, there has been an exponential increase in the number of SA performed each year in the United States. Comparing the prevalence of SA between 2000 and 2010, Day et al estimated a 7% to 13% increase per year.[2] By 2017, one study from the National Inpatient Sample found 1,08,300 primary SAs performed.[3] A Poisson model estimated of 3,50,558 SAs by 2025, largely attributable to the rapid increase in reverse total shoulder arthroplasty (RTSA) over the steady increase in anatomic total shoulder arthroplasty (TSA) and decline in hemiarthroplasty (HA).[3–5]

With technological and surgical advancements, improvements in perioperative care, and increasing

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efforts to reduce health care costs, there has been a push towards outpatient SA. Recently in 2021, the Center for Medicare & Medicaid Services (CMS) removed Current Procedural Terminology codes reflecting SA from the inpatient-only list, including codes 23472 (Arthroplasty, glenohumeral joint; total shoulder (glenoid and proximal humeral replacement (for example, total shoulder)) and 23474 (Revision of total shoulder arthroplasty, including allograft when performed; humeral and glenoid component).[6] Furthermore, ambulatory surgical centers (ASC) offer treatment at a significant cost savings compared to traditional hospital-based care.[7] A recent systematic review reported a mean cost savings of 17.6% to 57.6% for ambulatory procedures compared with inpatient procedures.[8] Additionally, surgeons and patients have higher levels of satisfaction with procedures in an ambulatory setting.[8] Recently, there has been more emphasis on outpatient total hip arthroplasty (THA) and total knee arthroplasty (TKA), focusing on a variety of topics including safety,[9,10] patient satisfaction,[11] and cost.[12] One common theme in the literature examining the transition to outpatient surgery is that physicians must be well-informed and balance the push for outpatient management with its safety.[13,14]

In 2018, Brolin et al surveyed 484 active American Shoulder and Elbow Surgeon (ASES) members to evaluate experience with and perceived barriers to outpatient SA.[15] For surgeons already performing outpatient SA, the five biggest barriers were patient comorbidities, patient social support, patient age, concern for medical complications and insurance contracts. For surgeons not performing outpatient SA, the five biggest barriers to performing outpatient arthroplasty were patient comorbidities, patient social support, patient age, concern for medical complication, and readmission risk. Both groups agreed on four of their top five concerns, highlighting the importance of a clear understanding of these issues for performing outpatient SA. The purpose of this systematic review is to evaluate the current evidence of the safety, patient selection, perioperative pain control, costs, and patient and physician satisfaction levels associated with outpatient SA.

Methods

Literature Search

A comprehensive systematic review of the literature was performed using PubMed (Medline) and Embase databases in October 2020 according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The review included the following for search terms: "shoulder replacement" or "shoulder arthroplasty" and "ambulatory" or "outpatient." Prior to data abstraction, the systematic review was registered in the international prospective register of systematic reviews (PROSPERO, registration number CRD42019119808). During full-text review, the reference lists were examined to ensure a full systematic review of the literature.

Study Selection

The inclusion criteria were determined prior to data collection. Articles were included if they had a study population that underwent SA that was discharged on the same day or after a 23-hour stay. Only articles in English were included. Three independent reviewers (SA, EC, DAL) evaluated all titles for eligibility. After title review, relevant abstracts were examined. After title and abstract assessment, the remaining studies underwent a full-text review. Review articles were excluded but the references were evaluated for inclusion.

Data Abstraction

Categories for data collection for each article included author names, study title, journal name, interventions, and outcome measures. Three reviewers (SA, EC, DAL) extracted outcome data on complications and safety, patient selection, pain management strategies, patient satisfaction, surgeon satisfaction, and cost effectiveness.

Results

The initial search generated a total of 226 potentially relevant articles. 51 full text articles were reviewed. Following full text review, 26 articles were included in the review (Figure 1).[16–41] Of the included studies, 18 articles discussed complications, readmissions, and safety,[16–19,21,22,24–33,40,41] 7 articles discussed patient selection,[21,27–31,40] 6 articles discussed pain management,[20,28,34–37] 6 articles discussed the cost implications of outpatient surgery,[15,22,23,30,38,41] 2 articles discussed patient satisfaction,[24,32] and 1 article discussed surgeon satisfaction.[15] The level of evidence of the included articles ranges from Level II to Level V.

Complications, Readmissions, and Safety

The 18 studies examining complications and safety of outpatient SA fall into two categories: retrospective cohorts and series from single centers[16–18,22,24,28,29,32,33,40] and larger database or registry studies (Table 1).[19,21,25–27,30,31,41] Seven studies found higher complications with inpatient SA,[18,21,27,28,30,31,33] one study found higher complications in outpatient SA,[25] four studies found no differences in complications or readmissions,[19,22,29,41] one study had mixed findings,[26] and five studies did not compare inpatient and outpatient SA.[16,17,24,32,40] Brolin et al found no statistical difference between inpatient (10%) and outpatient (13%) complication rates when comparing 30

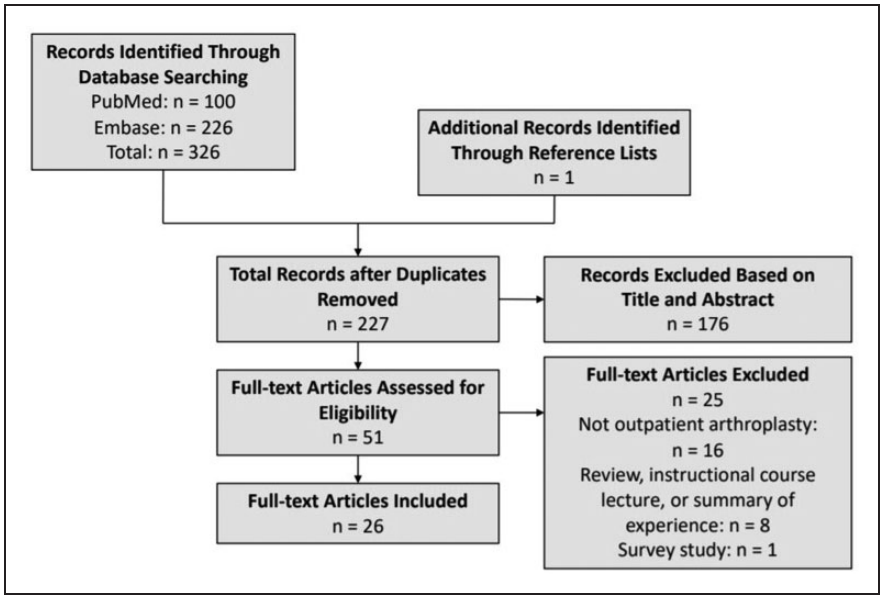

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart for study selection.

inpatient and outpatient SA performed by a single surgeon,[29] and Arshi et al found higher rates of surgical site infections (SSI) requiring irrigation and debridement at 6 months (OR = 1.49; 95% confidence interval (CI), 1.01–2.19; $P = .045$) and 1 year (OR = 1.65; 95% CI, 1.15–2.35; $P < .001$) in an outpatient SA cohort.[26]

Medical complications were more common in inpatient cohorts relative to outpatient SA patients, with complications ranging from 0%–17.7% for inpatients and 0%–15.9% for outpatients.[16,18,21,22,24,25,28,30,31] Common complications identified in the inpatient vs outpatient cohorts were blood transfusion (range, 4.48–4.7% vs 0.49–3.5%), urinary tract infection (range 0.9–8.7% vs 0.58–6.8%) and acute kidney injury (range, 0.4–4.3% vs 0–4.5%).[27,30,31]

Inpatient SA had a higher readmission rate compared to outpatient SA in several studies[21,27,30,33] (OR = 1.8, $P = .016$ for 30-day readmission and OR = 1.8, $P < .001$ for 90-day readmission).[27] Cancienne et al identified obesity, morbid obesity, diabetes mellitus, peripheral vascular disease, congestive heart failure, chronic lung disease, depression and chronic anemia as risk factors for readmission within 90 days after ambulatory SA.[30] The database study by Ode et al. similarly identified obesity as a significant risk factor for readmission ($P < .0001$).[41] Smaller single-center studies have identified no difference in 90-day morbidity or mortality rates between inpatient and outpatient SA.[22,24,33]

In contrast, Kramer et al. found no differences between same-day discharge and in-hospital stay groups in terms of 90-day readmission (OR = 0.71, 95% CI: 0.42-1.20), 90-day ED visits (OR = 1.08, 95% CI: 0.80–1.47), and 1-year mortality (OR = 1.61, 95% CI: 0.63–4.15), ultimately concluding that same-day discharge was not inferior to in-hospital stay SA in terms of 90-day readmission.[19] Harris et al. found higher all-cause 30-day readmission rates in the outpatient cohort (3.4% vs. 1.7%, $P < .01$), but no difference in 30-day readmissions specific to surgical complications (1.9% vs. 1.4%, $P = .32$).[25]

Some studies evaluated different outpatient settings. Charles et al. examined both ambulatory surgical centers and hospital-associated surgical centers and found no differences in complications between the two sites.[17] Ode et al. in noted a trend towards a higher, though not statistically significant, readmission rate for SA cases at an ambulatory center (8%) relative to hospital-based outpatient departments (6%) or inpatient settings (6%) ($P = .0844$).[41]

Overall, more studies reported higher readmission and complication rates for patients having inpatient SA, with diabetes, obesity and cardiac and pulmonary comorbidities as risk factors for readmission.

Patient Selection

Seven studies discussed patient selection for outpatient SA.[21,27–31,40] (Table 2). There were differing reports on the BMI of patients undergoing outpatient SA, with three studies reporting a lower BMI relative to a matched inpatient group,[21,29,31] one study reporting more obese patients in the outpatient SA group,[27] one study reporting no difference between BMI for inpatient and outpatient SA,[30] and one study evaluating only an outpatient cohort.[40] Patients undergoing outpatient SA had consistently fewer medical comorbidities such as

Table 1. Articles and Findings Relating to Complications, Readmissions, and Safety of Outpatient Shoulder Arthroplasty.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
Antonacci et al.[16]	Journal of the American Academy of Orthopaedic Surgeons, 2020	Complications and Readmissions After Reverse and Anatomic Total Shoulder Arthroplasty With Same-day Discharge	III	98 patients (104 arthroplasties) with 52 TSA, 52 RTSA	Retrospective case control	RTSA cohort significantly older than TSA cohort (67.5 ± 7.5 vs. 60.1 ± 7.4 years, $P < .001$) with higher Charlson Comorbidity Index (2.3 ± 0.8 vs. 1.5 ± 0.9, $P < .001$) Three post-operative seromas (5.8%) within 90 days in TSA group No significant differences in complications by procedures or by ASA class by procedures. Four post-operative complications (7.7%): two post-operative seromas, one periprosthetic fracture, one dislocation No 90-day readmissions in TSA group; one readmission for periprosthetic fracture in RTSA group
Arshi et al.[26]	Orthopedics, 2018	Relative Complications and Trends of Outpatient Total Shoulder Arthroplasty	III	1555 outpatient SA 15,987 inpatient SA	Retrospective Database Study (PearlDiver)	Stiffness requiring manipulation under anesthesia significantly lower among outpatients at 6 months (OR = 0.47; 95% CI: 0.34–0.66; $P < .001$) and 1 year (OR = 0.52; 95% CI: 0.38-0.71; $P < .001$) compared to the inpatient group. Post-op surgical site infections requiring I&D and/or arthrotomy was higher among outpatients at both 6 months (OR = 1.49; 95% CI: 1.01–2.19; $P = .045$) and 1 year (OR = 1.65; 95% CI: 1.15–2.35; $P < .001$). No statistically significant difference between the inpatient and the outpatient cohorts of the other queried complications at either 6 months or 1 year.
Basques et al.[27]	The Bone & Joint Journal, 2017	Comparative Outcomes of Outpatient and Inpatient Total Shoulder Arthroplasty: An Analysis of the Medicare Dataset	III	3493 outpatient SA 1,19,854 inpatient SA	Retrospective Database Study (United States Medicare Standard Analytical File)	Inpatient procedures were associated with increased rates of multiple complications: -Acute kidney injury (OR = 2.4, $P < .001$) -Thromboembolic events (OR = 2.5, $P = .005$) -Surgical site infection (OR = 1.9, $P = .037$) -Urinary tract infection (OR = 2.1, $P < .001$) -Hematoma (OR = 6.0, $P = .013$) -Transfusion (OR = 1.8, $P = .041$) -Capsulitis (OR = 3.3, $P < .001$) -Dislocation (OR = 1.6, $P = .017$)

(continued)

Table 1. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
						The 30- and 90-day re-admission after TSA was greater for inpatient procedures than for outpatient procedures (30-day re-admission: OR 1.8, $P = .016$; 90-day re-admission OR = 1.8, $P < .001$). Multivariate logistic regression showed an increased rate of 30-day re-admission after outpatient TSA for patients aged 85 years or more (OR = 34.1, $P < .001$) and patients with COPD (OR 2.7, $P = .036$) No independent risk factors were found for re-admission within 90-days of outpatient TSA
Bean et al.[28]	Journal of the American Academy of Orthopaedic Surgeons Global Research and Reviews, 2018	Outpatient Shoulder Arthroplasty at an Ambulatory Surgery Center Using a Multimodal Pain Management Approach	III	20 outpatient TSA/RSA in free standing ASC with 23 hour stay 40 inpatient TSA/RSA	Retrospective cohort from 2 surgeons at a single institution	-2 outpatients (9.5%) had 90-day minor complications in outpatient group (transient neuropraxia and fall) -7 inpatients (17.5%) had 90 day complications (myocardial infarction and stent; falls; transient neuropraxia; overnight ICU stay for hypoxia; readmission for constipation and superior mesenteric vein thrombosis)
Biron et al.[21]	Journal of the American Academy of Orthopaedic Surgeons, 2020	A Novel Machine Learning Model Developed to Assist in Patient Selection for Outpatient Total Shoulder Arthroplasty	IV	2122 patients with short length of stay ($<$ 1 day), 1006 long length of stay ($\geq$ 3 days)	Retrospective database (American College of Surgeons National Surgical Quality Improvement Program)	Readmission rate was significantly lower in short length of stay patients compared to long length of stay (2.39% vs. 5.51%, $P < .0001$) Revision surgery rate significantly lower in short length of stay patients (1.07% vs. 2.26%, $P = .0175$)
Borakati et al.[22]	World Journal of Orthopaedics, 2020	Day case vs inpatient total shoulder arthroplasty: A retrospective cohort study and cost-effectiveness analysis	IV	18 planned day cases, 41 inpatient stays	Retrospective cohort	No adverse events in both groups No readmissions in both groups
Brolin et al.[29]	Journal of Shoulder and Elbow Surgery, 2017	Neer Award 2016: Outpatient Total Shoulder	III	30 outpatient SA 30 inpatient SA	Retrospective Cohort Study	No re-operations, no hospital admissions. Inpatient complication rate 10% vs 13% in the

(continued)

Table 1. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
		Arthroplasty in an Ambulatory Surgery Center is a Safe Alternative to Inpatient Total Shoulder Arthroplasty in a Hospital: A Matched Cohort Study				outpatient setting, which was not significantly different
Cancienne et al.[30]	Journal of Bone and Joint Surgery, 2017	Ambulatory Total Shoulder Arthroplasty: A Comprehensive Analysis of Current Trends, Complications, Readmissions, and Costs	III	706 outpatient SA 11,041 inpatient SA	Retrospective Database Study (PearlDiver)	Significantly higher rate of UTI (8.7% vs 6.8%, $P=.003$) and blood transfusion (4.7% vs 3.5%, $P=.028$) in inpatient setting compared to the outpatient setting When combining 90 day medical or systemic complications, higher complication rate inpatient 17.7% compared to outpatient 15.9% ($P=.012$) At 1 year, outpatient SA patients had a shoulder specific complication rate of 8.4% vs 8% for inpatient SA
Charles et al.[17]	Journal of Shoulder and Elbow Surgery, 2019	Outpatient shoulder arthroplasty: outcomes, complications, and readmissions in 2 outpatient settings	IV	50 (44 anatomic TSA, 4 RTSA, 2 hemiarthroplasties)	Retrospective case series	6 patients (12%) had post-operative complications including four major: axillary nerve palsy, acute prosthetic joint infection, 2 subscapularis failures; two minor: deep venous thrombosis, postoperative hematoma One (2%) readmission for subscapularis failure No differences in complications whether outpatient surgery was performed at hospital-associated surgical center or ambulatory surgical center No differences in postoperative range of motion or functional scores between the two settings
Erickson et al.[18]	Journal of Shoulder and Elbow Surgery, 2020	Outpatient vs. inpatient reverse total shoulder	III	241 outpatients compared to 373 controls undergoing RTSA	Retrospective cohort	Complication rate significantly lower for inpatients compared to inpatient controls (7.0% vs. 12.7%, $P=.023$)

(continued)

Table 1. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
		arthroplasty: outcomes and complications				4.1% of outpatients had revision surgery (3 incision and debridement, 2 baseplate revision for loosening, 3 revisions for instability, 2 open reduction internal fixation for fracture) Patients who underwent outpatient RTSA had higher preoperative ASES scores (40.5 ± 17.6 vs. 36.3 ± 17.6, $P = .0046$) and 2 yr postoperative ASES scores (82.6 ± 14.3 vs. 78.9 ± 19.6, $P = .0392$)
Fournier et al.[40]	Journal of Shoulder and Elbow Surgery, 2019	Identifying appropriate candidates for ambulatory outpatient shoulder arthroplasty: validation of a patient selection algorithm	IV	61 outpatients	Retrospective series	One (1.6%) had a secondary operation for hematoma evacuation, 3 (4.9%) had transient postoperative nausea, and 4 (6.6%) had additional complications (2 arthrofibrosis, 1 anterior subluxation, 1 subscapularis rupture) within 90 days No readmissions within 90 days
Harris et al.[25]	Orthopedics, 2020	Hospital Readmission Rates Following Outpatient Versus Inpatient Shoulder Arthroplasty	IV	1714 undergoing outpatient TSA, 1714 inpatient TSA	Retrospective database (American College of Surgeons National Surgical Quality Improvement Program)	All-cause 30-day readmission rates higher in outpatient compared to inpatient group (3.4% vs. 1.7%, $P < .01$), but no difference in 30-day readmission for surgical complications (1.9% vs. 1.4%, $P = .32$) No difference in percentage of patients with unplanned return to the operating room (1.5% outpatient vs. 0.9% inpatient, $P = .11$)
Kramer et al.[19]	Journal of Shoulder and Elbow Surgery, 2019	Same-day discharge is not inferior to longer length of in-hospital stay for 90-day readmissions following shoulder arthroplasty	III	405 same-day discharges, 6098 in-hospital stay	Retrospective database (Kaiser Shoulder Arthroplasty Registry)	No differences between same-day discharge group and in-hospital stay group in terms of 90-day readmission (OR = 0.71, 95% CI: 0.42-1.20), 90-day ED visits (OR = 1.08, 95% CI: 0.80-1.47), and 1-year mortality (OR = 1.61, 95% CI: 0.63-4.15) Same-day discharge not inferior to in-hospital stay for 90-day readmission (1-sided OR upper bound = 1.10)
Leroux et al.[31]	Journal of Shoulder and Elbow Surgery, 2016	Outpatient Total Shoulder Arthroplasty: A Population-Based Study Comparing	III	173 outpatient SA 7024 inpatient SA	Retrospective Database Study (American College of Surgeons National Surgical	558 adverse events (7.75%) within 30 days of TSA 4 events (2.31%; n = 173) occurred outpatient 554 events (7.89%; n = 7024) occurred inpatient

(continued)

Table 1. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
		Adverse Event and Readmission Rates to Inpatient Total Shoulder Arthroplasty			Quality Improvement Program or ACS NSQIP)	2 readmissions within 30 days in the outpatient group (1.74%; n = 115), and 173 in the inpatient group (2.93%; n = 5899). In bivariate analysis, the odds of any adverse event were significantly less among the outpatient TSA cohort (OR = 0.28; P = .011). This difference approached but did not reach statistical significance in the multivariate analysis (OR = 0.4; P = .077).
Leroux et al.[32]	Journal of Shoulder and Elbow Surgery, Open Access, 2018	Safety and Patient Satisfaction of Outpatient Shoulder Arthroplasty	IV	41 outpatient SA	Retrospective Case Series	3 post-op complications requiring visit to urgent care within 90 days (Rash, phlebitis, hematoma) all treated conservatively
Nwankwo et al.[33]	Orthopedics, 2018	Outpatient Total Shoulder Arthroplasty Does Not Increase the 90-Day Risk of Complications Compared with Inpatient Surgery in Prescreened Patients	III	118 outpatient SA 64 inpatient SA	Retrospective Cohort Study	No difference between groups in ED visits, mortality or morbidity within 90 days of surgery Significantly higher odds of readmission after inpatient surgery compared to outpatient surgery when all SAs were included with both bivariate and multivariate analysis. This finding was not seen when only examining TSA
Ode et al.[41]	Journal of Shoulder and Elbow Surgery International, 2020	Ambulatory versus inpatient shoulder arthroplasty: a population-based analysis of trends, outcomes, and charges	III	974 outpatient SAs; 37,881 inpatient SAs	Retrospective database (State Inpatient Databases and State Ambulatory Surgery Databases)	State in which procedure was performed associated with readmission (P < .0001) History of obesity significantly associated with readmission (P < .0001) Higher, though not statistically significant, readmission rate for SA cases performed in an ambulatory surgery center (8%) versus hospital outpatient departments (6^) or inpatient settings (6%), P = .0844 On logistic regression analysis, outpatient surgery was not significantly associated with readmission (OR = 1.209, 95% CI: 0.95-1.539)
Tansey et al.[24]	Journal of Shoulder and Elbow Surgery International, 2020	Reverse shoulder replacement: a day-case procedure	IV	21 outpatient	Retrospective series	No readmissions, no immediate postoperative complications, no adverse events

OR: odds ratio; 95% CI: 95% confidence interval; SA: shoulder arthroplasty; TSA: total shoulder arthroplasty; RTSA: reverse total shoulder arthroplasty; ASA: American Society of Anesthesiologists.

Table 2. Articles and Findings Relating to Patient Selection in Outpatient Shoulder Arthroplasty.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
Basques et al.[27]	The Bone & Joint Journal, 2017	Comparative Outcomes of Outpatient and Inpatient Total Shoulder Arthroplasty: An Analysis of the Medicare Dataset	III	3493 outpatient SA 1,19,854 inpatient SA	Retrospective Database Study (United States Medicare Standard Analytical File)	Outpatients were more obese with fewer comorbidities like chronic kidney disease, diabetes, congestive heart failure and coronary artery disease compared to the inpatient cohort
Bean et al.[28]	Journal of the American Academy of Orthopaedic Surgeons Global Research and Reviews, 2018	Outpatient Shoulder Arthroplasty at an Ambulatory Surgery Center Using a Multimodal Pain Management Approach	III	20 outpatient TSA/RSA in free standing ASC with 23 hour stay 40 inpatient TSA/RTSA	Retrospective cohort from 2 surgeons at a single institution	-Outpatients were ASA II (66.7%) vs inpatients ASA III (62.5%) -Outpatients had less cardiopulmonary disease or cerebrovascular injuries prior to surgery (19.1% vs 35%) -Outpatients had less diabetes than inpatients (15% vs 24.3%) -Outpatients smoked less than inpatients (10% vs 18.9%)
Biron et al.[21]	Journal of the American Academy of Orthopaedic Surgeons, 2020	A Novel Machine Learning Model Developed to Assist in Patient Selection for Outpatient Total Shoulder Arthroplasty	IV	2122 patients with short length of stay ($<$ 1 day), 1006 long length of stay ($\geq$ 3 days)	Retrospective database (American College of Surgeons National Surgical Quality Improvement Program)	Multivariable regression predictors associated with long length of stay: age $\geq$ 70 years ($P<.001$), diabetes ($P<.001$), chronic obstructive pulmonary disease ($P<.001$), hypertension ($P=.008$), ASA class >2 ($P<.001$), congestive heart failure ($P=.008$) Multivariable regression predictors associated with short length of stay: male sex ($P<.001$), white race ($P<.001$), surgery performed in more recent year ($P=.001$) Short length of stay average age younger than long length of stay (67.8 years vs. 72.8 years, $P<.0001$) Short length of stay average BMI significantly lower (31.2 vs. 31.7 kg/m^2, $P=.062$)
Brolin et al.[29]	Journal of Shoulder and Elbow Surgery, 2017	Neer Award 2016: Outpatient Total Shoulder Arthroplasty in an Ambulatory Surgery Center is a Safe Alternative to Inpatient Total Shoulder	III	30 outpatient SA 30 inpatient SA	Retrospective Cohort Study	No statistically significant differences were found between the ASC and hospital cohorts regarding age, preoperative ASA score, operative indication, or BMI

(continued)

Table 2. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
		Arthroplasty in a Hospital: A Matched Cohort Study				
Cancienne et al.[30]	Journal of Bone and Joint Surgery, 2017	Ambulatory Total Shoulder Arthroplasty: A Comprehensive Analysis of Current Trends, Complications, Readmissions, and Costs	III	706 outpatient SA 11,041 inpatient SA	Retrospective Database Study (PearlDiver)	Obesity and morbid obesity were the only independent demographic risk factors for readmission ($P=.016$ and $P=.029$, respectively). Medical co-morbidities that put patients at risk for readmission were: -Diabetes mellitus (OR, 1.5; $P=.025$) -Peripheral vascular disease (OR, 1.7; $P=.025$) -Congestive heart failure (OR, 2.0; $P=.014$) -Chronic lung disease (OR, 1.8; $P=.021$) -Depression (OR, 2.4; $P<.0001$) -Chronic anemia (OR, 2.2; $P=.001$)
Fournier et al.[40]	Journal of Shoulder and Elbow Surgery, 2019	Identifying appropriate candidates for ambulatory outpatient shoulder arthroplasty: validation of a patient selection algorithm	IV	61 outpatients	Retrospective series	Patients selected for outpatient SA based on an algorithm approved by surgical and anesthesia teams Average group age: 58 years (37-69) Average BMI: 31 kg/m^2 (21–49) ASA class: 2 ASA I, 39 ASA II, 20 ASA III
Leroux et al.[31]	Journal of Shoulder and Elbow Surgery, 2016	Outpatient Total Shoulder Arthroplasty: A Population-Based Study Comparing Adverse Event and Readmission Rates to Inpatient Total Shoulder Arthroplasty	III	173 outpatient SA 7024 inpatient SA	Retrospective Database Study (American College of Surgeons National Surgical Quality Improvement Program or ACS NSQIP)	Outpatients were younger, more likely to be male, with lower ASA scores with lower BMI and less pulmonary disease and hypertension compared to inpatients. Outpatient operative times were faster than inpatient operative times.

OR: odds ratio; 95% CI: 95% confidence interval; SA: shoulder arthroplasty; TSA: total shoulder arthroplasty; RTSA: reverse total shoulder arthroplasty; ASA: American Society of Anesthesiologists; ASC: ambulatory surgery center.

pulmonary disease, hypertension, chronic kidney disease, diabetes, congestive heart failure and coronary artery disease.[21,27,29–31,40] Patients undergoing outpatient SA were more likely to be younger, male, and with a lower ASA score relative to those treated with inpatient SA.[21,28,31] The machine learning predictive model developed by Biron et al. found that male sex ($P < .001$), white race ($P < .001$), and surgery performed in a recent year ($P = .001$) were all predictive of short length of stay.[21]

Pain Management Strategies

Six articles described strategies for perioperative pain management, including reports on indwelling preoperative continuous nerve catheters, single shot (SS) interscalene nerve blockade (ISB) using ropivacaine or bupivacaine, and pericapsular local anesthetic injection at the time of surgery (Table 3).[20,28,34–37] Studies with indwelling continuous nerve catheters reported no readmissions for anesthetic related complications,[35–37] though one study[35] in the ambulatory group reported 3/8 emergency room visits, 2 of which (25% of the ambulatory group) were related to pain or the catheter. Shah et al evaluated patients with primarily continuous nerve catheters (73/82, 89%) and a small subset of SS interscalene nerve blockade (9/82, 11%).[37] Of the total 82 patients, the initial block was considered inadequate in 7.3% (repeat nerve block was required for 6.1% and 1.2% received additional local anesthetic by the surgeon) and 8.5% of patients required general anesthesia intraoperatively.[37] One study reported on outpatient SA with SS interscalene nerve blockade.[34] One patient (5.1%) presented for a repeat block on post-operative day #1, and no other patients required ED presentation or readmission for pain control. Bean et al reported on outcomes with patients treated primarily with a periarticular local anesthetic injection.[28] Only 9.5% of patients in their cohort received a regional nerve block. Overall, 4.8% of outpatients presented to an ED or Urgent Care within 90 days of surgery, as compared to 5.0% of inpatients.[28] A database study by Chan et al. examining utilization of peripheral nerve blocks found that 19.1% of inpatient SAs and 20.8% of outpatient SAs utilized peripheral nerve blocks, with an increasing trend of use for inpatients in more recent years.[20] The benefits of the nerve block included lower oral morphine equivalents utilized on the day of surgery in each of inpatient and outpatient groups.[20]

Cost Implications

Six articles discussed the individual patient and overall societal cost implications of outpatient SA (Table 4).[22,23,30,38,39,41] All studies consistently reported that outpatient SA can significantly decrease costs associated with SA with average or median USD cost estimations for inpatient surgery ranging from $18,336 to $76,109 compared to $14,722 to $44,530 for outpatient surgery.[23,30,38,39,41] Centers performing a higher volume of SA were less expensive than lower volume centers.[38] Steinhaus et al estimated cost savings between $747 and $15,507 per patient.[39] The authors extrapolated these data to an overall cost savings in 2016 ranged from $4.1 M to $349 M, and 10-year cost savings from 2016 to 2025 varied from $51 M to $5.4B. Ode et al. found the median charge for inpatient cases ($62,905) to be significantly higher than for outpatient cases ($37,395, $P < .001$).[41] These authors also noted median hospital outpatient department costs ($55,990) were significantly higher than ambulatory surgery centers ($31,790, $P < .0001$).[41] When itemized in one study, ambulatory SA had significantly lower PACU costs ($P < .0001$), laboratory costs ($P < .0001$), physical and occupational therapy costs ($P < .0001$), and narcotic prescription costs ($P < .0001$), but significantly higher costs for anticoagulant prescription ($P = .014$) and antiemetic prescription costs ($P = .001$).[30] Another economic analysis by Walters et al. evaluated differences in bundled vs. unbundled payments for outpatient SA, noting that the bundled group had significantly lower charges for implants, total surgical day charges, and staff charges, and similar charges for surgery, anesthesia, and postoperative charges; ultimately, the total charges for the bundled group were significantly lower ($\$42,410.27 \pm \$10,051.50$ vs. $\$44,529.80 \pm \$5367.24$, $P = .024$).[23]

Patient Satisfaction

Two studies specifically addressed patient satisfaction following outpatient SA.[24,32] 35 of 41 patients (85.4%) completed a post-surgical telephone questionnaire in the study by Leroux et al.[32] 94.3% of patients felt ready for outpatient discharge, and all but 2 patients (who needed an overnight stay in the ASC with 23-hour stay capabilities) stated they would have outpatient SA again. 97% of patients reported a good to excellent outpatient experience (poor, fair, average, good, excellent scale). The 2 patients that stated they needed an overnight stay were taking narcotics pre- and post-operatively for chronic non-shoulder related reasons. 16/21 patients in the series by Tansey et al. responded to a satisfaction survey at 12 months post-operatively, with 11 (69%) reporting they were "very satisfied" and 3 (19%) reporting they were "satisfied."[24] 81% of these patients reported they would undergo the surgery again as an outpatient.[24]

Surgeon Satisfaction

One study examined surgeon satisfaction with outpatient SA.[15] An online survey was sent to 484 active ASES

Table 3. Articles and Findings Relating to Pain Management Strategies in Outpatient Shoulder Arthroplasty.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
Banghu et al.[34]	Canadian Journal of Anesthesia, 2017	Single-injection Interscalene Bupivacaine and Dexamethasone for Same-day Discharge Total Shoulder Arthroplasty: A Case Series	IV	19 outpatient SA	Case series (pilot study) examining single shot interscalene nerve blocks	-Onset of shoulder pain at 28 hours (range 17.0-44.5 hours) -Median visual analogue satisfaction score day 5 was 9.5 cm (range 7.1-9.9)
Bean et al.[28]	Journal of the American Academy of Orthopaedic Surgeons Global Research and Reviews, 2018	Outpatient Shoulder Arthroplasty at an Ambulatory Surgery Center Using a Multimodal Pain Management Approach	III	20 outpatient TSA/RTSA in free standing ASC with 23 hour stay 40 inpatient TSA/RTSA	Retrospective cohort from 2 surgeons at a single institution	45% inpatient cohort had interscalene nerve blocks 9.5% outpatient cohort had interscalene nerve blocks 20 mL 1.3% liposomal bupivicaine and 20 mL 0.25% bupivicaine and epinephrine injected periarticularly at end of case Pain scores at 2 weeks 2 for outpatient, 3 for inpatient ($P = .0441$)
Chan et al.[20]	Regional Anesthesia and Pain Medicine, 2020	Peripheral nerve block use in inpatient and outpatient shoulder arthroplasty: a population-based study evaluating utilization and outcomes	IV	3293 outpatient, 94,787 inpatient	Retrospective database (Premier Healthcare claims database)	Peripheral nerve blocks utilized in 18,144 (19.1%) inpatient SAs and 685 (20.8%) outpatient SAs In hospitals where peripheral nerve blocks were used, day 0 oral morphine equivalents decreased by −12.5% (−13.9 to −11.2%) for inpatients and −8.3% (−15.6% to −0.4%) for outpatients ($P < .05$ for each)
Gallay et al.[35]	Clinical Orthopaedics and Related Research, 2008	Development of a Regional Model of Care for Ambulatory Total Shoulder Arthroplasty: A Pilot Study	IV	8 outpatient SA 8 inpatient SA	Case series (pilot study) examining continuous brachial plexus nerve block	8 outpatients discharged, no readmissions, 3 ER visits, average pain 1.0 (range 0–3), average patient satisfaction 1 (very satisfied), all patients said they would have outpatient SA again if given choice 8 inpatients discharged POD 1, no readmissions, 0 ER visits, average pain 1.1 (range 0–3), average patient satisfaction 1 (very satisfied)

(continued)

Table 3. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
						Catheters removed at an average of 6 days for both groups
Ilfeld et al.[36]	Anesthesia and Analgesia, 2005	Total Shoulder Arthroplasty as an Outpatient Procedure Using Ambulatory Prerineural Local Anesthetic Infusion: A Pilot Feasibility Study	IV	6 outpatient SA 8 inaptient SA	Case series (pilot study) examining interscalene catheters for pain control	5 of 8 inpatients met discharge criteria in PACU and POD 1. 1 patient did not meet discharge criteria in PACU but met discharge criteria on POD 1. 6/8 patients were discharged on POD 1, 1 patient was discharged on POD 2 due to high intra-operative blood loss. 1 patient erroneously included in analysis and was subsequently excluded. 5 of 6 outpatients were discharged from PACU, 1 patient was discharged due to ending late in the OR and was subsequently discharged on POD 1. Average numeric pain rating scale ranged from 0-4 between POD 0-3
Shah et al.[37]	Indian Journal of Orthopedics, 2007	Interscalene Brachial Plexus Block for Outpatient Shoulder Arthroplasty: Postoperative Analgesia, Patient Satisfaction and Complications	II	82 consecutive TSA and HA performed in ASC	Prospective cohort examining post-operative pain control, nausea, and patient satisfaction with continuous vs single injection interscalene nerve block	73 (89%) patients with continuous interscalene nerve blocks, 9 (11%) patients with single injection interscalene nerve blocks Pain scores (0-10 scale) at rest 0.8 ± 2.3 in PACU, 2.5 ± 3.1 at 24 h and 2.8 ± 2.1 at seven days Nausea scores (0-10 scale) 0.2 ± 1.2 in the PACU, and 0.4 ± 1.4 at 24 h with 3 patients requesting anti-nausea medication Satisfaction scores (0-5 scale) were 4.8 ± 0.6 and 4.8 ± 0.7, respectively, at 24 h and seven days.

SA: shoulder arthroplasty; TSA: total shoulder arthroplasty; RTSA: reverse total shoulder arthroplasty; ASC: ambulatory surgery center.

Table 4. Articles and Findings Relating to Cost Implications of Outpatient Shoulder Arthroplasty.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
Borakati et al.[22]	World Journal of Orthopaedics, 2020	Day case vs inpatient total shoulder arthroplasty: A retrospective cohort study and cost-effectiveness analysis	IV	18 planned day cases, 41 inpatient stays	Retrospective cohort	Mean cost of admission: £260 per day Cost of catheter insertion, infusion, and removal: £56 Median savings with outpatient arthroplasty: £529 (interquartile range: 247.33-789, $P<.0001$).
Cancienne et al.[30]	Journal of Bone and Joint Surgery, 2017	Ambulatory Total Shoulder Arthroplasty: A Comprehensive Analysis of Current Trends, Complications, Readmissions, and Costs	III	706 outpatient SA 11,041 inpatient SA	Retrospective Database Study (PearlDiver)	Outpatient SA had significantly lower cost per patient ($14,722) compared to inpatient SA ($18,336) ($P<.0001$) Ambulatory SA had significantly lower: -PACU costs ($P<.0001$) -Laboratory costs ($P<.0001$) -Physical and occupational therapy costs ($P<.0001$) -Narcotic prescription costs ($P<.0001$) Ambulatory SA had significantly higher costs for -Anticoagulant prescription ($P=.014$) -Antiemetic prescription costs ($P=.001$).
Gregory et al.[38]	Journal of Shoulder and Elbow Surgery, 2018	Quantification of patient-level costs in outpatient total shoulder arthroplasty	IV	1542 outpatient SA 21,331 inpatient SA	Retrospective Database Study	Inpatient SA costs $76,109 (SD $48,981) vs outpatient SA $22,907 (SD $13,599); ($P<.001$) Inpatient SA remained 41.1% more expensive than outpatient SA ($32,330 SD $24,221 vs $22,907 SD $13,599; $P<.0001$) after excluding inpatient specific costs. High-volume inpatient SA was less expensive than low-volume inpatient SA
Ode et al.[41]	Journal of Shoulder and Elbow Surgery International, 2020	Ambulatory versus inpatient shoulder arthroplasty: a population-based analysis of trends, outcomes, and charges	III	974 outpatient SAs; 37,881 inpatient SAs	Retrospective database (State Inpatient Databases and State Ambulatory Surgery Databases)	Median charge for inpatient cases $62,905 (range, $41,327-$87,881) was significantly higher than median charge of $37,395 (range, $21,976-$61,775) for outpatient cases ($P<.0001$) Adjusting for covariates (demographics, comorbidities, readmission, regional anesthesia, and state), charges for combined outpatient SA were 40% lower than for inpatient SA ($P<.0001$)

(continued)

Table 4. Continued.

Author	Journal and Year	Title	Level of Evidence	Number of Patients	Study Design	Findings
						Hospital outpatient departments costs were significantly higher than ambulatory surgery center costs (median $55,990 for hospital vs. $31,790 for ambulatory center, $P < .0001$)
Steinhaus et al.[39]	Journal of Orthopaedics, 2018	Outpatient Total Shoulder Arthroplasty: A Cost-identification Analysis	V	NA	Cost Estimation Model	Inpatient example case = $3300 per inpatient day Ambulatory SA could save $5594 compared to 2.2 day inpatient stay For low and high cost assumptions the savings could be between $747 and $15,507 per patient. Assuming 15,000 total outpatient SAs performed in 2016 in the US -2016 cost savings estimated to be $82 M. -10-year cost savings from 2016 to 2025 estimated $1.1B. For low and high cost assumptions, overall cost savings in 2016 ranged from $4.1 M to $349 M, and 10-year cost savings from 2016 to 2025 varied from $51 M to $5.4B.
Walters et al.[23]	Journal of the American Academy of Orthopaedic Surgeons, 2020	Bundled Payment Plans Are Associated With Notable Cost Savings for Ambulatory Outpatient Total Shoulder Arthroplasty	III	76 outpatient anatomic TSAs (39 bundled payment group, 37 unbundled)	Economic analysis	Bundled group was significantly older (58 ± 6.3 years vs. 54 ± 7.9 years, $P = .021$) Total charges were lower for the bundled group for: -Implants ($3583.08 difference, $P = .014$) -Total surgical day charges ($3456.25 difference, $P = .022$) -Staff charges ($27.18 difference, $P = .015$) -Total charges ($2119.53 difference, $P = .024$) Similar charges between groups for surgery, anesthesia, and postoperative charges

SA: shoulder arthroplasty; TSA: total shoulder arthroplasty; RTSA: reverse total shoulder arthroplasty.

members, which was completed by 37% (179 participants) of members. Only 20.7% (37/179) surgeons performed outpatient SA. Of those surgeons performing outpatient SA, 78.4% (29/37) reported an excellent experience overall.

Discussion

The aims of this study were to summarize the literature on the safety and feasibility of outpatient SA. Though there is a lack of high-quality randomized control trials examining outpatient SA, our review summarizes the available evidence that suggests that outpatient SA can be a safe procedure with potentially lower overall associated costs and high patient satisfaction scores in carefully selected patient populations. In the near future, higher volume studies are expected given the increasing nature of outpatient SA. Outpatient SA rates have increased over time, and this trend is exemplified by the fact that 12/26 (46.2%) articles included in the review were published in 2019 or 2020.[16–25,40,41]

With the push towards outpatient management of SA, it is important for institutions and individual physicians to independently determine if they are prepared to transition from the inpatient to outpatient setting using these evidence-based criteria for patient selection. All but two studies[25,26] examining complications and readmissions included in this review show either no difference or increased complication rates with inpatient SA compared to ambulatory SA, especially patients with diabetes or pulmonary or cardiac co-morbidities.[27,29–31,33] Our review found overall higher complication rates for inpatient SA compared to outpatient SA when looking at larger database studies, but these results should be interpreted with caution. There is selection bias as these studies were performed retrospectively, and patients with more comorbidities were selected for the inpatient setting. It was found that patients undergoing ambulatory surgery were more likely to be younger males with a lower relative BMI and a low ASA score compared to their matched inpatient cohorts, and had a lower readmission rate.[28,29,31] This concept was further emphasized by Fournier et al who recommended inpatient SA for patients with advanced age, increased BMI and pulmonary or cardiac comorbidities.[40]

To help physicians better select patients for outpatient surgery, Fournier et al outlined a decision tree used at their institution. In order to qualify for outpatient SA, patients had to be under 70 years old with a pre-op hematocrit >30. Two or more pulmonary comorbidities (sleep apnea, morbid obesity, and chronic obstructive pulmonary disease) were a contraindication for outpatient surgery, and cardiac comorbidities (coronary artery disease, hypertension, and congestive heart failure) were risk stratified based on timing of intervention and cardiology clearance.[35]

It is important to consider the definition of outpatient SA when interpreting published results. Of the included articles in this review, only 2 studies published from the same group evaluated same day discharge from a free-standing outpatient surgery center without 23-hour stay.[29,40] While some studies discussed same calendar day discharge, many of the database studies and retrospective reviews do not specify the setting of same-day surgery. Performing outpatient same-day surgery in a free-standing ASC without a 23-hour stay capability and discharge on the same calendar day of surgery has different safety and cost implications compared to performing outpatient SA in an ASC physically connected to a hospital or with 23-hour stay capabilities. In the study by Ifeld et al. valuating post-operative pain control, there was one patient admitted in the outpatient group due to the case ending late.[36] The protocol of transitioning a patient from an outpatient to an inpatient stay can be logistically and financially complex, especially in a true free-standing ASC without 23-hour stay abilities. These scenarios should be considered, and an action plan formulated for potential patients requiring ongoing care when developing an outpatient SA program.

The concept of outpatient arthroplasty is not new, especially in the realms of hip and knee arthroplasty. In hip and knee literature, patient social support is a key theme for successful outpatient joint arthroplasty.[42,43] For patient selection, Leroux et al mentioned that a reliable caregiver at home was a requirement for outpatient SA.[32] Ensuring appropriate social support for early recovery should be considered when selecting patients for outpatient SA.

As interest in cost reductions for joint arthroplasty grows, especially given the initiation of bundled payments, there has been more research investigating the true cost of outpatient arthroplasty. Outpatient TKA and THA have been shown to be more cost effective than inpatient surgery, with savings driven primarily by the costs of the inpatient stay.[44,45] The findings from all studies included in this review evaluating outpatient compared to inpatient costs demonstrate similar cost reductions when SA was performed in the outpatient setting.[22,30,38,39,41] It is important to consider potential disincentives towards efficient and affordable care delivered in the outpatient setting. Hospital systems may lose facility fees, and lose revenue related to inpatient admissions, while surgeons with ownership in surgery centers may be financially motivated to perform these surgeries in an outpatient setting. As SA was just recently approved as an outpatient procedure with Medicare with the 2021 CMS updates, previous limitations in utilization may improve over time.[6,28] Regulatory support is necessary

to ensure access to outpatient procedures for appropriately-indicated patients, regardless of their payor status. Current data demonstrate approximately $2119.53 in cost savings in patients undergoing outpatient SA with bundled payment plans.[23]

Appropriate pain control is also a key component of successfully performing SA in the outpatient setting. The included studies suggest a possibly higher rate of re-presentation after discharge with indwelling nerve catheters rather than SS interscalene nerve blocks or even local periarticular anesthetic injection, though the included studies have small sample sizes. Swenson et al reported outcomes of 620 patients treated with indwelling catheters for post-operative pain, including 190 patients with interscalene catheters.[46] There was an overall 4.2% rate of patients requiring re-intervention by the anesthesiologists, with the highest rate (6.8%) seen in patients with interscalene catheters. Additionally, five patients with an interscalene catheter had dislodgement of the catheter during the early post-operative period with three patients requiring repeat SS nerve block.[46] Ilfeld et al. reported that a continuous infusion of ropivacaine via catheter decreased the time to discharge following shoulder arthroplasty relative to patients treated with placebo nerve catheter infusion.[47] These studies demonstrates low rates of complications of continuous nerve catheters but emphasizes the importance of having post-operative systems in place to manage these instances when they arise to minimize potential need for re-admission or treatment through an ED. Additionally, future clarification of the role of continuous nerve catheters relative to perineural injection or single-shot injection would be beneficial in determining the optimal regional anesthetic for outpatient SA.

Both patient and surgeon satisfaction are important considerations when transitioning to outpatient management of SA. With the possibility of reimbursements being linked to patient satisfaction and a push towards value-based care, both of these metrics are being more closely examined. Patients report high satisfaction scores following outpatient SA,[24,32] and Brolin et al showed that 78.4% of surgeons performing outpatient SA reported an excellent experience.[15] If both patient and surgeon satisfaction scores are higher in the outpatient setting and SA can be safely performed in the outpatient setting, the proportion of outpatient SA is likely to continue to increase.

Our current review is not without limitations, primarily related to the limitations of the included studies. There are limited studies on outpatient SA and most of these studies represent lower-quality evidence with small sample sizes. The studies that compare complication rates between inpatient and outpatient SA have selection bias, though still do demonstrate that this procedure may be performed safely with appropriate and careful patient selection. Given the heterogeneity of the outcome measures reported, we are also not possible to perform a meta-analysis to provide more quantitative synthesis of the data. Furthermore, given the heterogeneity in reporting and small numbers, we are unable to break down outcomes reliably by SA type such as TSA, RTSA, and HA.

Conclusion

This systematic review demonstrates that outpatient SA, when performed in appropriately selected patients, can be a safe, cost-effective alternative to inpatient SA that leads to high levels of patient and surgeon satisfaction. Given the lack of high-level evidence, however, future research is needed to establish appropriate patient selection and utilization of outpatient SA.

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