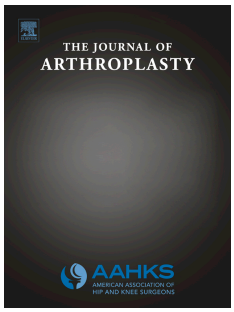

A Proposed Patient Selection Algorithm for Total Joint Arthroplasty Same-Day Discharge from an Ambulatory Surgery Center

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A Proposed Patient Selection Algorithm for Total Joint Arthroplasty Same-Day Discharge from an Ambulatory Surgery Center

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A Proposed Patient Selection Algorithm for Total Joint Arthroplasty Same-Day Discharge from an Ambulatory Surgery Center

Abstract

Introduction: Identifying appropriate patients for same-day discharge total joint arthroplasty (TJA) is critical for maintaining optimal patient safety and outcomes. This study investigated patient outcomes after same-day discharge TJA at a single ambulatory surgery center (ASC) and proposes a TJA patient-selection algorithm based on findings and existing literature.

Methods: A retrospective chart review of 660 patients was performed between July 2019 and October 2021 for all patients who underwent primary TJA in a single ASC. Successful same-day discharge (SDD), length of surgery (LOS), estimated blood loss (EBL), complications, and readmission events were recorded for each patient. There were 20 total complications in 331 primary total knee arthroplasties (TKAs) (6.0%) and 15 total complications in 329 primary total hip arthroplasties (THAs) (4.6%).

Results: There was one direct admission to the hospital in TKA patients and four direct admissions in THA patients, making the successful SDD rate 99.7% in TKAs, 98.8% in THAs, and 99.2% overall. In the TKA cohort, body mass index (BMI) was associated with total complications *(r* = -0.15, *P* = 0.006), comorbidities with wound complications (*P* = 0.006), and EBL was with readmissions (r = 0.30, *P* < 0.001), revision surgery (*r* = 0.12, *P* = 0.04), and total complications *(r* = 0.16, *P* = 0.03). In the THA cohort, BMI was weakly associated with wound complications (*r* = -0.12, *P* = 0.02), EBL was with emergency department visits (*r* = 0.18, *P* = 0.002) and total

complications (r = 0.14, P = 0.01). However, there was no direct association between any of the analyzed characteristics and direct admission.

Conclusion: In our ASC cohort, patients had low rates of perioperative complications and hospital admissions, supporting the safety of same-day discharge TJA using our proposed evidence-based algorithm to guide patient selection for same-day discharge.

Keywords: same-day discharge, outpatient total joint arthroplasty, patient selection algorithm

Introduction

Primary total joint arthroplasty (TJA) continues to be one of the most common orthopaedic procedures performed today. With a rising elderly population, the demand for primary TJAs has been rising for several decades. Traditionally, inpatient hospital stay following TJA has been the standard of care [1]. However, advances in surgical and anesthetic techniques, perioperative pain control, and accelerated physical rehabilitation have allowed for decreased length of stay (LOS) [2]. This natural progression has resulted in a rising trend towards same-day discharge in certain patient populations. Same-day discharge (SDD) following TJA started to increase in prevalence in the early 2010s, as we noted a 0.95 to 20.5% increase between 2011 and 2015 [3]. With the onset of the COVID-19 pandemic, the appeal of outpatient surgery and same-day discharge continued to rise for patients and providers to reduce exposure risks [4]. Additionally, the removal of primary total hip arthroplasty (THA) in 2020 and primary total knee arthroplasty (TKA) in 2018 from the inpatient-only list by the Centers for Medicare and Medicaid (CMS) further fueled the transition to outpatient TJA [4]. A study by Agarwal et al. found that between January 2018 and February 2021, the percentage of elective TKA volume performed in the outpatient setting increased by 183.4% [4]. Outpatient total joint arthroplasty is projected to surpass inpatient at 51% in 2026 [5]. The recent literature suggests equivocal or improved patient outcomes regarding complications and readmission associated with outpatient TJA [1].

As SDD and outpatient TJA continue to rise in popularity, it is important to continue to critically analyze and optimize patient safety. This priority is reflected in a 2018 statement from the American Association of Hip and Knee Surgeons (AAHKS) stressing patient safety as a core principle for physicians providing outpatient TJA [6]. The organization urged providers and facilities to closely monitor and review patient demographics and outcomes in regard to SDD and

to discontinue outpatient TJA if rates of complications were unsatisfactory. Today, centers across the world continue to implement facility-specific criteria for optimal patient selection. There remains a population of patients with important medical or social factors that likely require inpatient TJA in contrast to a population of healthy, younger patients that are easily selected for outpatient TJA. However, the challenge is determining the optimal postoperative plan for patients who are somewhere in between the ends of that spectrum. Several studies have reported on important factors to consider, including age, medical comorbidities, and social factors [7]. The decision for inpatient versus outpatient or SDD is complex and ultimately requires patient-specific shared decision-making. However, developing easily applicable protocols supported by evidence can help guide physicians in patient selection. This study investigated the outcomes after same-day discharge TJA at a single ambulatory surgery center (ASC) to determine associations between pre-operative factors and post-operative complications. Using our existing exclusion criteria and protocol, we present a TJA patient-selection algorithm based on findings and existing literature to help guide optimal patient selection for SDD.

Methods

Case Selection

Following institutional review board approval, charts and records were reviewed for all patients between July 1, 2019, and October 31, 2021, who underwent primary THA and TKA in a single free-standing ASC. Our total patient cohort is representative of five different arthroplasty surgeons operating at this free-standing ASC. A total joint arthroplasty protocol was developed in conjunction with anesthesia based on a review of the literature on patient optimization and patient factors that increase the risk of medical and surgical complications (Figure 1). Per the total joint arthroplasty protocol in this free-standing ASC, patients were excluded from arthroplasty at this ASC if they had major cardiac or pulmonary disease, poorly controlled diabetes, pre-operative anemia, lack of home support, pre-operative opioid use, body mass index (BMI) > 38, age > 80 years, or current smoking status.

Data Collection

Patient charts were retrospectively reviewed, and data was collected for patient demographics and peri-operative factors including attending surgeon, surgical approach, estimated blood loss (EBL), and successful SDD. Post-operative complications were also recorded including failure to discharge or direct admission to the emergency department (ED), 30 and 90-day readmission events, wound complication, infection, revision surgery or return to operating room (OR), and instability.

Patients Characteristics

A total of 331 primary TKAs were included in our study. These patients had a mean age of 62 years (range, 26 to 86), 55% being men, a mean BMI of 30.1 (range 21.4 to 39.5), a mean ASA of 1.9 ± 0.4, a mean CCI of 2.0 ± 1.1, and a mean EBL of 76.5 ± 35.1 ml (Table 1). All TKAs

were performed with a standard medial parapatellar approach with tourniquet use, cementing, and implant design at the discretion of the attending surgeon. There were 20 total complications in 331 primary TKAs (6.0%). There were seven ED visits (2.1%) (four wound drainage/dehiscence, one constipation, one knee instability, and one pyelonephritis), seven wound complications (2.1%) (four wound drainage, three cellulitis/adhesive reaction), five readmissions (1.5%) (one vomiting and diarrhea, one presumed periprosthetic joint infection (PJI), one pulmonary embolism, one pneumonia, and one new-onset atrial fibrillation), four revision surgeries (1.4%) (one for stiffness, one for aseptic loosening, one incision and drainage with poly exchange, and one for instability), and one post-operative instability or dislocation (0.3%). All wound complications except for one with PJI requiring revision were resolved with local wound care and/or oral antibiotics. There was one direct admission or failure to discharge for syncope and transient hypotension (0.3%) with the procedure having occurred under spinal anesthesia and nerve block, making our successful same-day discharge rate 99.7%.

A total of 329 primary THAs (191 with a direct anterior approach, 71 with a posterior approach, and 67 with an antero-lateral approach) were included in our study. These patients had a mean age of 60 years (range, 27 to 81), 49% being men, a mean BMI of 28.0 (range, 18.8 to 37.4), a mean ASA of 1.7 ± 0.5, a mean CCI of 1.8 ± 1.0, and a mean EBL of 222.9 ± 74.0 ml (Table 1). There were 15 total complications in 329 primary THAs (4.6%). There were five revision surgeries (1.5%) (one 2-stage revision for infection, one abductor repair, one head, one cup revision for instability, and one open iliopsoas release), four ED visits (1.2%) (one gastrointestinal bleed, one wound drainage, one calf deep vein thrombosis (DVT), and one dislocation reduced in the ED), four readmissions (1.2%) (one gastric ulcer, one dislocation requiring head liner exchange, one dislocation requiring cup revision, and one iliopsoas bursitis),

three wound complications (0.9%) (three wound drainage treated with local wound care), and three postoperative instability or dislocations (0.9%). There were four direct admissions or failure to discharge (1.2%), making our successful same-day discharge rate 98.8%. There was one patient who had general anesthesia and a posterior approach who was admitted for post-operative hypoxia and later diagnosed with sleep apnea. There were two patients who had antero-lateral approaches with spinals, and were admitted for orthostasis. The last patient had a direct anterior approach with spinal and was admitted for postoperative nausea and emesis.

Data Analyses

In order to determine whether there are significant correlations between any preoperative variables and postoperative complications, we used the Pearson correlation coefficient to compare continuous preoperative variables (age, BMI, EBL) with the binary postoperative complications and the *Chi*-square test to compare categorical preoperative variables (gender, American Society of Anesthesiologists (ASA) score, the Charlson comorbidity index (CCI)) with the binary postoperative complications in TKA and THA separately. We used the standard *P*-value of less than 0.05 to determine statistically significant correlations.

Results

Total Knee Arthroplasty

There were no associations between failure to discharge and any of the demographic variables or baseline and operative characteristics. However, BMI was weakly associated with total complications (r = -0.15, P = 0.006), CCI was associated with wound complications (P = 0.006), and EBL was weakly associated with readmissions (r = 0.30, P < 0.001), revision surgery (r = 0.12, P = 0.04), and total complications (r = 0.16, P = 0.03) (Table 2).

Total Hip Arthroplasty

There were no associations between failure to discharge and any of the demographic variables and baseline and operative characteristics. However, BMI was weakly associated with wound complications (r = -0.12, P = 0.02), EBL was weakly associated with ED visits (r = 0.18, P = 0.002) and total complications (r = 0.14, P = 0.01) (Table 3).

Discussion

This retrospective study reports on the complications following same-day discharge of TKA and THA performed at a single free-standing ambulatory surgery center. Our total complication rate of 6.0 and 4.6% in TKA and THA, respectively, was comparable to other studies reporting on total complications following SDD total joints, ranging from 2 to 11% [8–10]. However, it is important to note variations in how studies define total complications. In total, there were five direct admissions or failure to discharge, making the successful SDD rate 99.2%, which was superior to current reports ranging from 51 to 93% [11,12]. In our cohort, we found a statistically significant correlation between decreasing BMI and increased wound and total complications. Increased risk of postoperative complications has been well-documented in association with morbidly obese patients (BMI > 40). However, underweight patients (BMI < 20), though less studied, have been shown to have an increased risk of surgical site infection, periprosthetic fracture, and dislocation following TJA [13,14]. Potential risk factors in the underweight cohort include nutritional deficiencies impairing bony and soft-tissue healing potential as well as reduced subcutaneous fat, predisposing the surgical wound to dehiscence or necrosis [13,14]. While morbidly obese patients were screened from outpatient surgery by our selection criteria, there was no formal threshold for underweight patients, which merits further investigation and consideration in pre-operative risk assessment. Furthermore, CCI was associated with wound complications. In fact, poorly controlled diabetes as well as other comorbidities were shown to increase the risk of wound infections [13,15,16]. In addition, EBL was associated with readmission, ED visits, reoperations, and total complications. High intra-operative blood loss could lead to several complications in addition to transfusions, which were shown to be associated with postoperative infections, mismatched transfusions, acute lung injury, and allergic reactions

[17–22]. There were otherwise no statistically significant associations between pre- and perioperative factors and direct admissions.

There have been well-established, identified risk factors associated with poorer outcomes in total joints in the literature, including BMI, age, and pre-existing comorbidities. Nowak et al. found that particular variables associated with 30-day morbidity in outpatient TKA included age 68 or older, chronic dyspnea, COPD, and a BMI of 31.4 or higher [23]. They also found that possible protective factors included younger age, men, lower BMI, higher hematocrit, and fewer comorbidities prompting outpatient over inpatient surgery [23]. Higher BMI > 40 has also been associated with longer operative time, readmission rate, infection, and various postoperative complications [13]. Interestingly, despite an increased risk profile, morbidly obese patients have still been found to have a consistent improvement in pain and function following arthroplasty [13]. As noted by the diversity in the literature, the optimal threshold for BMI does not exist, and patients at the extremes of underweight or morbidly obese should be optimized and selected thoughtfully for outpatient arthroplasty.

There are multiple other factors related to failure for same-day discharge following outpatient total joint arthroplasty. In our study, we had one TKA that required direct admission due to syncope in the recovery unit, while our THA patients were admitted for either orthostasis, emesis, or hypoxia. Some of these complications may have been secondary to spinal anesthesia, as sequelae such as transient hypotension and nausea and vomiting have been reported [24]. However, more serious complications such as dural puncture, lasting neurologic deficits, urinary retention, and infection were not observed, supporting our utilization of spinal anesthesia [24,25].

Further investigation and management of post-spinal sequelae could continue to improve our patient outcomes and successful discharge rates following planned outpatient arthroplasty.

Some reasons cited in the literature for failed SDD are prior opioid use, longer surgical time, failure to receive a pre-operative nerve block, or complications with older age or comorbidities [12]. Other studies found that the most common factors associated with failed SDD were logistical issues such as procedure start time after 11 am or general anesthesia, or failure to meet ambulation goals and pain control [26]. These studies show that modifiable perioperative factors play an important role in successful SDD following TJA. One study that looked at patient satisfaction following outpatient procedures at two academic medical centers found that 94.6% of patients undergoing TJA would choose outpatient surgery again, with a total of two admissions and no repeat readmissions [27]. The success of their outpatient TJAs could be attributed to their preoperative protocol requiring patient engagement and consent, formal education, postoperative pain control plan, immediate physical therapy, and home support. Another study utilizing standard questionnaires found that patients preferred outpatient arthroplasty compared to inpatient, which further supports improved patient satisfaction with SDD at home [28].

Based on our promising results, we utilized our current patient selection criteria to create a concise and effective algorithm to guide orthopaedics in shared decision-making for SDD (Figure 1). In addition to the selection criteria highlighted in our algorithm, our facility has developed a comprehensive treatment pathway that includes medical screening, formal in-person pre-operative education, perioperative medications sent before surgery, physical therapy in the recovery room, and coordinated transportation home and home care services. We believe that these measures contribute significantly to our excellent patient outcomes and cost savings and should be implemented across surgery centers.

Potential Limitations

There are a few potential limitations to the current study. Given the retrospective nature of the study, there was no randomization or matched controls for this study. Additionally, there were five independent arthroplasty surgeons contributing to our patient cohort with differing surgical techniques and postoperative care protocols, which could have affected our findings. Furthermore, details about the surgical procedures such as the use of cement, local anesthetics, usage of a tourniquet, and cruciate-retaining or posterior-stabilizing implant, were not collected. Given our low rate of complications, it is possible that significant associations were undetected and could be better evaluated with a larger sample size. While we comprehensively reviewed all the electronic medical record systems available in our system, it is possible that patients sought care outside of our single-health network and their complications were not captured in our chart review. Future studies should focus on factors associated with failure to discharge and patient-reported outcome measures, which were not specifically addressed in our study, to further optimize the efficacy of SDD in TJA.

Conclusion

In our ASC cohort, patients had low rates of perioperative complications and hospital admissions, supporting the safety of same-day TJA in the ASC setting. Utilizing our pre-existing patient selection criteria and pertinent literature, we recommend an evidence-based selection algorithm to help further guide providers in patient selection for outpatient TJA. In addition to objective selection guidelines in place, it is essential to have standardized pre- and post-operative treatment and education pathways in place to optimize outcomes and efficiency.

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Figure Legend:

Title (Table 1): Summative Analysis of Pre-operative Variables versus Complications

Table 1. *P* values denoting statistically significant correlations between pre-operative variables and complications using Pearson correlation and *Chi*-square. Highlight denotes significance $P < 0.05$

Abbreviation key: emergency department (ED), American Society of Anesthesia (ASA), Charlson Comorbidity Index (CCI), body mass index (BMI), estimated blood loss (EBL)

Title (Figure 1): Patient Selection Algorithm for Same Day Discharge Total Joint Arthroplasty

Figure 1. Comprehensive flow chart representing recommendations and process for determining patient candidacy for arthroplasty and optimal surgical setting

Abbreviation key: body mass index (BMI), coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), complete blood count (CBC), basic metabolic panel (BMP)

Variables	Total Knee Arthroplasty (TKA) (n=331)	Total Hip Arthroplasty (THA) (n=329)
Age (years) (mean ± SD)	62 ± 7.8	60 ± 7.9
Number men n (%)	182 (55)	161 (49)
Body Mass Index (mean ± SD)	30.1 ± 4.2	28.0 ± 4.3
ASA (mean ± SD)	1.9 ± 0.4	1.7 ± 0.5
Charlson Comorbidity Index (mean ± SD)	2.0 ± 1.1	1.8 ± 1.0
Estimated blood loss (ml) (mean ± SD)	76.5 ± 35.1	222.9 ± 74.0

Table 1: Demographics and baseline characteristics of the TKA and THA cohorts

Variables	ED visits	Readmissions	Revision	Dislocation	Wound complication	Direct admission	Total Complications
Age	0.90	0.96	0.15	0.35	0.23	0.83	0.30
Sex	0.63	0.12	0.77	1.00	0.64	0.92	0.11
Body Mass Index	0.47	0.23	0.16	0.69	0.13	0.10	**0.006**
ASA	0.18	0.53	0.87	0.09	0.87	0.09	0.69
Charlson Comorbidity Index	0.87	0.39	0.57	0.88	**0.006**	0.99	0.70
Estimated blood loss (ml)	0.82	**< 0.001**	**0.04**	0.45	0.48	0.50	**0.03**

Table 2: Association between perioperative characteristics and adverse events in the TKA cohort. *P* values are listed. (TKA: Total knee arthroplasty; ASA: American Society of Anesthesiology)

Variables	ED visits	Readmissions	Revision	Dislocation	Wound complication	Direct admission	Total Complications
Age	0.85	0.10	0.09	0.24	0.77	0.71	0.27
Sex	0.64	1.00	0.97	1.00	0.98	0.65	1.00
Body Mass Index	0.66	0.76	0.80	0.44	**0.02**	0.22	0.78
ASA	0.98	0.46	0.38	0.56	0.29	0.98	0.93
Charlson Comorbidity Index	0.52	0.83	0.94	0.56	0.93	0.44	0.91
Estimated blood loss (ml)	**0.002**	0.60	0.60	0.88	0.07	0.46	**0.01**

Table 3: Association between perioperative characteristics and adverse events in the THA cohort. *P* values are listed. (THA: Total hip arthroplasty; ASA: American Society of Anesthesiology)