Arthroplasty Today 27 (2024) 101354

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original Research

Successful Transition to Same Calendar Day Discharge in Total Joint Arthroplasty at an Academic Center

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ARTICLE INFO

Article history:
Received 15 August 2023
Received in revised form
7 February 2024
Accepted 14 February 2024
Available online xxx

Keywords:
Total joint arthroplasty
Outpatient
Disparities

ABSTRACT

Background: There has been a shift toward same-day discharge (SDD) in total joint arthroplasty (TJA) in recent years. Our clinical standard had been next-day discharge, but the COVID pandemic led to a hospital bed shortage, causing us to shift to SDD directly from the Post-Anesthesia Care Unit (PACU). The aim of our project was to investigate if the SDD protocol was successful and if it changed complications or 90-day readmission rates. Our secondary aim was to investigate if the protocol created disparities in patient selection.

Methods: A retrospective review compared the first 100 patients intended to discharge from PACU to the 100 patients prior to the SDD protocol undergoing elective primary TJA procedures at our academic institution from September 1, 2020, to March 23, 2021. The SDD protocol started on November 19, 2020.

Results: During this SDD period, 98% (98/100) of patients were successfully discharged from the PACU. The 90-day readmission rate changed from 0% to 2% ($P = .4975$), and the overall complication rate changed from 2% to 5% ($P = .4448$). Most complications were manipulation under anesthesia to improve range of motion. Manipulations under anesthesia changed from 1% to 4% ($P = .3687$).

Conclusions: The transition to same SDD in TJA at our academic institution was successfully implemented without markedly increasing complications, readmissions, or changing patient selection. The COVID-19 pandemic likely influenced the recovery of patients before and after the protocol. Future studies are needed to validate this data during the post-COVID era.

Introduction

There has been a shift toward same-day discharge (SDD) in total joint arthroplasty (TJA) in recent years [1,2]. Many factors have led to this movement including preoperative optimization, rapid recovery pathways, and the removal of TJA from the Medicare inpatient-only list. Outpatient TJA has been shown to have fewer adverse events with no increase in 30-day readmission rates compared to inpatient TJA [3-5].

Some patients, however, are not ideal candidates for outpatient TJA due to medical conditions requiring perioperative monitoring (ie, cardiopulmonary disease), social issues such as living alone or upstairs, and patients with poor baseline physical function. Our group has previously published on exclusion criteria for outpatient total knee arthroplasty (TKA) including medical and psychosocial factors [6]. Selection criteria play a critical role in upholding rigorous standards for patient safety in outpatient TJA. However, it is imperative to ensure that these criteria do not incorporate any implicit bias.

A recent national study found notable disparities in the utilization of outpatient TJA between different racial groups, with black patients exhibiting lower rates compared to white patients [7]. This highlights the importance of addressing potential systemic barriers and ensuring equitable access to outpatient TJA for all patients, irrespective of their racial or ethnic background.

The previous standard at our academic institution was next-day discharge for elective TJA, which was successful for 96% of patients [8]. Recently, the COVID-19 pandemic created a shortage of hospital

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https://doi.org/10.1016/j.artd.2024.101354

beds and an aversion to admitting otherwise healthy patients to avoid viral exposure. This limited bed availability and recent literature demonstrating its safety led our group to consider all TJA patients for SDD and to discharge them home directly from the Post-Anesthesia Care Unit (PACU).

This study was conducted at a large tertiary academic medical center. To our knowledge, only one other large tertiary academic medical center has published the results of an outpatient TJA program [3]. Most of the literature about outpatient arthroplasty programs has been described at ambulatory surgery centers or orthopaedic hospitals, where greater resources allow for coordinated program implementation [9].

We hypothesized that the protocol would be successfully implemented without increasing complications or 90-day readmission rates. Secondarily, we hypothesized that the protocol created disparities in patient selection.

Material and methods

Study design

This study design was a retrospective cohort review that compared the first 100 patients intended to discharge from PACU after the protocol to the 100 patients prior to the protocol. In each group, the sample size is a convenience sample instead of one constructed from a power analysis. These patients all underwent elective primary TJA procedures at our academic institution from September 1, 2020, to March 23, 2021. The SDD protocol started on November 19, 2020. The study was approved by our institution's Institutional Review Board. Patient data was collected from the electronic medical record.

Patients undergoing primary TJA of the knee or hip, Current Procedural Terminology 27,447 and 27,130, respectively, were included. Exclusions were patients under 18 years of age, patients with linked hardware removal and conversion surgery, patients with International Classification of Diseasese diagnosis of acute femoral neck or acetabular fracture, septic joint or septic arthritis, and patients with a planned admission during the protocol period.

We collected baseline patient demographics, including age, body mass index (BMI), American Society of Anesthesiologists (ASA) scores, Elixhauser comorbidity index, and patient address. We also obtained length of stay (LOS), PACU LOS, 90-day readmission, diagnosis/Current Procedural Terminology code, and procedures performed.

Patient addresses were used to calculate the area deprivation index (ADI). The higher the ADI, the more deprived the area. ADIs are broken down by national percentile and state decile. ADIs were calculated using the Neighborhood Atlas webpage by the University of Wisconsin−Madison and validated by multiple studies [10].

Continuous patient characteristics (age, BMI, Elixhauser comorbidity index) were summarized by SDD group (before vs after SDD implementation) as means and standard deviations (SDs) and compared for differences between groups using Wilcoxon's rank-sum test. LOS and PACU LOS were summarized and analyzed in the same way. Because only 4 patients (2.0%) and 5 patients (2.5%) had ASA scores of 1 and 4, respectively, we dichotomized ASA scores as 1 or 2 vs 3 or 4. Dichotomized ASA scores, 90-day readmission rates, overall complications, and manipulations under anesthesia (MUAs) were summarized as numbers and percentages and compared for group differences with Fisher's exact test.

Same calendar-day discharge protocol

Specific details regarding our general anesthesia protocol; primary total hip arthroplasty (THA) and TKA protocols such as preoperative optimization, intraoperative techniques, and postoperative protocols; and physical therapy (PT) protocols can be found in our previous studies [8].

Patient selection

Preoperatively, we assessed the patient's willingness and candidacy for outpatient TJA. Our group has also published on medical and psychosocial exclusion criteria factors, such as congestive heart failure, end stage renal disease, BMI > 35, age > 70, lives alone, weak social support, lack of transportation, history of smoking, chronic narcotic use, etc. [6] Although our group has published these guidelines, strict adherence to these criteria or a calculator such as the Outpatient Arthroplasty Risk Assessment was not performed [11]. We previously performed a systematic review of many of the TJA risk stratification tools and found that they are neither fully comprehensive nor universally applicable in all instances [12]. The decision for outpatient TJA was ultimately based on the operating surgeon's clinical discretion and patient willingness based on preoperative discussion of expectations. Patients understood that if they did not have a same-day TJA, their surgery would be delayed until the hospital census improved and/or COVID conditions relaxed.

To evaluate changes in patient selection under this protocol, we compared demographic factors between the pre- and post-outpatient groups, including age, gender, race, BMI, Elixhauser comorbidity index, ASA scores, as well as national and state ADI scores. Although ASA scores and Elixhauser comorbidity index are not specifically in the selection criteria, there is overlap between these scores and the conditions in the criteria that could have tended to exclude higher-scoring patients after the transition to SDD. Similarly, although the geographic location where one lives is not an exclusion criterion, a change in the protocol could have tended to exclude patients that live in more deprived geographic areas through lack of transportation or immediate social support at home, thereby leading to a lowering of ADI scores after the protocol's implementation [6].

Additions to established protocols

Preoperatively, the patients received a single-shot peripheral nerve block from the anesthesia team. TKAs routinely received adductor canal blocks, but the blocks for THAs were variable including pericapsular, lateral femoral cutaneous blocks or no block at all. No patients received epidurals.

No dedicated outpatient operating rooms (ORs), recovery rooms, or staffing were provided. All the surgeries in this series were performed in traditional inpatient ORs. Intraoperatively, all patients underwent general anesthesia, as previously described [8]. Patients were transferred to the PACU in standard fashion. The changes in PACU were that patients worked with PT in a side hall to mobilize and assess safety with transfers, received durable medical equipment, received a second dose of intravenous cephalosporin, and cleared our discharge criteria. These changes and the discharges were overseen by our Advanced Practice Registered Nurse. The discharge criteria include that the patient remained hemodynamically stable during mobilization after surgery, tolerated oral fluids, had adequate pain control with oral medications, was safely ambulated with PT, and had a combined sign-off with the surgical team and anesthesia provider [6].

Otherwise, our group maintained typical follow-up without extra patient phone calls or assignment to a care coordinator. We maintained our system to address patient questions via our "after-hours" telephone line, which is staffed by the surgeons and mid-level team members that we have previously described [13].

Exclusions

During the SDD period, 6 patients were scheduled to stay overnight and were excluded from the analysis. Two of the six patients had a history of sickle cell disease and had a planned overnight stay to monitor for sickle cell disease pain crisis precipitation at the recommendation of each of the patients' hematologists. The third patient had a planned overnight stay for a history of malignant hyperthermia and an aortic aneurysm. The fourth patient had a planned overnight stay due to her age (95 years old) with poor social support at home. The fifth patient underwent a planned overnight stay to work specifically with inpatient PT at their gym to clear her 8 stairs to get into the home. The sixth patient was an inmate and underwent a planned overnight stay with lab monitoring prior to discharging back to prison per the correctional facility's established policies.

Results

Patient selection

When comparing the patients before and after the SDD protocol was implemented, the average age changed from 64.6 to 62.4 years old ($P = .29$). Average BMI changed from 29.7 to 30.1 kg/m^2 ($P = .84$). The average Elixhauser comorbidity index changed from 2.0 to 1.7 ($P = .63$). The percentage of black patients changed from 25% to 14% ($P = .11$). The percentage of females changed from 60% to 50% ($P = .20$). The number of patients with an ASA of 3 or 4 decreased from 50% to 37% ($P = .09$). No significant differences were noted in state or national ADI ($P = .46$ and $P = .66$) (Table 1).

Table 1
Patient characteristics.

Patient characteristic	Before (n = 100)	After (n = 100)	*P*-value[a]
Age (y)			.29
mean (SD)	64.6 (11.0)	62.4 (13.0)	
Gender, percent (N)			.20[b]
Female	60% (60)	50% (50)	
Male	40% (40)	50% (50)	
Race, percent (N)			.11[b]
Black	25% (25)	14% (14)	
White	73% (73)	82% (82)	
Other	2% (2)	4% (4)	
BMI (kg/m^2)			.84
mean (SD)	29.7 (5.9)	30.1 (5.5)	
Elixhauser comorbidity index,			.63
mean (SD)	2.0 (6.8)	1.7 (6.9)	
ASA Score, percent (N)			.09[b]
ASA 1 or 2	50% (50)	63% (63)	
ASA 3 or 4	50% (50)	37% (37)	
Arkansas State ADI score (decile)			.46
mean (SD)	3.8 (3.0)	4.1 (2.9)	
National ADI score (percentile)			.66
mean (SD)	59.8 (26.1)	61.5 (25.6)	

ADI, area deprivation index.
[a] *P*-values are from Wilcoxon's rank-sum test.
[b] Fisher's exact test.

Failure to launch patients

During the SDD period, 98% of patients were successfully discharged from the PACU. Prior to the protocol, all 100 patients stayed at least one night in the hospital. The 2 patients who were "failures to launch" and underwent an unplanned overnight observation were both discharged the following morning. The first patient was oversedated, slow to wake up in the PACU, and was not able to clear PT. The patient subsequently cleared PT the next morning and was able to safely discharge home. The second patient had an episode of supraventricular tachycardia with right bundle branch block and hypoxia in PACU. The supraventricular tachycardia did not respond to initial vagal maneuvers; cardiology was consulted, and the patient was observed overnight. The patient was then discharged the subsequent morning with a beta blocker and a 14-day monitor as an outpatient, per the cardiology team's recommendations.

Readmissions and complications

The 90-day readmission rate changed from 0% to 2% ($P = .50$) in the SDD group.

The first readmission after the protocol was implemented was for intractable hematemesis after Duracef was started 2 weeks postoperatively for a superficial wound reaction about the TKA incision. The second readmission in the SDD group was for recurrent THA instability requiring an unplanned return to the OR for revision THA.

The overall complication rate changed from 2% to 5% ($P = .44$) after the change to SDD. Prior to the SDD protocol, 2 patients experienced a complication: one TKA patient required a MUA, and a second THA patient underwent outpatient irrigation and debridement for superficial dehiscence that did not track deep to the fascia. The 5 complications after the protocol were 4 TKA patients who required MUA and a THA patient requiring outpatient irrigation and debridement for superficial dehiscence that did not track deep to the fascia. Overall, patients requiring a MUA changed from 1% to 4%. ($P = .37$). Criteria for MUA were <90 degrees of flexion by 4-6 weeks postoperative visit. (Table 2) Prior to the protocol, one patient required a MUA. This patient had chronic pain preoperatively and cited COVID closures for why the patient was unable to go to many PT sessions postoperatively. After the protocol, 4 patients required a MUA. The first patient cited poor pain control with PT. The second patient cited poor driving conditions and icy weather as reasons why the patient did not complete the requisite PT. The third patient with a history of congestive heart failure and elevated BMI had significant swelling and pain postoperatively that limited improvement with PT. The fourth patient had a preoperative knee flexion contracture with a remote history of tibial osteomyelitis. Two of the 4 surgeons accounted for all the MUAs with one surgeon accounting for 4 of the 5.

PACU LOS

PACU LOS group means (SDs) were 116 (54) minutes before SDD was implemented, vs 165 (63) minutes after it was implemented ($P < .0001$).

Discussion

The transition to same calendar day discharge from PACU in TJA was successfully implemented at our academic institution, and although we did not find a statistically significant increase in complications, 90-day readmission rates, or disparities in patient selection, there were a few concerning trends.

After the protocol, 90-day readmission rate changed from 0% to 2%, and the overall complication rate changed from 2% to 5%, but neither were statistically significant. These numbers are slightly higher than the readmission rate and complication rate described by Hoffman et al. in the systematic review of outpatients, where the readmissions were 0.89% and complications were 1.29% [9]. MUAs made up most of our complications, which changed from 1% to 4% but was not statistically significant. While the Hoffman systematic review showed a mere 0.5% of outpatient arthroplasty patients required an MUA out of 1009 cases, a larger national study with

Table 2
Manipulation under anesthesia (MUA).

Patient	Time of MUA (days PO)	Preoperative ROM (prior to TKA)	ROM day of MUA	Intraoperative ROM after MUA	6 wk PO ROM	Final ROM
A	49	−5 to 110	10-65	5-120	20-85	Lost to f/u after 6 wks
B	54	0-140	2-90	0-120	3-130	10 mos 0-130
C	42	0-100	5-45	2-115	n/a	Lost to f/u
D	45	10-80	0-80	0-115	3-110 at 2wk	0-125 at 3 mos
E	36	15-90	0-82	0-110	0-120 at 2wk	0-120 at 1 y

PO, post operative; ROM, range of motion.

141,000 patients in the PearlDiver database revealed rates of up to 4.3% for MUA in unilateral TKAs [9,14]. The reasons for the increase in MUAs in our patients are difficult to ascertain with a smaller sample size and are likely multifactorial. Two of these patients started with limited preoperative range of motion (ROM), 10-80 and 15-90, which may bias the results. The COVID-19 pandemic likely influenced the recovery of all our patients before and after the protocol. The COVID-19 pandemic started in March 2020. In the patient sample prior to the protocol, the first surgery was performed in November 2020. Although COVID did not affect the fact that these patients were staying overnight prior to the SDD protocol, COVID likely affected the postoperative course. In fact, the one patient requiring an MUA prior to the protocol cited COVID closures of PT as a contributing factor. COVID closures were not documented as reasons for the other patients undergoing MUA, but they may have been an implicit contributing variable. Stricter adherence to our exclusion criteria could potentially have decreased the MUAs, with 4 of the 5 patients requiring a MUA having a BMI > 35, but only one had a BMI > 37.

Patient selection did not significantly change based on proxies including BMI, age, Elixhauser comorbidity index, ASA score, or state and national ADI scores. Although not statistically significant, our data did show a trend toward younger age and a lower Elixhauser comorbidity index. This trend is in line with a recent national study of the PearlDiver database of 1.75 million TKA and THAs, with 2.9% TKA and 2.2% THA SDDs, which showed that patients undergoing SDD were younger with fewer comorbidities [15]. In our study, although the change in black patients, from 25% to 14%, was not statistically significant, it is a concerning trend in light of the recent national study showing that black patients are less likely to utilize outpatient TJA [7]. These trends are likely multifaceted and may stem more from inequities in access to care including sociodemographic barriers and support networks not adequately captured in our data than underlying comorbidities. If we had a larger sample size, we may have found similar results to these national studies.

We observed a higher rate of discharge on the day of surgery (98%) compared to what was documented in a preceding study at a large tertiary academic medical center (79%) without major changes to our selection criteria [3]. Our discharge rate was similar to a systematic review by Hoffman et al., which had a cumulative discharge rate of 94.5% for a total of 1009 patients, but most in this review were outpatient surgical facilities or orthopaedic hospitals [9]. Our previous standard of next-day discharge for 96% of patients was certainly a great foundation to build on [8]. During that period, PT would see the patient on the floor the afternoon of surgery and routinely have everything arranged for the patient to discharge the next morning. Adapting these responsibilities to the PACU for SDD was a relatively smooth transition, as we utilized our orthopaedic advanced practitioner to coordinate recovery education and streamline therapy, which proved less challenging than some anticipated.

PACU LOS only increased 49 minutes after the SDD protocol. PACU LOS before and after SDD were less than that of another academic center implementing a similar SDD, where the average LOS was 351 minutes for outpatients and 236 minutes for inpatients [3]. Our PACU LOS was more in line with PACU LOS in ambulatory surgery centers [3]. The time increase in our patients was likely due to patients working with PT, receiving DME, receiving outpatient meds, discharge instructions from nurses and midlevel providers, and discharge orders being implemented. It should be noted that all our patients underwent rapid-recovery general anesthesia along with standardized regional anesthesia before and after the protocol and did not change due to SDD. Factors that minimized the time increase likely include coordination from the TJA floor Advanced Practice Registered Nurses, excellent communication between PT and case managers, and potentially COVID decreasing PACU volume of other inpatient surgeries at the time and allowing for a higher staff-to-patient ratio in PACU. Although the accrual was slower after the initiation of the same-day protocol (100 patients in 2.5 months pre, 100 patients in 4.5 months post), the average number of primary TJA surgeries per day in each group were similar and likely did not affect the ability to participate in SDD (2.56 vs 2.22, pre vs post). The change in surgical volume per day was due overall to decrease elective surgeries throughout our hospital system to allow for resource utilization for COVID care.

There are several limitations to our study. This is a retrospective study at a single academic institution in a rural southern state during the COVID pandemic which may mean our results are not generalizable to other populations. There may be other factors influencing patients' decisions to discharge from PACU such as COVID fear factors specific to this period. Although the readmission numbers could have been affected by postop patients being less likely to come to the hospital for readmission due to concerns of COVID exposure, this was not expressed to our surgeons, and there were not any more stringent readmission criteria before or after the pandemic. Nearly all primary TJAs during this period who did not agree to SDD were delayed, which may have led to a selection bias. We did not differentiate between THA and TKA. We may have failed to capture subtle differences in demographic variables between groups by using ASA scores and the Elixhauser comorbidity index as proxies rather than considering individual factors. Based on data collection and analysis, we felt these proxies would be best for this sample size. If a larger sample size had been utilized, it is possible that the trends observed in our data would have demonstrated a statistically significant difference regarding complications, readmissions, and disparities in patient selection. Furthermore, our sample sizes were convenience samples rather than those determined from a power analysis. Future studies are needed to validate this data during a non-COVID era to improve the external validity.

Conclusions

A large academic tertiary care hospital with several surgeons can successfully and rapidly implement SDD TJA without increasing complications or readmissions or creating disparities in patient selection. The time increase in PACU is not burdensome. Despite the

lack of statistically significant differences in complications, 90-day readmission rates, or patient selection variables, we consider the trends identified in our data to hold value for readers to consider when transitioning to SDD at their institution.

Conflicts of interest

C. Lowry Barnes receives royalties from DJO and Zimmer; is a paid consultant of MicroPort Orthopaedics; has stock options in Avantgarde Health, BEKHealth, Clozex Medical, Excelerate Health Ventures, Green OR, Hayle Surgical, In2Bones SAS, MiCare Path, Plakous, Ride Health, ROM3 Rehab, LLC, Sleep Partners, LLC, and Sniffle; is an editorial/governing board member of Journal of Knee Surgery and Journal of Surgical Orthopaedic Advances; and is a board/committee member of American Association of Hip and Knee Surgeons, HipKnee Arkansas Foundation, and Southern Orthopaedic Association. B. M. Stronach receives royalties from MiCare Path, Sawbones/Pacific Research Laboratories, and Tightline Development LLC; is a speaker bureau of DJ Orthopaedics; is a paid consultant of DJ Orthopaedics and Johnson & Johnson; has stock options in Joint Development LLC; is an editorial board member of JBJS-Br; and is a board/committee member of AAOS and the American Association of Hip and Knee Surgeons. S. C. Mears has stock options in Delta Ortho LLC; is an editorial board member of the Journal of the American Geriatrics Society and SAGE; and is a board/committee member of Fragility Fracture Network. J. B. Stambough receives royalties from Signature Orthopaedics; is a paid consultant and receives financial/material support from Smith & Nephew; is an editorial board member of the Journal of Arthroplasty; and is a board/committee member of American Association of Hip & Knee Surgeons (AAHKS), Education Committee (AJRR), and Steering Committee. All other authors declare no potential conflicts of interest.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101354.

CRediT authorship contribution statement

Candler G. Mathews: Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Jeffrey B. Stambough:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Benjamin Stronach:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Eric R. Siegel:** Formal analysis, Validation. **C. Lowry Barnes:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Simon C. Mears:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing.

Acknowledgments

The project described was supported by the Translational Research Institute (TRI), grant UL1 TR003107 through the National Center for Advancing Translational Sciences of the National Institutes of Health (NIH). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. In addition, the Bill and Betty Petty Research Fund at the University of Arkansas for Medical Sciences supported this work.

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