ORIGINAL RESEARCH

Migration of Hospital Total Hip and Knee Arthroplasty Procedures to an Ambulatory Surgery Center Setting and Postsurgical Opioid Use: A Private Practice Experience

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BACKGROUND: An enhanced recovery pathway using individualized multimodal pain management with scheduled nonopioid and opioid regimens previously enabled reproducible same-day discharge of Medicare beneficiaries and commercially insured patients undergoing total hip arthroplasty (THA) or total knee arthroplasty (TKA) procedures in the hospital or in ambulatory surgery center settings.

OBJECTIVES: To analyze the migration trends for TKA and THA procedures from a hospital to an ambulatory surgery center facility and to assess perioperative outcomes before and after incorporating liposomal bupivacaine into a multimodal pain management regimen for these procedures.

METHODS: This retrospective medical chart review study included patients undergoing THA or TKA with an enhanced recovery pathway in a hospital or an ambulatory surgery center between 2013 and 2019. The outcome measures included length of stay at the hospital or the ambulatory center, and opioid consumption. We compared the outcomes before and after the addition of liposomal bupivacaine to surgeon-applied periarticular intraoperative local anesthetic field blocks between in-hospital patients who received and patients who did not receive liposomal bupivacaine in 2013 and 2014, and the impact of liposomal bupivacaine use in the hospital versus the ambulatory center from 2015 to 2019.

RESULTS: In 2013 and 2014, the addition of liposomal bupivacaine increased the same-day hospital discharge rate to 32% versus 4% without liposomal bupivacaine (odds ratio, 14.3; 95% confidence interval, 5.9-33.3; $P < .0001$); the same-day hospital discharge rates increased to 73% in 2015. From 2015 through 2019, 89% of all patients were discharged on the same day from the hospital. In-hospital opioid use was 22% lower in the liposomal bupivacaine cohort than in the patients who did not receive this medication ($P = .0035$). In 2018 and 2019, same-day discharge from the hospital or the ambulatory surgery center rates were 96% and 100%, respectively, and 84% of the patients used postsurgical opioid prescriptions of 30 or fewer tablets. The complication rates and healthcare resource utilization did not increase with the incorporation of liposomal bupivacaine into the enhanced recovery pathway and increased same-day discharge rates.

CONCLUSION: An enhanced recovery pathway using individualized, scheduled multimodal pain management protocol in patients undergoing THA or TKA facilitated reproducible, high same-day discharge rates and low postoperative opioid consumption. These results suggest that the use of liposomal bupivacaine for intraoperative field blocks supports predictable same-day discharge rates after THA or TKA. This protocol could facilitate same-day hospital discharge and the migration of THA and TKA procedures from the hospital to lower-cost ambulatory surgery centers.

KEY WORDS: ambulatory surgery center, enhanced recovery pathway, hospital discharge, knee and hip arthroplasty, liposomal bupivacaine, pain management, postsurgical opioid use

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Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are highly prevalent procedures, with more than 1.5 million primary procedures originally projected to be performed in the United States in 2020 before the 2019 coronavirus pandemic.[1] Traditionally, THA and TKA have been expensive inpatient procedures.[2] In 2017, osteoarthritis was the second most expensive condition with Medicare as the expected payer among US hospitals, with aggregate hospital costs of $11.3 billion and 713,000 hospital stays[3]; as such, the migration of TKA and THA procedures to outpatient settings, while also maintaining low complication rates, is desirable to lower the overall healthcare-related expenses.[3-6]

The Centers for Medicare & Medicaid Services (CMS) eliminated TKA and THA from the inpatient-only list of procedures in January 2018 and in January 2020, respectively.[7,8] As of January 2020, CMS also reimburses TKA procedures performed in an ambulatory surgery center and as of January 2021, THA procedures performed in ambulatory surgery centers.[8,9]

The ability to perform total joint replacement, including THA and TKA, in outpatient settings has been facilitated by advancements in surgical and perioperative pain management techniques that have reduced the facility length-of-stay requirements and have enabled greater rates of same-day discharge.[10-14] The migration of THA and TKA to the outpatient setting requires consistent and reproducible same-day discharge to home; however, the previous rates of successful same-day discharge varied from 74% to 100%.[12-15] The reasons for unsuccessful same-day discharge include opioid-related adverse events (eg, postoperative nausea and vomiting), inadequate pain management, the inability to meet physical discharge requirements, reduced motor function, sensory deficits, and patient preference.[12,15,16]

Opioid use may have advantages and disadvantages for securing same-day discharge after THA or TKA; opioids are effective analgesics that can help to meet pain management needs and facilitate facility discharge, but they can be associated with adverse events postoperative (eg, nausea, vomiting, sedation) and the risk for misuse/chronic addiction.[12,15-18] Opioid overprescribing, diversion, addiction risk, and adverse events have inspired the use of multimodal pain management to limit these concerns and to facilitate same-day discharge in lower extremity arthroplasty procedures.[13,14,17,18]

Since our previous reports of our enhanced recovery pathway using individualized scheduled nonopioid and individualized limited-opioid multimodal pain management,[13,14] multiple studies have reported successful multimodal pain management programs, with suggestions for scheduled versus nonscheduled multimodal pain management medication combinations containing a variety of opioid and nonopioid pain medications.[19-21] In many cases, these studies have recommended limited postsurgical opioid prescriptions (ie, limiting the quantity and dose strength) for opioid-naïve patients.[19-21]

Liposomal bupivacaine, a long-acting formulation of bupivacaine, can be combined with bupivacaine in periarticular injections in multimodal pain management programs,[14,20,22] and can reduce in-facility opioid use, decrease length of stay, improve pain control, and help attain functional milestones.[22-24]

Our previously published retrospective studies involved 821 patients who were undergoing THA or TKA procedures, including patients with Medicare insurance who had the procedure in an inpatient setting (N = 601) or patients with commercial insurance who had the procedure in an ambulatory surgery center (N = 220) between 2015 and 2017.[13,14] We used an enhanced recovery pathway aimed at presurgical optimization and individualization of scheduled multimodal pain management regimens (opioid and nonopioid). This pathway enabled high same-day facility discharge rates (84% for inpatient; 100% for ambulatory surgery center), low opioid use beyond an initial 1-week postsurgical prescription (16% for inpatient; 18% for ambulatory surgery center), high levels of patient satisfaction with postoperative pain control (98% for inpatient; 99% for ambulatory surgery center), and low postsurgical complication rates and low healthcare resource utilization.[13,14]

To the best of our knowledge, these were the first published studies to demonstrate the effects of a postsurgical multimodal pain management program using a scheduled nonopioid pain medication regimen for postsurgical home opioid consumption after THA or TKA. In addition, these studies were the first to report the use of presurgical opioid and nonopioid pain medications for the individualization of perioperative multimodal pain management programs.[13,14]

With the use of such preoperative investigations, we were able to limit or eliminate many of the causes of unsuccessful same-day discharge to home as a result of a standardized multimodal pain management program that did not take into account patient-specific responses to medications (eg, quality of pain control and adverse events).[12,15,16] In addition, we were able to tailor the opioid dose to the minimum dose that is considered effective for each patient.

These previous studies had several limitations. The development of the enhanced recovery pathway began in 2010 with the goal of meeting the "triple aim" of healthcare (ie, patient satisfaction, population health, and value), while maximizing the proportion of all patients who could participate in our enhanced recovery pathway.[14,25] At that time, few studies were available to

validate which enhanced recovery pathway elements would be required for safe and reproducible same-day facility discharge after THA or TKA.

This current retrospective analysis expands on our previous studies,[13,14] by characterizing outcomes with an enhanced recovery pathway protocol established through trial and error. Previous enhanced recovery pathway components that were explored without success at our study center before 2013 included general anesthesia, periarticular local anesthesia without liposomal bupivacaine, and spinal anesthesia with bupivacaine hydrochloride.

The goals of this current article were to investigate the migration trends for TKA and THA procedures from a hospital to an ambulatory surgery center facility between 2013 and 2019; to assess the perioperative outcomes before and after incorporating liposomal bupivacaine into a multimodal pain management regimen for TKA and THA; and to provide updated data regarding complications, same-day facility discharge rates, and opioid consumption using the enhanced recovery pathway protocol that we used in our previous studies.[13,14]

Methods

This retrospective medical chart review study was conducted from 2013 to 2019 using data for patients undergoing THA or TKA that was performed by a single surgeon (JVH) in a hospital inpatient setting or a freestanding ambulatory surgery center. JVH performed all the THA and TKA procedures during the study duration. The study was approved by 2 Institutional Review Boards; the patients' data were deidentified, and waivers of written informed consent were granted by the Institutional Review Boards.

We developed the enhanced recovery pathway protocol used in this study to improve patient-centric outcomes. All patients who were undergoing THA or TKA in the hospital or the ambulatory surgery center setting were considered eligible for this enhanced recovery pathway. The components of this enhanced recovery pathway have been described in detail previously,[14] and its major elements are listed in **Appendix Table 1** (available at **www.AHDBonline.com**).

The enhanced recovery pathway protocol incorporated individualized patient-specific multimodal pain management regimens and surgeon-applied periarticular interoperative local anesthetic field blocks injections, which included bupivacaine, ketorolac, epinephrine, and saline administered between 2013 and June 2014, and liposomal bupivacaine mixed with bupivacaine hydrochloride, administered from June 2014 onward.

The opioid regimens were initiated on the day of surgery and continued on a scheduled basis until the liposomal bupivacaine field block subsided (within 1-3 days) or until the patient wished to discontinue the treatment. Patients were advised to discontinue opioids as soon as possible. The enhanced recovery pathway program did not have any major pathway changes between 2013 and the end of 2015, except for the addition of liposomal bupivacaine in June 2014 and the substitution of chloroprocaine for bupivacaine in August 2015.

All available charts from 2013 to 2014 for patients who underwent TKA or THA with or without receiving liposomal bupivacaine in a hospital setting were included in the study. Liposomal bupivacaine use began for patients who had THA in June 2014 and for patients who had TKA in February 2014. Between 2015 and 2019, the first patient from the first surgery day of the month for each procedure (ie, TKA or THA) for each month of the year was included, followed by patients from the second surgery day of each month. This pattern was repeated until approximately the a priori number of patients (approximately 100 annually) were included in the study, except for 2019, when 114 patients were included.

The study's clinical outcomes included perioperative opioid exposure; postdischarge opioid consumption in morphine milligram equivalents (MMEs); and postsurgical complications, which were grouped as major events (ie, deep-vein thrombosis or pulmonary embolism, dislocation or fracture, and infection), and any other complications (eg, urinary tract infection, constipation).

The health economic outcomes included same-day discharge to home without home services, hours spent in the facility, readmissions to a hospital facility, return for surgery within 8 weeks, and emergency department visits. In the 2013 to 2014 period, we compared patients in the hospital setting who received liposomal bupivacaine versus patients who did not receive liposomal bupivacaine. In the 2015-2019 study period, we compared patients undergoing THA or TKA in the hospital setting versus patients undergoing the procedures in the ambulatory surgery center setting.

The patient-reported opioid consumption from discharge after procedure to week 8 was available for the 2018-2019 period. At 4 weeks and 8 weeks after the procedure, patients were asked about their consumption of opioid tablets, the length of their opioid use (in days), and if they received the prescriptions from any other source. We monitored the opioid prescriptions from our internal records and cross-referenced them through the state of Oregon prescription monitoring program (ie, the opioid prescription data from 2 years before the procedure and up to 8 weeks after) to validate the patient-reported consumption. Overall, 2 patients who had long-term opioid use and undetermined pill counts were excluded from the analysis of the postdischarge opioid

Table 1 Patient Cohorts, by Year

Year	Patients receiving liposomal bupivacaine: Hospital setting, N (%)[a]	Patients receiving liposomal bupivacaine: Ambulatory surgery center setting, N (%)[a]	Patients not receiving liposomal bupivacaine: Hospital setting, N (%)[a]	Patients not receiving liposomal bupivacaine: Ambulatory surgery center setting, N (%)[a]	All patients, N (%)[b]
2013	NA	NA	77 (100)	NA	77 (8.5)
2014	223 (68.8)	NA	101 (31.2)	NA	324 (35.7)
2015	83 (83.0)	17 (17.0)	NA	NA	100 (11.0)
2016	71 (72.4)	27 (27.6)	NA	NA	98 (10.8)
2017	71 (72.4)	27 (27.6)	NA	NA	98 (10.8)
2018	71 (74.0)	25 (26.0)	NA	NA	96 (10.6)
2019	81 (71.1)	33 (28.9)	NA	NA	114 (12.6)
Total 2013-2019	600 (66.2)	129 (14.2)	178 (19.6)	0	907 (100)

[a]Percentage of annual total.
[b]Percentage of all patients.
NA indicates not applicable.

consumption. Patient satisfaction rates were not available for the study period, because of a change in the electronic medical record system.

Statistical Analysis

A multivariate general linear model with binomial distribution and logit link was used for categorical outcomes, such as same-day facility discharge and gamma distribution with log link, for the perioperative opioid exposure and postdischarge opioid consumption outcomes, which were reported in MMEs and length of stay (reported as hours in the facility).

The covariates included age, sex, year of surgery, having cardiovascular disease or diabetes, the type of surgery (ie, THA or TKA), the class of insurance, and tobacco use. Some of these factors, including age and sex, have been historically associated with prognosis in TKA and THA surgeries.[26]

A *P* value of <.05 was considered statistically significant.

Results

A total of 907 patients who underwent THA or TKA procedures were included in this study (**Table 1**). From 2013 to 2014, all THA and TKA procedures were performed in a hospital setting. During that period, 223 patients underwent the procedure with surgeon-applied interoperative local anesthetic periarticular field blocks containing liposomal bupivacaine and 178 patients underwent the procedure without liposomal bupivacaine. From 2015 to 2019, all patients received liposomal bupivacaine; 377 patients underwent THA or TKA in a hospital setting and 129 had the procedure in an ambulatory surgery center setting (Table 1).

The migration of patients with commercial insurance to the ambulatory surgery center began in June 2015. In 2016, 87% of commercially insured patients had surgery in an ambulatory surgery center, and in 2017 and 2018, 100% of commercially insured patients had surgery in an ambulatory surgery center (not shown).

The patients' covariate factors showed some variables between the cohorts. For example, patients who received treatment in the hospital had a median age of 10 years older than patients who received treatment in the ambulatory surgery center (**Table 2**). Almost all (90%) patients who underwent THA or TKA in the ambulatory center were commercially insured, whereas most (range, 77%-82%) patients who underwent THA or TKA in a hospital setting were insured by Medicare. Among the in-hospital population, the patients who received liposomal bupivacaine had a significantly higher rate of cardiovascular disease and/or diabetes than those who did not receive liposomal bupivacaine (*P* = .0003). The sex distribution was comparable between the patients in the hospital and ambulatory surgery center settings; across these cohorts, the proportion of female patients ranged from 55% to 59% (Table 2).

In the 2013-2014 period, 72 of 223 (32%) patients in the liposomal bupivacaine group left the hospital without an overnight stay (ie, same-day discharge) compared with 7 of 178 (4%) patients in the group without liposomal bupivacaine. A lower percentage (7%) of patients in the liposomal bupivacaine group spent ≥2 nights in the facility compared with 22% of patients who did not receive liposomal bupivacaine. After adjusting for covariates, the patients receiving liposomal bupivacaine had a more than 14-fold higher odds of having same-day discharge compared with patients who did not receive liposomal bupivacaine (odds ratio, 14.3; 95% confidence interval [CI], 5.9-33.3; *P* <.0001). Similarly, patients who received liposomal bupivacaine spent significantly fewer hours at the facility (ie, lower length of stay) than patients who did not receive liposomal bupivacaine (**Table 3**).

This significant reduction in length of stay after THA or TKA in the liposomal bupivacaine group versus the group without liposomal bupivacaine was consistent in patients with different insurance subtypes, including commercial insurance (ratio of least squares means [LSMs], 0.72; 95% CI, 0.59-0.87; *P* = .0009) and Medicare (ratio of LSMs, 0.71; 95% CI, 0.63-0.79; *P* <.0001; **Appendix Table 2**, available at **www.AHDBonline.com**).

A large increase in same-day discharge rates with liposomal bupivacaine was observed from 2014 to 2015—from 32% to 73% of patients went home the same day (including 68% of patients in the hospital setting and 100% of patients in the ambulatory setting). From 2015 to 2019, 92% of patients who received the medication

Table 2 Patient Baseline Demographics and Characteristics

Characteristic	Hospital cohort		Ambulatory surgery center cohort	*P* value	
	Patients receiving liposomal bupivacaine (N = 600)	Patients not receiving liposomal bupivacaine (N = 178)	Patients receiving liposomal bupivacaine (N = 129)	Hospital use of liposomal bupivacaine vs no liposomal bupivacaine	Liposomal bupivacaine in the hospital vs ambulatory surgery center
Age				.5404	<.0001
Mean, yrs (SD)	69.5 (8.7)	69.3 (9.1)	57.9 (7.1)		
Median, yrs (Q1, Q3)	70 (66, 75)	70 (64, 75)	60 (54, 63)		
Sex				.3880	.9513
Female, N (%)	332 (55)	105 (59)	71 (55)		
Male, N (%)	268 (45)	73 (41)	58 (45)		
Year category				<.0001	<.0001
2013-2014, N (%)	223 (37)	178 (100)	–		
2015-2017, N (%)	225 (38)	–	71 (55)		
2018-2019, N (%)	152 (25)	–	58 (45)		
Joint				.0004	.0014
Hip, N (%)	256 (43)	103 (58)	75 (58)		
Knee, N (%)	344 (57)	75 (42)	54 (42)		
Insurance type				.0041	<.0001
Commercial, N (%)	71 (12)	37 (21)	116 (90)		
Medicaid, N (%)	31 (5)	4 (2)	–		
Medicare, N (%)	490 (82)	131 (77)	–		
Other, N (%)	8 (1)	–	13 (10)		
Cardiovascular disease/diabetes, N (%)	322 (54)	68 (38)	75 (58)	.0003	.3547
Tobacco use, N (%)	307 (51)	93 (52)	53 (41)	.8000	.0377
Anticoagulation therapy, N (%)	39 (6)	8 (4)	3 (2)	.3240	.0649

Q indicates quartile; SD, standard deviation.

Table 3 Adjusted[a] Length of Stay and Opioid Consumption in the Hospital Setting, 2013-2014

Parameter	Surgery	Liposomal bupivacaine cohort		No liposomal bupivacaine cohort			
		Patients, N	LSM (95% CI)	Patients, N	LSM (95% CI)	Ratio (95% CI)[b]	*P* value
Hours at facility (length of stay)[c]	THA	75	28.90 (24.62-33.93)	103	41.11 (34.60-48.86)	0.70 (0.61-0.81)	<.0001
	TKA	148	27.94 (22.76-34.30)	75	40.76 (32.49-51.13)	0.69 (0.61-0.78)	<.0001
	THA + TKA	223	30.41 (25.52-36.24)	178	43.61 (36.20-52.54)	0.70 (0.64-0.76)	<.0001
Total in-hospital opioid consumption, morphine milligram equivalent	THA	75	85.8 (65.4-112.7)	103	91.9 (68.4-123.4)	0.93 (0.73-1.20)	.5951
	TKA	148	82.2 (55.4-122.0)	75	116.4 (75.2-180.0)	0.71 (0.55-0.90)	.0056
	THA + TKA	223	96.2 (69.7-133.0)	178	123.6 (87.8-173.9)	0.78 (0.66-0.92)	.0035

[a]The analytic model was adjusted for age, sex, type of surgery, year of surgery, class of insurance, cardiovascular disease/diabetes condition, and tobacco use.
[b]Liposomal bupivacaine versus no liposomal bupivacaine.
[c]Hours at facility defined as check into the facility to discharge from the facility.
CI indicates confidence interval; LSM, least squares mean; THA, total hip arthroplasty; TKA, total knee arthroplasty.

had a same-day discharge (including 89% of patients in the hospital setting and 100% of patients in the ambulatory setting). In 2018 and 2019, 100% and 96% of patients who underwent THA or TKA in the hospital setting and received liposomal bupivacaine had a same-day discharge, respectively.

Table 4 Adjusted[a] Complication Rates and Healthcare Resource Utilization in the Hospital Setting, 2013-2014

Parameter	Patients receiving liposomal bupivacaine, N (%) (N = 223)	Patients not receiving liposomal bupivacaine, N (%) (N = 178)	Odds ratio	*P* value
Complications				
Any complication	34 (15.2)	45 (25.3)	0.54 (95% CI, 0.33-0.89)	.0160
DVT or PE	2 (0.9)	2 (1.1)	0.97 (95% CI, 0.12-7.64)	.9797
Dislocation or fracture	3 (1.3)	2 (1.1)	1.16 (95% CI, 0.19-7.27)	.8741
Infection	5 (2.2)	2 (1.1)	2.11 (95% CI, 0.40-11.12)	.3785
Other	22 (9.9)	17 (9.6)	1.10 (95% CI, 0.56-2.16)	.7780
Healthcare resource utilization				
Emergency department visit without admission	32 (14.3)	17 (9.6)	1.73 (95% CI, 0.92-3.26)	.0897
Hospital admission (± emergency department visit)	14 (6.3)	9 (5.1)	1.26 (95% CI, 0.53-3.00)	.6038
Return to surgery in <8 weeks	6 (2.7)	3 (1.7)	1.60 (95% CI, 0.39-6.54)	.5162

[a]The analytic model was adjusted for age and sex.
CI indicates confidence interval; DVT, deep-vein thrombosis; PE, pulmonary embolism.

Table 5 Adjusted[a] Complication Rates and Healthcare Resource Utilization, 2015-2019

Parameter	Patients receiving liposomal bupivacaine in the hospital, N (%) (N = 377)	Patients receiving liposomal bupivacaine in an ambulatory surgery center, N (%) (N = 129)	Odds ratio	*P* value
Complications				
Any complication	41 (10.9)	10 (7.8)	0.53 (95% CI, 0.21-1.37)	.1926
DVT or PE	3 (0.8)	1 (0.8)	0.77 (95% CI, 0.04-14.38)	.8630
Dislocation or fracture	1 (0.3)	0 (0)	NA	NA
Infection	3 (0.8)	1 (0.8)	0.26 (95% CI, 0.01-6.42)	.4091
Other	38 (10.1)	8 (6.2)	0.54 (95% CI, 0.19-1.51)	.2390
Healthcare resource utilization				
Emergency department visit without admission	41 (10.9)	4 (3.1)	1.65 (95% CI, 0.49-5.54)	.4203
Hospital admission (± emergency department visit)	17 (4.5)	3 (2.3)	0.43 (95% CI, 0.09-2.15)	.3063
Return to surgery in <8 wks	4 (1.1)	3 (2.3)	0.10 (95% CI, 0.01-1.05)	.0552
Return to long-term opioid use for pain in 8 wks	9 (2.4)	3 (2.3)	0.90 (95% CI, 0.17-4.76)	.9025

[a]Model covariates included age and sex.
CI indicates confidence interval; DVT, deep-vein thrombosis; NA, not applicable; PE, pulmonary embolism.

Between 2015 and 2019, a significant downward annual trend was seen in the length of time that patients spent in the hospital and the ambulatory settings (P <.0001 overall and within the THA and TKA subgroups). The mean adjusted hospital facility hours for THA and TKA decreased from 14 hours in 2015 to 7 hours in 2019, and the mean adjusted ambulatory surgery center facility hours decreased from 12 hours in 2015 to 7 hours in 2019. Between 2015 and 2019, no significant difference was seen in the duration of facility use between the patients in the hospital and in the ambulatory settings at any time point.

In the 2013-2014 period, hospital opioid use in MMEs was 22% lower in the liposomal bupivacaine group than in the group without liposomal bupivacaine among patients undergoing THA or TKA (P = .0035; Table 3). A significant 29% reduction in opioid consumption was seen in patients undergoing TKA who received liposomal bupivacaine versus the patients who did not receive liposomal bupivacaine (P = .0056; Table 3).

Compared with the patients who underwent in-hospital THA or TKA, the patients who had the procedure in the ambulatory center consumed significantly fewer

opioids from 2015 to 2017; these results were consistent among patients who spent fewer than the median hours at the treatment facility (hospital: adjusted LSM MMEs, 30; 95% CI, 25.9-34.9; ambulatory surgery center: adjusted LSM MMEs, 18.5; 95% CI, 14.3-23.9; *P* <.0002) and among patients who spent more than the median hours at the treatment facility (hospital: adjusted LSM MMEs, 42.5; 95% CI, 35.3-51.3; ambulatory surgery center: adjusted LSM MMEs, 27.7; 95% CI, 20.3-37.8; *P* <.0082). However, these 2 groups had comparable opioid consumption in 2018 and in 2019. In-facility opioid consumption generally decreased over time from 2015 to 2019 in the hospital and in the ambulatory settings.

Postdischarge opioid prescription and consumption data were also available from 2018 and 2019. Patients were prescribed a mean of 373.5 MMEs (standard deviation [SD], 222.2) at discharge, with 44.4% (mean, 174.6 MMEs [SD, 185.7]) of the prescribed postdischarge opioids being consumed. During this period, 37% of the patients reported consuming ≤10 opioid tablets, and 84% reported consuming ≤30 opioid tablets after discharge (**Appendix Table 3**, available at **www.AHDBonline.com**).

From 2013 to 2014, the odds of overall complication rates were 46% lower (odds ratio, 0.54; 95% CI, 0.33-0.89; *P* = .016) in the liposomal bupivacaine group versus the group without liposomal bupivacaine (**Table 4**). No significant differences were observed in emergency department visits, hospital admissions, or return to surgery within 8 weeks between the groups. The readmission rate at 30 days was 9.6% from 2013 to 2014.

Between 2015 and 2019, the rates were low in the hospital and in the ambulatory settings for the return to long-term opioid use for pain in 8 weeks (2%), complications (range, 8%-11%), emergency department visits (range, 3%-11%), return to surgery in <8 weeks (range, 1%-2%), and hospital admissions (range, 2%-5%; **Table 5**). The rates of major complications such as deep-vein thrombosis or pulmonary embolism, dislocation or fracture, infection, and transfusion also remained <1% in the hospital and in the ambulatory surgery center during this period. The readmission rate at 30 days was 2% from 2015 to 2019. Between 2015 and 2019, only 1 (0.2%) patient in the overall study population was discharged to a skilled-nursing facility; the remaining patients were discharged to home.

Discussion

The use of the enhanced recovery pathway resulted in high same-day discharge rates, low levels of opioid use, and low complication and healthcare resource utilization rates. Of note, no increases were found in the complication rates and healthcare resource utilization rates after increased same-day discharge rates.

The addition of liposomal bupivacaine into surgeon-placed periarticular field blocks reduced the facility length of stay and facilitated reproducible same-day discharge to home, including a more than 14-fold higher odds of same-day discharge in 2013 and in 2014 among the patients receiving liposomal bupivacaine compared with those who did not receive the medication, and an additional improvement in same-day discharge rates in 2015. Of note, the 68% same-day hospital discharge rate in 2015 was much greater than a previously reported same-day discharge rate of 3.2% across more than 700 hospitals in the United States and in Canada between 2015 and 2018.[27] Further improvements in same-day discharge were seen over time, with 96% to 100% of patients undergoing THA or TKA in a hospital setting having same-day discharge without in-home outpatient services in 2018 and 2019.

Ultimately, in the current study, the cumulative same-day discharge rate from 2015 to 2019 was 1.4-fold higher than that observed from 2013 to 2014. Other studies have noted higher levels of unsuccessful same-day discharge to home, and recommended keeping patients for overnight stays, which could increase costs.[12,15] We believe that the optimization of individualized multimodal pain management programs via medication trials, and the use of scheduled opioid and nonopioid medications in the current study, as well as the evolving patient expectations regarding same-day discharge, likely contributed to the high same-day discharge rates observed in those studies.[19,20,28]

Notably, the surgeon (JVH) who performed the procedures is reported online by Dexur's database analysis of Medicare claims data for the third-lowest length of stay for THA and TKA procedures across the United States (0.17 days vs a national average of 2.41 days) and to have less than a 1% complication rate after THA and TKA based on Medicare claims between January 2014 and June 2019.[29,30] The healthcare facility where he performs many of his procedures was awarded the Joint Replacement Excellence Award (in 2021) and America's 100 Best Hospitals for Joint Replacement Award (2020).[31]

From discharge to week 8 in 2018 and 2019, the patients were prescribed a mean of 373.5 MMEs of opioids, with a mean of 174.6 MMEs of the prescribed opioids (44.4%) being consumed, equivalent to 116 mg of oxycodone (approximately 23 tablets of oxycodone 5 mg) or 175 mg of hydrocodone (approximately 35 tablets of hydrocodone 5 mg, acetaminophen 325 mg).[32]

A single postsurgical opioid prescription of 30 tablets may be sufficient for most patients with the enhanced recovery pathway used in this study, as indicated by the

84% of patients who reported consuming 30 or fewer opioid tablets. This recommended postsurgical opioid prescription volume is lower than that reported in other studies, which generally reported a range of 45 to 60 tablets postsurgical opioid prescriptions after THA and TKA,[21,33] although 1 study suggested that a prescription of 12 tablets of tramadol was sufficient.[20]

We believe that the low postsurgical opioid requirements in our current study were facilitated in part by the use of a scheduled nonopioid pain control regimen, as well as the preoperative individualization of the opioid and nonopioid components of the perioperative multimodal pain management protocol.

Over the entire study period, a low incidence of complications was found in all patients, including deep-vein thrombosis or pulmonary embolism, infection, and fracture or dislocation. Moreover, the overall healthcare resource utilization (eg, readmissions, emergency department visits) was low, further supporting safe THA and TKA procedures, as well as the potential cost-savings in an outpatient setting with this enhanced recovery pathway protocol, although this study did not collect cost data.

Overall, the current study's results are consistent with previous studies from the same center from June 2015 to November 2017 that demonstrated high (84%-100%) same-day discharge rates, high (97%-99%) patient satisfaction, and low rates (<2%-<3%) of adverse events.[13,14] Moreover, the favorable study outcomes with liposomal bupivacaine–containing field blocks after THA or TKA are consistent with previous studies demonstrating that the use of liposomal bupivacaine for pain management after THA or TKA is associated with reduced opioid consumption, improved patient readiness for discharge, and a short length of stay,[23,34-37] and that liposomal bupivacaine can be included as part of a multimodal pain management protocol within an enhanced recovery pathway to minimize opioid use.[13,14]

Limitations

This study has several limitations. First, all of the procedures were performed by the same surgeon (JVH) using the same enhanced recovery pathway in 2 centers (ie, a hospital and an ambulatory surgery center), so the generalizability of these findings to other surgeons or the use of enhanced recovery pathway protocols is unclear.

Second, because THA and TKA were not approved for Medicare reimbursement until January 2020, we were unable to collect data in this population in an ambulatory surgery center setting. However, similar improvements in length of stay and opioid consumption were observed from 2015 to 2019 in the hospital setting, which predominantly included Medicare beneficiaries, compared with the ambulatory surgery center setting. Therefore, these data suggest that the benefits of this enhanced recovery pathway may facilitate greater migration of THA and TKA procedures from the hospital to the ambulatory surgery center among the Medicare population in the future.

Furthermore, since February 2020, the previously mentioned surgeon (JVH) has performed TKA in Medicare beneficiaries in the ambulatory surgery center setting, and since January 2021 THA for Medicare patients in the same ambulatory surgery center. Data analysis for these Medicare patients on the safety of same-day discharge to home from the ambulatory surgery center setting compared with the hospital setting using our enhanced recovery pathway is ongoing.

Finally, another study limitation is that patient satisfaction data were not available for the study population. However, our previous studies from the same center had reported high satisfaction rates.[13,14]

Conclusion

The data from this study show that the adoption of the enhanced recovery pathway used in this study, including a multimodal pain management program, was associated with the safe migration of THA and TKA procedures from the hospital to the ambulatory surgery center setting and favorable clinical and health economic outcomes. Such migration may facilitate high rates of same-day hospital discharge and increased migration of THA and TKA procedures for Medicare beneficiaries from the hospital to an ambulatory surgery center in the future.

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Author Disclosure Statement

Dr Van Horne is on the Speaker's Bureau of DePuy Synthes, Medtronic, and Pacira BioSciences; he has been a consultant to DePuy Synthes, has received research funding from Medtronic, and owns stocks of Medtronic and Johnson & Johnson; Mr Liao and Dr Romo-LeTourneau are employees of Pacira BioSciences and may hold stocks in the company; Ms Van Horne has no conflicts of interest to report.

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