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Opioid-Based Analgesia: Impact on Total Joint Arthroplasty

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ABSTRACT

The objective of this study was to characterize the impact of opioid-based analgesia in total joint arthroplasty. The primary outcomes were incidence of in-hospital complications, length of stay, and discharge destination. Six hundred and seventy-three primary total hip and knee arthroplasties were retrospectively reviewed. The incidence of opioid-related adverse drug events was 8.5%, which accounted for 58.2% of all postoperative complications. Age, anesthesia technique, ASA score, and surgery type were significant risk factors for complications. After adjusting for these confounders, opioid-related adverse drug events were significantly associated with increased length of stay ($P < 0.001$) and discharge to extended care facilities ($P = 0.014$).

Opioid-based analgesia is the most commonly used intervention for acute surgical pain in the United States [1,2] and has traditionally been the primary mode of pain control after total joint arthroplasty (TJA) [3]. While this modality provides powerful relief, the reliance on opioids is limited by detrimental side effects including sedation, respiratory depression, confusion, constipation, nausea, vomiting, pruritus, and urinary retention. These opioid-related adverse drug events (ADEs) have been shown to increase postsurgical length of stay (LOS) and cost of care [4–6]. However, the specific impact of these adverse events in primary TJA including their incidence is not well defined. In addition, the relationship between opioid-based analgesia and discharge destination has not been previously investigated.

In an era of bundled care payments, the need for efficient, cost-effective, and safe postoperative TJA analgesia has never been more pressing. Building on previous studies, we hypothesized that opioid-based analgesia was associated with high incidence of opioid-related ADEs as well as increased LOS and rate of discharge to extended care facilities (ECFs).

Material and Methods

IRB approval was obtained. A sample of six hundred and seventy-three consecutive patients admitted to our institution in 2011 and 2012 with CPT codes 27447 (total knee arthroplasty; TKA) and 27130 (total hip arthroplasty; THA) was retrospectively reviewed. Three surgeons performed the operations. All patients were admitted from home on the day of surgery. Following surgery, patients had a standardized clinical pathway with regards to pain control, mobilization, and anticoagulation. In general, intravenous patient-controlled analgesia with either hydromorphone or fentanyl was provided immediately following surgery and transitioned to oral opioids on the first postoperative day. Physical and occupational therapy (PT/OT) was initiated on the day of surgery and continued daily until discharge. Enoxaparin was used for DVT prophylaxis unless contraindicated. Patients were cleared for discharge when they were medically stable, had adequate pain control, were able to void and tolerate oral diet, had no surgical concerns, and were functionally suitable for their discharge destination as determined by PT/OT.

The primary measures in the study were in-hospital complications, LOS, and discharge destination. A complication was defined as any event (medical or surgical) that required expert consultations or workups, escalation of care (e.g., transfer to step-down or intensive care), or interventions beyond the standard course of care (e.g., intubation, application of negative pressure wound therapy, increased doses of IV medications). Postoperative anemia was not included as a complication in this study. Opioid-related ADEs consisted of the commonly accepted adverse opioid effects, such as sedation, respiratory depression, confusion, constipation, nausea, vomiting, pruritus, and urinary retention [7]. Sedation was defined as the state of depressed consciousness during which the patient could not be easily aroused. Respiratory depression was defined as a decrease in respiratory rate with oxygen desaturation. Decreased oxygen saturation at night in patients with obstructive sleep apnea was not counted as an opioid-

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related respiratory depression. Because a number of patients developed multiple opioid-related ADEs during hospitalization, only the major event was included. In addition, an opioid-related ADE was included only if it resulted in functional impairment (e.g., inability to participate with physical therapy), escalation of care (e.g., intubation, rapid response activation, reversal of opioid overdose), or secondary adverse events (e.g. sedation causing respiratory depression or ileus causing severe nausea and vomiting). LOS was the number of hospital nights from admission to discharge. Prolonged hospitalization was defined as LOS > 2 days for THA and > 3 days for TKA based on the standard targets for discharge at the time the joint arthroplasties in this study were performed. Discharge destination was categorized as either home or extended care facility (skilled nursing care and acute rehabilitation).

Results were summarized using the mean, standard deviation, median, IQR, and range for continuous variables and counts and percentages for categorical variables. The relationship between each categorical variable and outcome was assessed using the chi-square test. Comparison of continuous variables was performed using either the Student's t-test or Kruskal–Wallis test dependent on the distribution of the variable. Multivariable logistic regression models were used to determine if opioid-related ADEs predicted LOS and discharge destination while adjusting for baseline covariates predictive of complications. All statistical tests were two-sided, and a P value ≤ 0.05 was considered to be statistically significant. The conditional power of the study given the sample size and the odds ratio of significant multivariable model covariates ??were reviewed for statistical adequacy. SAS version 9.2 was used for all analyses.

Results

673 procedures were reviewed in this study, including 278 THAs (41.3%) and 395 TKAs (58.7%). There were 408 females (60.6%) and 265 males (39.4%) with a mean age of 63.1 years (range: 15 to 92). The mean American Society of Anesthesiologists (ASA) score was 2.6 (range: 1 to 4). 508 patients (75.5%) underwent spinal anesthesia while 165 (24.5%) had general anesthesia. The mean LOS was 3 days (range: 1 to 9). 379 patients (56.3%) were discharged to home and 294 (43.7%) to ECF. 98 patients (14.6%) developed postoperative complications during hospitalization. Advanced age ($P = 0.002$), general anesthesia ($P = 0.005$), higher ASA score ($P < 0.001$), and THA ($P = 0.001$) were significant risk factors for the development of complications. Postoperative complications were associated with prolonged LOS and discharge to ECF ($P < 0.001$). The demographic and clinical characteristics of the patients in the study group are outlined in Table 1.

Among the 98 patients who developed postoperative complications, 57 (8.5%) were attributed to opioid use (Table 2). Urinary retention (n = 20), delirium (n = 16), and nausea (n = 7) were the most common opioid-related events. After adjusting for age, gender, ASA score, anesthesia technique, and surgery type, opioid-related ADEs were significantly associated with longer LOS ($P < 0.001$) and discharge to ECFs ($P = 0.014$). The average increase in LOS was 1.0 day. The incidence of opioid-related ADEs due to anesthesia technique was borderline significant ($P = 0.052$). The C-index of the multivariable logistic regression model for LOS and discharge destination was 0.853 and 0.762, respectively. Tables 3 and 4 summarize the results of multivariable logistic regression models for LOS and discharge destination, which had > 90% power for each primary endpoint.

Discussion

With 80% of the world's opioid supply consumed in the U.S., it is no wonder why some authors have described opioid use as a national epidemic [8]. Over the past decade, there has been an abundance of data in the arthroplasty literature favoring the use of multimodal analgesia as a safer alternative to the traditional opioid-based management. The main premise of multimodal analgesia has been decreased reliance on opioids, and hence lesser opioid-related ADEs [9]. However, the impact of opioid-based analgesia in TJA has not been well characterized. The purpose of this study was to determine the incidence of opioid-related ADEs in a primary TJA patient population and the impact of these adverse events on global outcomes, such LOS and discharge to home.

Table 1
Demographic and Clinical Characteristics of Patients in the Study (n = 673).

Feature	Patients Without Complications	Patients With Complications	*P* Value
N	575 (85.4%)	98 (14.6%)	
Surgery type			0.001
THA	223 (38.8%)	55 (56.1%)	
TKA	352 (61.2%)	43 (43.9%)	
Gender			0.211
Female	343 (59.6%)	65 (66.3%)	
Male	232 (40.4%)	33 (33.7%)	
Age, years	62.5±11.4	66.5±12.6	0.002
ASA score			<0.001
1–2	253 (44.0%)	23 (23.5%)	
3-4	322 (56.0%)	75 (76.5%)	
Anesthesia technique			0.005
Spinal	445 (77.4%)	63 (64.3%)	
General	130 (22.6%)	35 (35.7%)	
LOS, days	2.8±0.6	4.1±1.3	<0.001
Prolonged LOS	163 (28.4%)	79 (80.6%)	<0.001
Discharge destination			<0.001
Home	348 (60.5%)	31 (31.6%)	
ECF	227 (39.5%)	67 (68.4%)	

THA = total hip arthroplasty; TKA = total knee arthroplasty; ASA score = American Society of Anesthesiologists score; LOS = length of stay; ECF = extended care facility. Prolonged LOS defined as LOS > 2 days for THA and > 3 days for TKA.

Table 2
Incidence of Postoperative Complications in the Study (n = 98).

Complication	N
Cardiovascular	
Hypotension[a]	4
Tachycardia	3
Atrial fibrillation	3
Pulmonary embolism	3
Atrial fibrillation/pulmonary embolism	1
Myocardial infarction	1
Pulmonary	
Respiratory depression[a]	1
Neurologic	
Delirium[a]	16
Sedation[a]	2
CSF leak	1
Gastrointestinal	
Nausea[a]	7
Ileus[a]	5
Urinary	
Urinary retention[a]	17
Urinary traction infection	8
Acute renal failure	7
Blood	
Thrombocytopenia	3
Thrombocytopenia/leukocytosis	1
Surgical	
Wound drainage	5
Peroneal nerve palsy	1
Other/Multiple complications	
Rash	1
High grade fever	1
Electrolyte imbalance	1
Urinary retention[a]/wound drainage	1
Atrial fibrillation/urinary retention[a]	1
Myocardial infarction/urinary retention[a]	1
Peroneal nerve palsy/urinary traction infection	1
Hypotension[a]/thrombocytopenia/wound drainage	1
Hypotension[a]/deep venous thrombosis/wound drainage	1

[a] Denotes an opioid-related adverse drug event.