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Impact of Intrathecal Fentanyl on Hospital Outcomes for Patients Undergoing Primary Total Hip Arthroplasty With Neuraxial Anesthesia

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ABSTRACT

Background: Intrathecal opioids have been used to reduce pain after total joint arthroplasty; however, the utility of these drugs is disputed. We examined the impact of eliminating intrathecal fentanyl on outcomes for patients undergoing direct anterior approach total hip arthroplasty (THA).
Methods: Retrospective review of 376 THA patients from a single institution was conducted. Univariate analysis was used to compare intraoperative medication usage and postoperative outcomes for THA patients receiving intrathecal fentanyl compared with those who did not receive intrathecal fentanyl.
Results: Recovery room pain scores were significantly lower for patients who received intrathecal fentanyl (intrathecal fentanyl 1.4 vs no 2.2, $P = .001$), but no difference in opioid consumption was observed (intrathecal fentanyl 9.3 milligram morphine equivalent vs no 10.5 milligram morphine equivalent, $P = .200$). Intraoperative use and dose of intravenous morphine, hydromorphone, and dexamethasone did not differ significantly between groups. There were no significant differences in length of stay between the groups (intrathecal fentanyl 1.1 days vs 1.1 days, $P = .973$), 90-day readmission, or recatherization rates between groups (readmission, intrathecal fentanyl 4.8% vs no 5.8%, $P = .709$; recatherization, intrathecal fentanyl 0% vs no 0.7%, $P = 1.00$).
Conclusion: The administration of intrathecal fentanyl does not have a significant effect on early postoperative narcotic consumption, length of stay, 90-day readmissions, or recatheterization after THA with neuraxial anesthesia. Intrathecal fentanyl does not appear to improve outcomes and should not be included as a standard element of THA rapid recovery protocols.

Introduction

Total hip arthroplasty (THA) is one of the most common surgical procedures performed in the United States, and its demand is expected to increase exponentially in upcoming years [1]. The direct anterior approach to THA has become increasingly popular and has resulted in significant improvements in quality-of-life outcomes for patients [2]. The expanding use of direct anterior THA justifies the growing need to evaluate the impact of various anesthetic and pain management approaches on outcomes.

Enhanced recovery after surgery (ERAS) protocols have been shown to decrease length of stay (LOS) and complications after total joint arthroplasty (TJA) and have become a standard of care nationally [3]. Within ERAS protocols, neuraxial anesthesia (NA) has shown promise in decreasing blood loss and LOS for patients undergoing THA [4]. NA encompasses both epidural and spinal anesthesia. The present study focuses on the impact of spinal anesthesia, which is injected into the subarachnoid space between lumbar vertebrae and blocks conduction of nerve impulses by decreasing the sodium permeability of the neuronal membrane causing inhibition of depolarization responsible for the sympathetic block [5].

Intrathecal opiates have been combined with NA agents in an effort to further improve patient outcomes by providing prolonged analgesia after TJA [6,7]. These medications, such as intrathecal morphine and fentanyl, spread within the cerebrospinal fluid, and their action is offset by systemic absorption in the spinal cord and spread to adjacent epidural space. Intrathecal morphine has low

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lipid solubility which leads to a longer duration of analgesic action due to the slower redistribution from the dorsal horn of the spinal cord. Intrathecal fentanyl is a more lipophilic agent with a rapid onset and shorter duration of analgesic action [8]. Early mobilization after TJA has shown improvements in preventing venous thromboembolism, pneumonia, atelectasis, urinary tract infections, sepsis, myocardial infarction, and stroke [9]. Fast-track pathways for THA, such as ERAS protocols that incorporate early mobilization, have reported reduced LOS, reduced venous thromboembolism, and improved patient satisfaction [10,11]. In an effort to increase early mobilization by reducing side effects such as somnolence, nausea, and dizziness, fentanyl replaced morphine as the choice of intrathecal opioid at our institution because of its shorter duration of analgesic action [12,13].

Multiple studies have shown intrathecal opioids in conjunction with spinal anesthesia lead to improved patient outcomes such as lower pain scores and less initial opioid consumption [6–8,14]. In contrast, others have observed that although intrathecal opioids reduce pain immediately after TJA, there is ultimately little or no improvement in recovery or patient outcomes associated with the use of intrathecal opioids combined with NA [15,16]. This study aims to examine the impact of eliminating intrathecal fentanyl on outcomes for patients undergoing direct anterior approach THA. We hypothesize there will be no difference between postoperative outcomes for patients receiving intrathecal fentanyl and patients who do not receive intrathecal fentanyl.

Materials and methods

This study was deemed institutional review board exempt by our institution's clinical research committee. A retrospective chart review was conducted for primary unilateral THA performed under spinal anesthesia by 4 board-certified surgeons at a single institution between July 2017 and July 2018. Data were collected using an administrative database for patient demographics (age, sex, race, body mass index, and procedure performed). Intraoperative medication usage data were collected using the anesthesia records for each individual patient; this included the occurrence of use and dosage of intravenous (IV) fentanyl, bupivacaine, hydromorphone, and dexamethasone. American Society of Anesthesiologists score was used to quantify preoperative health status.

Perioperative protocol

All patients were cared for in a coordinated Joint Replacement Center and received written educational materials, a nurse-taught preoperative course, preoperative medical evaluations, and preoperative strengthening programs—including home exercise or outpatient physical therapy. An established rapid recovery protocol was used for all patients which included a multimodal pain management regimen of celecoxib, acetaminophen, pregablin, and short-acting opioids. Patient-controlled analgesia and nerve blocks were not used in this patient population. All patients received hyperbaric bupivacaine administered into the intrathecal space via a lumbar puncture. Some patients in this group also received intrathecal fentanyl. Intrathecal morphine preparations were not used in this patient population. At anesthesiologists' discretion and patient request, NA was paired with propofol sedation. Patients receiving spinal anesthesia were not intubated, mechanically ventilated, and did not receive inhaled anesthetic agents. All patients undergoing THA received aggressive intraoperative fluid management, IV or topical tranexamic acid utilization, and assisted ambulation on the day of surgery when clinically appropriate.

Table 1
Population demographics.

Patient characteristics	Intrathecal fentanyl (N = 84)	No intrathecal fentanyl (N = 292)	*P* value
Age	66.8 ± 8.4	65.3 ± 10.1	.152
Sex			.203
Female	54 (64.3)	165 (56.5)	
Male	30 (35.7)	127 (43.5)	
Race			.898
White	75 (89.3)	263 (90.1)	
Body mass index (kg/m^2)	29.0 ± 5.4	28.6 ± 5.2	.587
ASA 3 or 4	25 (29.8)	63 (21.6)	.118

P value < .05 are in bold. Data are expressed as mean ± SD or n (%).
ASA, American Society of Anesthesiologists classification.

Study population

There were 376 patients who met the inclusion criteria for this study. All patients underwent a THA performed via anterior approach using a modern fracture table and fluoroscopy between July 2017 and July 2018. All patients received hyperbaric bupivacaine administered via lumbar puncture. Of the 376 patients receiving an anterior THA with NA in the study timeline, 84 patients received intrathecal fentanyl, and 292 did not receive intrathecal fentanyl intraoperatively.

Study outcome

The primary outcomes of the study were the influence of intrathecal fentanyl on postanesthesia care unit (PACU) morphine milligram equivalents (MME), PACU pain score as measured on a 0 to 10 numeric rating scale, LOS, 90-day readmissions, and recatherization rates.

Statistical analysis

Univariate analysis using chi-squared and t tests were used to determine differences between groups. A *P* value less than or equal to 0.05 was statistically significant. All statistical analyses were performed using SPSS (SPSS 25.0; IBM Inc., Somers, NY).

Results

In total, 84 (22.3%) of the patients undergoing THA received intrathecal fentanyl, and 292 (77.7%) did not. The dose of intrathecal fentanyl ranged from 10 to 120 mcg with an average of 33.1 ± 25.9 mcg. There were no significant differences in average age, sex, race, or body mass index between the groups (Table 1). As there were no significant demographic differences between patients

Table 2
Intraoperative medications.

Medication	Intrathecal fentanyl (N = 84)	No intrathecal fentanyl (N = 292)	*P* value
Total fentanyl dose (mcg)	93.2 ± 49.9	75.3 ± 72.1	**.010**
IV fentanyl	79 (94.0)	196 (67.1)	**<.001**
Dosage (mcg)	59.8 ± 50.3	75.3 ± 72.1	**.027**
Bupivacaine dosage (mL)	1.91 ± 2.2	1.7 ± 0.7	.155
Morphine	3 (3.6)	7 (2.4)	.556
Dosage (mg)	0.4 ± 1.9	0.2 ± 1.1	.235
Hydromorphone	1 (1.2)	11 (3.8)	.236
Dosage (mg)	0.01 ± 0.1	0.07 ± 0.5	.313
Dexamethasone	37 (44.1)	127 (43.5)	.928

P value < .05 are in bold. Data are expressed as mean ± SD or n (%).

Table 3
Postoperative outcomes.

Outcome	Intrathecal fentanyl (N = 84)	No intrathecal fentanyl (N = 292)	*P* value
PACU MME	9.3 ± 7.0	10.5 ± 9.6	.200
PACU pain	1.4 ± 1.9	2.2 ± 2.1	**.001**
LOS, d	1.1 ± 0.6	1.1 ± 0.6	.973
LOS, h	32.9 ± 14.0	32.7 ± 15.1	.912
Readmissions	4 (4.8)	17 (5.8)	.709
Recatheterization	0 (0)	2 (0.7)	1.00

P value < .05 are in bold. Data are expressed as mean ± SD or n (%).
LOS, length of stay; PACU MME, postanesthesia care unit milligram morphine equivalent; PACU Pain, postanesthesia care unit pain score.

receiving intrathecal fentanyl and those who did not, all analyses were conducted using univariate tests without statistical controls. Intraoperatively, patients receiving intrathecal fentanyl received a significantly higher total dose of fentanyl (intrathecal fentanyl 93.2 mcg vs no 75.3 mcg, $P = .010$). Patients who did not receive intrathecal fentanyl received a significantly higher dose of IV fentanyl (intrathecal fentanyl 59.8 mcg vs no 75.3 mcg, $P = .027$). All patients received similar doses of bupivacaine (intrathecal 1.91 mL vs no 1.7 mL, $P = .155$), IV morphine (intrathecal fentanyl 0.4 mg vs no 0.2 mg, $P = .235$), IV hydromorphone (intrathecal fentanyl 0.01 mg vs no 0.07 mg, $P = .313$), and IV dexamethasone (intrathecal fentanyl 44.1% vs no 43.5%, $P = .928$) in the operating room (Table 2).

In the PACU, there was no difference in narcotic consumption between groups (intrathecal fentanyl 9.3 MME vs no 10.5 MME, $P = .200$), but pain scores were significantly lower for patients who received intrathecal fentanyl (intrathecal fentanyl 1.4 vs no 2.2, $P = .001$). There were no significant differences in LOS between the groups (intrathecal fentanyl 1.1 vs 1.1 days, $P = .973$; intrathecal fentanyl 32.9 vs no 32.7 hours, $P = .912$). There were no significant differences in readmission rates or urinary retention requiring catherization between groups (readmission, intrathecal fentanyl 4.8% vs no 5.8%, $P = .709$; recatherization, intrathecal fentanyl 0% vs no 0.7%, $P = 1.00$) (Table 3).

Discussion

THA significantly improves patient-reported quality of life by impacting both physical and mental health [17]. However, as pain is an inevitable aspect of treatment, the patient experience can be enhanced by optimizing perioperative pain management while facilitating discharge at the earliest time safely possible. Although intrathecal opioids may reduce pain immediately after TJA, there is ultimately little or no improvement in surgical outcomes associated with the use of intrathecal opioids combined with NA [15,16]. In a previous study, 56 patients were randomly assigned to bupivacaine with fentanyl or bupivacaine alone for total knee arthroplasty with the primary outcome of comparing the time to two-segment regression of the sensory block. There were no significant differences in time to two-segment regression of sensory block between groups, leading to the conclusion that spinal anesthesia with bupivacaine alone is not inferior to bupivacaine in conjunction with fentanyl [15]. Based on our results, we echo the following conclusion: NA with bupivacaine alone is not inferior to NA with intrathecal fentanyl in patients undergoing THA.

Although studies have demonstrated an association between intrathecal opioids, lower pain scores, and less initial opioid consumption in TJA, these drugs carry a significant side effect profile that could delay recovery [6–8,14]. Postoperative nausea and vomiting are reported for around 35% of patients who receive intrathecal opioids without additional prophylactic antiemetic. In addition, patients undergoing TJA receiving IV opioids have a higher rate of pruritus and urinary retention [8]. As the opioids are administered intrathecally, there is a chance for rostral spread within the cerebrospinal fluid, which can lead to respiratory depression as early as 20-30 minutes after administration of lipophilic agents such as fentanyl [8]. Collectively, these side effects can delay early ambulation resulting in extended LOS for patients undergoing THA. In our study, patients receiving intrathecal fentanyl did demonstrate significantly lower pain scores in PACU. However, given the low pain scores in both groups (1.4 and 2.2), we suggest this difference is not clinically significant. In addition, this finding is confounded by the fact that patients receiving intrathecal fentanyl were more likely to also receive IV fentanyl and at higher dosages. While our results did not demonstrate an association between intrathecal fentanyl and complications such as recatheterization or increased LOS, the potential risk of side effects appear to outweigh any early postoperative analgesia benefits.

The recent removal of THA from the Medicare inpatient-only list and the continued trend toward ambulatory surgery center–based THA promotes the exploration of new methods to reduce LOS while maintaining high standards of care [18,19]. ERAS protocols have become a standard of care nationally in an effort to reduce the LOS and rate of complications after TJA [3]. Eliminating intrathecal fentanyl administered in conjunction with NA could decrease postoperative complications and ultimately the cost associated with TJA. Furthermore, given the potential for addiction and the societal impact of the opioid epidemic, all efforts to minimize narcotics in TJA should be made.

The retrospective nature of this study has limitations, including selection bias that lessens the applicability of our findings to the broader population of patients undergoing THA. In addition, we did not control for the history of previous opioid use in patients included in the study, which can significantly affect the postoperative pain response and outcomes. A strength of our single-institution design is that all patients were subject to the same protocols which remained unchanged over the study period, thus limiting other potential confounding factors. We recommend a retrospective review of a large-scale database to validate our findings rather than a prospective study given that intrathecal fentanyl did not appear to improve patient outcomes and is associated with side effects that could pose a risk to the patient population.

Conclusion

The administration of intrathecal fentanyl does not have a significant effect on early postoperative narcotic consumption, LOS, 90-day readmissions, or recatheterization after THA with NA. Intrathecal fentanyl does not appear to improve outcomes and should not be included as a standard element of THA rapid recovery protocols.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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