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Background

- Enhancing the efficacy of spinal anesthesia can be achieved by adding an intrathecal opioid, potentiating the analgesic benefits of local anesthetics.
- Studies have shown that intrathecal opioids help lower pain scores, decrease opioid consumption, and prolong analgesia.
- Fentanyl has become the preferred adjuvant over morphine due to its rapid onset, shorter duration, and lower risk of side effects, which may facilitate early mobilization after total joint arthroplasty (TJA).
- This study evaluated whether adding intrathecal fentanyl to a reduced dose of bupivacaine improves outcomes compared to the standard bupivacaine dose alone in patients who underwent total knee arthroplasty (TKA) or total hip arthroplasty (THA).

Methods

This retrospective, single-center, cohort study included adult patients, aged 18–89 years, who underwent primary elective TKA or THA between August, 2022, and October, 2024. The local IRB has approved this study; given minimal risk to patients, a total waiver of written informed consent was granted by the IRB.

Patients were retrospectively divided into two study groups:

- Fentanyl group:** Received spinal anesthesia with intrathecal fentanyl and a reduced dose of bupivacaine.
- Control group:** Received spinal anesthesia with the standard dose of bupivacaine only.

Primary Outcome:Time to first postoperative opioid

Secondary Outcomes: Time to return of normal motor function, post anesthesia care unit (PACU) and hospital length of stay (LOS), opioid consumption, postoperative pain at rest and with activity, frequency of nonopioid analgesia and antiemetics, rates of pruritis and urinary retention postoperatively.

Table 1. Demographics	Fentanyl (n=2083)	Control (n=2599)	P-Value
Age (years)	71 ± 9	69 ± 9	<0.001
BMI (kg/m²)	31.5 ± 6.2	31.8 ± 6.1	0.212
Sex			0.393
Female	1283 (61.6)	1569 (60.4)	
Male	800 (38.4)	1030 (39.6)	
Race			0.292
Black/African American	140 (6.7)	153 (5.9)	
Asian	24 (1.2)	17 (0.6)	
White	1805 (86.7)	2279 (87.7)	
Native American/Pacific Islander	6 (0.3)	8 (0.3)	
Other	94 (4.5)	126 (4.9)	
Unknown	14 (0.7)	16 (0.6)	
Ethnicity			0.115
Hispanic/Latino	80 (3.8)	105 (4.0)	
Not Hispanic/Latino	1972 (94.7)	2472 (95.1)	
Unknown	31 (1.5)	22 (0.9)	
ASA Risk Score			0.510
I	1 (<0.1)	0 (0.0)	
II	865 (41.5)	1099 (42.3)	
III	1206 (57.9)	1491 (57.4)	
IV	11 (0.5)	9 (0.3)	
Joint			0.268
Hip	900 (43.2)	1165 (44.8)	
Knee	1183 (56.8)	1434 (55.2)	

Abbreviations: BMI, Body Mass Index; ASA, American Society of Anesthesiologists

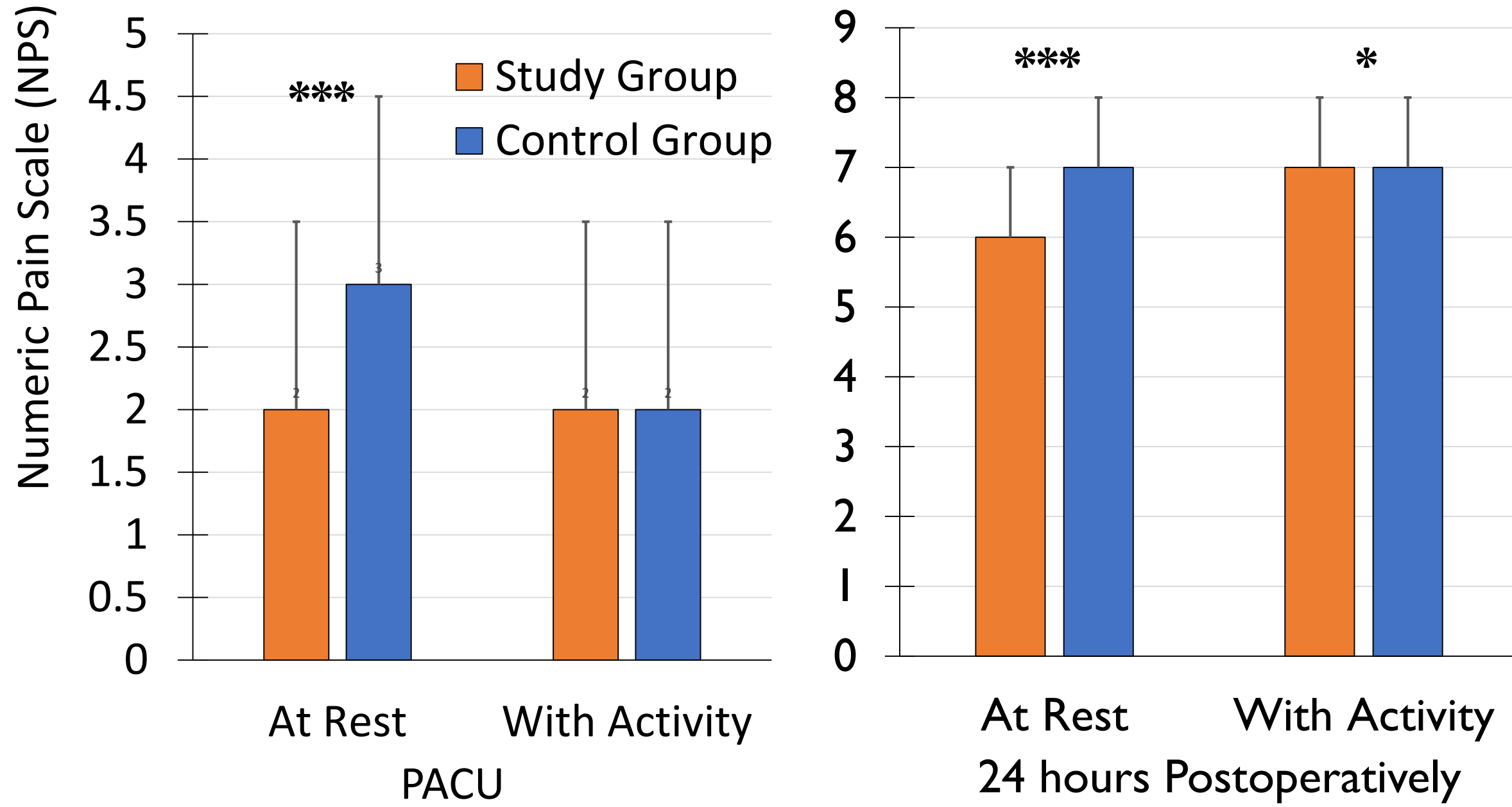


Figure 2: Comparison of Pain Scores at Rest and During Activity in the PACU and Within the First 24 Hours Postoperatively; p<0.05*, p<0.001***

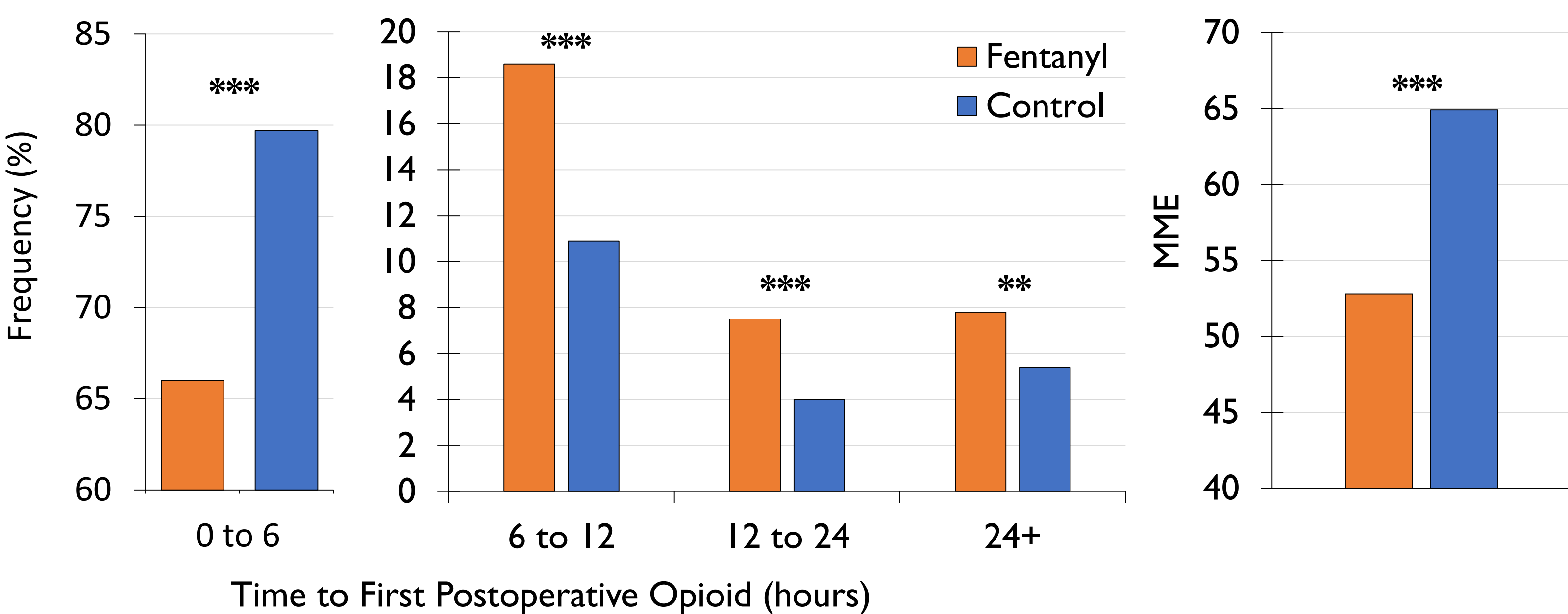


Figure 1: (Left and Middle) Primary Outcome: Time to First Postoperative Opioid from PACU arrival; (Right) Total Intra and Postoperative Opioid Consumption presented in Morphine Milli-Equivalence (MME). p<0.01** p<0.001***

Table 2. Secondary Outcomes	Fentanyl (n=2083)	Control (n=2599)	P-Value
Post anesthesia care unit length of stay, minutes (mean, ± SD)	80 ± 27	86 ± 31	<0.001
Hospital length of stay, hours (mean, ± SD)	32 ± 12	32 ± 12	0.509
Time to positive motor test minutes (mean, ± SD)	8 ± 20	17 ± 65	<0.001
Antiemetics			
Used (n, %)	67%	60%	<0.001
Frequency (median [IQR])	1 [1]	1 [1]	<0.001
Non-Opioid Analgesics (median [IQR])			
Intraoperative	2 [1]	1 [1]	<0.001
Postoperative	9 [5]	9 [4]	<0.001
Total	11 [4]	11 [5]	<0.001

Table 3.A Linear Regression	Predictor	P-value	Coefficient	95% CI
Total Opioid Use (MME)	IF group	<0.001	-11.8	-14.0, -9.6
	Hip Joint Replaced	<0.001	-5.5	-7.8, -3.3
	Age	<0.001	-1.2	-1.3, -1.1
	ASA Score	<0.001	9.8	7.6, 12.1
	Female Sex	<0.001	6.2	3.9, 8.5
Table 3.B Logistic Regression			Odds Ratio	95% CI
>24 Hours to First Opioid	IF group	<0.001	1.46	1.15, 1.85
	Joint Replaced	<0.001	1.46	1.14, 1.85
	Age	<0.001	1.02	1.01, 1.04
	ASA Score	<0.001	0.63	0.50, 0.80
	Female Sex	<0.001	0.44	0.34, 0.56

Results Summary

- Time to first opioid was significantly delayed in the IF versus control group; total postoperative opioid use in MME was significantly lower in the IF group as well (Figure 1).
- Pain at rest was significantly lower in the IF versus control group both in the PACU and at 24 hours postoperatively (Figure 2).
- PACU length of stay and time to positive motor exam were shorter in the IF than control group (Table 2).
- The IF group used more antiemetics and non-opioid analgesics than the control group (Table 2).
- Regression analysis revealed a significant correlation between the higher total opioid use and factors such as no IF use, knee joint replaced, younger age, higher ASA score, and female (Table 3.A). While factors such as IF use, hip joint replaced, older age, higher ASA score, and female, were significantly correlated to a prolonged time (>24 hr) to first opioid use (Table 3.B).

Discussion

- Combining intrathecal fentanyl with a reduced dose of bupivacaine in spinal anesthesia offers significant clinical benefits over a higher dose of bupivacaine alone, particularly for TJA patients.
- This strategy leads to enhanced postoperative pain control, evidenced by lower pain scores in the initial 0-6 hours post-surgery and a prolonged time to the first opioid requirement. Additionally, the reduced bupivacaine dosage accelerates recovery from spinal anesthesia and improves functional motor recovery.
- Prospective randomized controlled trials are needed to further evaluate these benefits in larger, more diverse, patient groups.

References

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