

Analgesic efficacy of perioperative ultrasound-guided fascia iliaca block in geriatric patients receiving spinal anesthesia for hip fracture surgery

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Abstract

Introduction: Effective perioperative pain management in elderly patients undergoing hip fracture surgery remains challenging. Inadequate pain control not only increases the patient's distress but may also lead to postoperative complications. The fascia iliaca compartment block (FICB) has been shown to enhance analgesia and improve patient comfort. This study aims to compare the analgesic efficacy of FICB when performed prior to spinal anesthesia in patients undergoing hip fracture surgery.

Methods: A prospective randomized study was conducted in 54 elderly patients undergoing hip fracture surgery under spinal anesthesia. Patients were randomly assigned to receive either an ultrasound-guided FICB with 0.25% bupivacaine 40 mL (block group) or sham ultrasound without injection (control group). The prespecified primary outcome was total postoperative morphine consumption at 24 and 48 h. Secondary outcomes included pain during

positioning for spinal anesthesia, postoperative pain, patient satisfaction, and adverse events. Longitudinal pain outcomes were analyzed using a linear mixed-effects model.

Results: Total morphine consumption at 24 and 48 h was not significantly different between the groups. However, patients in the block group had significantly lower postoperative pain during ambulation. Mixed-effects modelling confirmed a significant overall group effect for postoperative pain on movement ($P = 0.009$). Pain during positioning for spinal anesthesia was significantly lower in the block group ($P < 0.001$). Correspondingly, the time required to perform spinal anesthesia was significantly shorter in the block group ($P < 0.001$). The incidence of complications was similar between groups.

Conclusions: Although postoperative opioid consumption did not differ between groups, FICB improved pain during positioning for spinal anesthesia and decreased pain during ambulation without increasing complications.

Keywords: ageing, hip fracture, nerve block, pain management, perioperative care

Introduction

Hip fracture is a common and serious condition in elderly patients, often associated with severe pain, immobility, and functional limitation. Perioperative management in this population remains a major challenge for anesthesiologists due to multiple comorbidities and the increased risk of adverse effects from systemic analgesic drugs such as opioids and non-steroidal anti-inflammatory drugs. Inadequate pain control not only worsens the patient's distress but can also lead to postoperative complications, including delirium, respiratory compromise, infection, and delayed mobilisation.¹ Previous studies reported that major adverse cardiac events occurred in up to 24.8% of elderly patients undergoing hip fracture surgery.²⁻⁴ Therefore, anesthesiologists play a crucial role in preoperative optimization, intraoperative pain control, and postoperative management to minimize perioperative morbidity.

Regional anesthesia techniques such as fascia iliaca compartment block (FICB) and femoral nerve block (FNB) have been increasingly recognized as essential components of multimodal pain management for hip fracture surgery. The 2020 guidelines for the management of hip fractures recommend that peripheral nerve blocks should be provided in the emergency department for analgesia and should be used as an adjunct to general or spinal anesthesia during surgery. Performing a peripheral nerve block before positioning for spinal anesthesia reduces the need for sedation

or intravenous analgesia.⁵ Compared with FNB, FICB provides broader analgesic coverage by blocking the femoral and lateral femoral cutaneous nerves, which supply most of the hip and thigh region, providing better incisional analgesia after surgery. The use of ultrasound guidance has improved accuracy, safety, and adequacy of peripheral nerve analgesia, making it suitable even in frail elderly patients on the ward or in the pre-operative holding area.⁵⁻⁸

Although spinal anesthesia is the main anesthetic technique for hip fracture surgery, patients often experience severe pain during positioning for spinal anesthesia. Administering FICB prior to spinal anesthesia may provide effective analgesia, facilitate patient positioning, and reduce perioperative analgesic requirements. Several studies have demonstrated that FICB offers analgesic benefits and reduces the use of opioids in geriatric patients with hip fractures during preparation for operation or in the emergency department.⁵⁻⁸ However, local evidence in Samut Songkhram province regarding its effectiveness in improving postoperative pain control in patients receiving spinal anesthesia is limited. This study was initially designed with postoperative morphine consumption as the primary outcome. Secondary outcomes include pain during positioning for spinal anesthesia, postoperative pain at rest and on movement, time to first dose of analgesia, length of hospital stay, patient satisfaction, and the incidence of anesthesia and surgery related complications.

Materials and methods

This prospective, randomized, single-blind study was approved by the Research Ethics Board of Somdetphraphutthaloetla Hospital (COA No.105 003/2568). This study was registered with the Thai Clinical Trials Registry (TCTR 20251031004). The trial was registered retrospectively after patient enrollment had begun. From February 2025 to October 2025, elderly patients aged 60-95 years who were scheduled for hip fracture surgery at Somdetphraphutthaloetla Hospital with American Society of Anesthesiologists (ASA) physical status I-III were included in this study. Data were collected within 48 h post-operatively. Patients with these conditions i) inability to communicate with investigators, ii) contraindication to regional anesthesia, iii) diagnosed pathological fracture due to malignancy, iv) chronic opioid use, v) body weight < 40 kg or body mass index (BMI) > 30 kg/m² were excluded from the study. Written informed consent was obtained from all participants.

Patients were randomly allocated into two groups using varying block randomization generated via computer software (www.sealedenvelope.com) to ensure a balance in group numbers throughout the study. Group assignments were sealed in opaque, sequential numbered envelopes prepared by a third party not involved in the study. Preoperative evaluation was conducted at least one day prior to surgery according to standard anesthetic evaluation.

Study intervention

All patients received standard preoperative care including appropriate preoperative fluid therapy, continued their usual oral medications, and were given oral paracetamol 500 mg two hours before surgery. Standard intraoperative monitoring comprised pulse oximetry, ECG, and non-invasive blood pressure measurement. The research team opened the randomization envelope in the waiting area 30 min before transferring the patients to the operating room. Both the anesthesiologists and nurses providing care in the operating room were blinded to group allocation. However, the other anesthesiologist performing the block in the block room was not blinded due to the nature of the intervention. Intervention was given to the patients according to their group.

Block group: Patients received a single shot ultrasound-guided FICB using 0.25% bupivacaine 40 mL, administered 30 min before surgery. The procedure was performed by a staff anesthesiologist with more than five years of experience in ultrasound-guided nerve blocks, using a high-frequency linear transducer (Konica Minolta®) at lateral one-third of the imaginary line between the pubic tubercle and anterior superior iliac spine (ASIS). Sonoanatomy visualization included the iliacus muscle, anterior inferior iliac spine (AIIS), and deep circumflex iliac artery (DCIA). The goal of the supra-inguinal FICB technique was to deposit the local anesthetic agent beneath the fascial layer of the iliacus muscle.^{9,10} Block success was assessed 20-30 min after injection using cold sensation testing on the anterior aspect of the

thigh (femoral nerve) and anterolateral thigh (lateral femoral cutaneous nerve).

Control group: Patients underwent ultrasound scanning at the same anatomical location (lateral one-third of the line between the pubic tubercle and ASIS). Sonoanatomy visualized the iliacus muscle, AIIS, and DCIA in the same manner as the block group. To maintain blinding, patients underwent an identical preparation process to the block group. The skin was prepared with antiseptic solution, and sterile draping was applied in the same manner. A syringe was positioned at the skin to simulate needle insertion, without actual skin puncture or the injection of any agent. Patients were not informed of their group allocation, and efforts were made to standardize the procedural environment between groups. Outcome assessors were blinded to group allocation.

All patients underwent spinal anesthesia at the L2-3 or L3-4 interspace using a 27-gauge Quincke spinal needle and 0.5% isobaric bupivacaine 2.2 to 3.0 mL. The success of the anesthetic technique was evaluated by cold sensory block reaching at least the T10 dermatome before proceeding to surgery. Patients were continuously monitored for hypotension and bradycardia. If mean arterial blood pressure dropped below 70 mmHg or more than 20 percents of the baseline, 6 mg of ephedrine or norepinephrine 4 mcg intravenous was administered as appropriate, titrated to maintain blood pressure. In the case of bradycardia (HR < 50 bpm), intravenous atropine was administered. Intraoperative

fluid therapy using a balanced crystalloids solution was used.

After surgery, all patients were transferred to the recovery room and managed per standard protocols. If pain occurred, intravenous morphine 2 mg was administered and titrated until numeric rating scale (NRS) was below four. Once transferred to the orthopedic unit, patients followed a standard multimodal analgesic protocol that was used in this study: paracetamol 500 mg orally every 6 h and intravenous morphine 2 mg every 2 h as needed for NRS reached four or higher. Additionally, ondansetron 4 mg intravenously was given for nausea and vomiting every 6 h, chlorpheniramine 10 mg for pruritus, and pethidine 20 mg as needed for shivering.

Outcome measurement

The prespecified primary outcome was total postoperative morphine consumption required for rescue postoperative pain during the first 24 and 48 h after hip surgery. Secondary outcomes included perioperative pain and clinical outcomes. Pain intensity was assessed using a NRS (0-10, where 0 indicates no pain and 10 indicates the worst imaginable pain). Pain during positioning for spinal anaesthesia was recorded prior to neuraxial block placement. Postoperative pain scores at rest and on movement (defined as assisted ambulation) were assessed at 24 and 48 h after surgery. Secondary outcomes included time required to perform spinal anesthesia (defined as the time from operating room entry to readiness for surgical positioning), time to first dose of morphine request after

surgery, and patient satisfaction with anesthetic care (NRS 0-10, where 0 indicates total dissatisfaction and 10 indicates complete satisfaction).

The incidence of postoperative adverse effects, including hypotension, nausea, vomiting, shivering, and pruritus were recorded within 24 and 48 h. Nausea was defined as a subjectively unpleasant sensation associated with the urge to vomit, while vomiting was defined as rhythmic contractions of the abdominal muscles with or without expulsion of gastric contents. Other outcomes included length of hospital stay and anesthesia or surgery related complications, such as local anesthetic systemic toxicity, postoperative infection, muscle weakness, falls, and nerve injury within 48 h after surgery. These were also recorded as secondary outcomes.

Sample size calculation and statistical analysis

The sample size was prospectively calculated based on the originally prespecified primary outcome of postoperative morphine consumption. Based on the study by Schulte et al,¹¹ morphine requirement for postoperative pain control within the first 24 h was reported to be 11 mg. A 50% reduction in morphine consumption was considered clinically significant. With a significant level of 0.05 and the β -error at 0.2 (study power 80%), the sample size necessary to detect differences was 24 participants per group. Allowing for 10% dropout rates, the final target sample size required was 27 participants per group.

Given that the overall opioid consumption observed in this study was substantially lower than anticipated, a post hoc sample size estimation was performed based on the clinically relevant secondary outcome of pain during ambulation at 24 h postoperatively. Using the observed mean difference of 0.8 points, the estimated sample size required with 80% power and a two-sided alpha of 0.05 was 45 patients per group. These findings suggest that this study may have been underpowered to detect differences in pain during ambulation at 24 h postoperatively.

Data analysis was performed using intention-to-treat methods by a statistician who was not involved in this study. Descriptive statistics were used to summarize baseline characteristics. Between-group comparisons were performed using independent t-test, Mann-Whitney U test, chi-square test, or Fisher's exact test as appropriate. Pain scores measured at multiple time points were analyzed using a linear mixed-effects model with group, time, and group $\times$ time interaction as fixed effects and subjects as a random effect. Baseline pain score was included as a covariate in the mixed-effects model to account for pre-existing differences. Effect sizes were reported as regression coefficients with 95% confidence intervals. Normality was assessed using the Shapiro-Wilk test, and missing data were handled under the missing-at-random assumption. A *P*-value < 0.05 was considered statistically significant. The statistical software was Stata 10.1 (Stata Corp LLC, College Station, TX, USA).

Results

A total of 57 patients undergoing hip fracture surgery under spinal anesthesia were assessed for eligibility. Three patients were excluded due to contraindications to spinal anesthesia, including one patient receiving enoxaparin and two patients with prolonged INR. The remaining 54 patients were randomized equally into the block group and control group and were analyzed using the intention-to-treat principle. None of the patients dropped

out (Figure 1). Baseline demographic data, comorbidities, and fracture types were comparable between the two groups (Table 1). The mean age was approximately 80 years old in both groups, with no statistically significant difference in BMI and hematocrit levels. Pre-operative pain was moderate with no significant difference between the groups. There were no significant differences in intraoperative data such as the timing of surgery, volume of local anesthetic agents for spinal anesthesia, or duration of surgery.

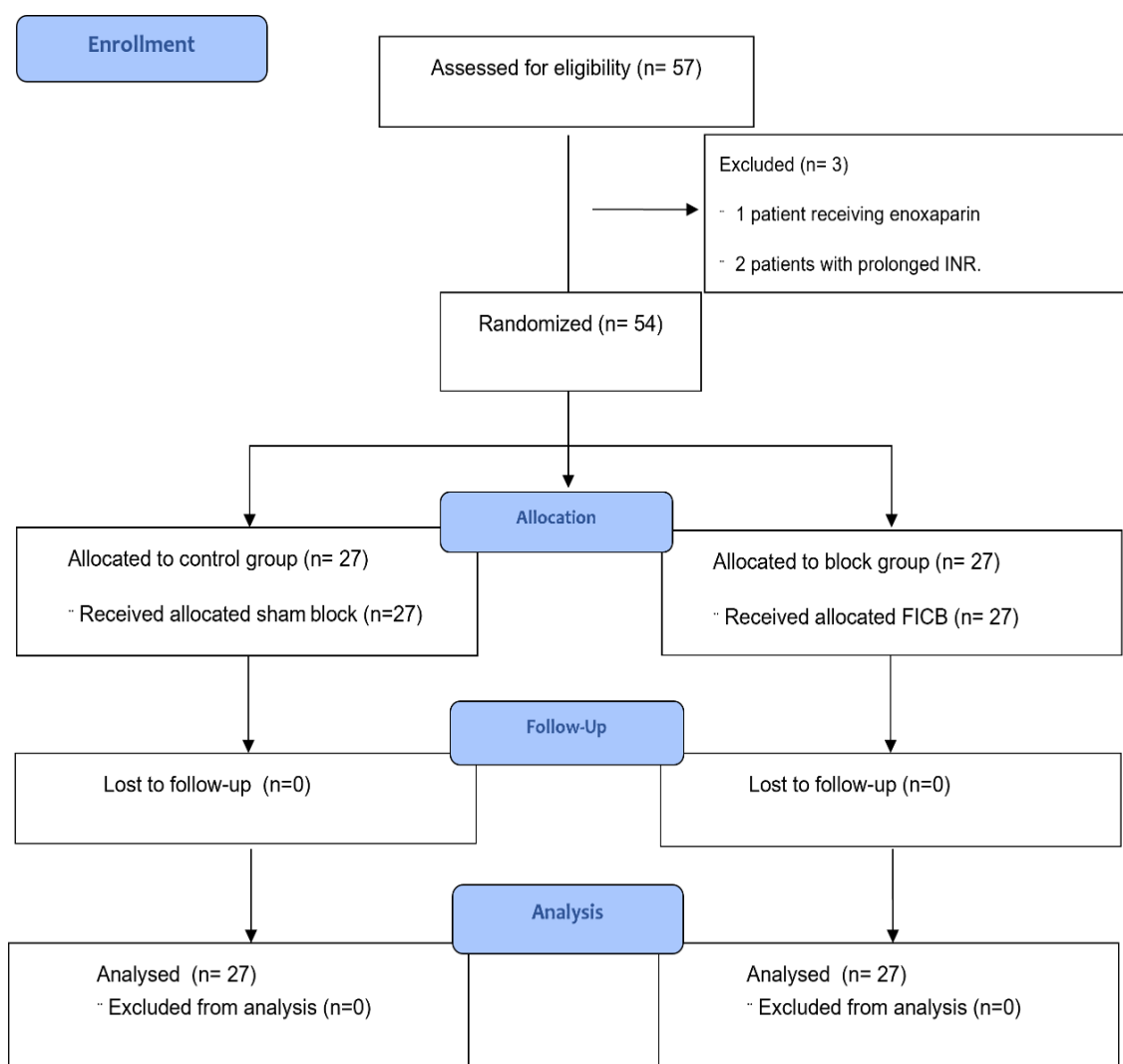


Figure 1 CONSORT Flow Diagram

Table 1 Patient demographics data and operative characteristics

	Block (n=27)	Control (n=27)	P-value
Age (yr), mean $\pm$ SD	80.4 $\pm$ 8.2	80.6 $\pm$ 8.6	0.922
Body mass index (kg/m ²), mean $\pm$ SD	23.5 $\pm$ 5.9	22.4 $\pm$ 2.5	0.360
Preoperative Hct (%), mean $\pm$ SD	34.4 $\pm$ 3.9	33.7 $\pm$ 4.1	0.517
Preoperative pain score (0-10), mean $\pm$ SD	6.33 $\pm$ 1.98	5.62 $\pm$ 1.47	0.139
Underlying diseases, n (%)			
Dyslipidemia	13 (48.1)	16 (59.3)	0.410
Diabetes mellitus	10 (37.0)	8 (29.6)	0.564
Hypertension	5 (18.5)	2 (7.4)	0.420
Old cerebrovascular accident	6 (22.2)	2 (7.4)	0.250
Chronic obstructive pulmonary disease	2 (7.4)	0	0.491
Chronic kidney disease	2 (7.4)	4 (14.8)	0.669
Atrial fibrillation	2 (7.4)	0	0.491
Types of operation, n (%)			0.467
CRIF $\pm$ PFNA	21 (77.8)	24 (88.9)	
Bipolar hemiarthroplasty	6 (22.2)	3 (11.1)	
Surgery within 72 h, n (%)	18 (66.7)	19 (70.4)	0.770
Total volume of 0.5% isobaric bupivacaine (mL), mean $\pm$ SD	2.9 $\pm$ 0.3	2.8 $\pm$ 0.2	0.599
Estimated blood loss (mL), mean $\pm$ SD	64.4 $\pm$ 45.2	52.2 $\pm$ 56.7	0.070
Duration of surgery (min), mean $\pm$ SD	47.6 $\pm$ 17.2	46.1 $\pm$ 18.8	0.764

As the prespecified primary outcome, there was no statistical difference in postoperative morphine requirements at 24 and 48 h among groups. Similarly, time to first dose of morphine request after surgery showed no significant difference (Table 2). Pain-related outcomes demonstrated clinically meaningful differences between groups. Pain scores during positioning for spinal anesthesia were significantly lower in the block group compared to the control group. Correspondingly, the time required to perform spinal anesthesia

was significantly shorter in the block group ($P < 0.001$). Postoperative pain scores during ambulation were also significantly reduced in the block group at both 24 h ($P = 0.028$) after surgery. Pain scores at rest tended to be lower in the block group, although the differences did not reach statistical significance (Table 3).

A linear mixed-effects model adjusting for baseline pain demonstrated no significant difference between the block group and the control group in resting pain scores ($P = 0.067$). Pain decreased significantly over time, with

Table 2 Postoperative outcomes

	Block (n=27)	Control (n=27)	P-value
Morphine requirement at 24 h (mg), median (IQR)	2 (0-5)	3 (1-6)	0.210
Morphine requirement at 48 h (mg), median (IQR)	0 (0-2)	0 (0-3)	0.118
Time to first dose of morphine (h), median (IQR)	8 (4-48)	5 (4-15)	0.220
Nausea in 24 h, n (%)	0	2 (7.4)	0.490
Hypotension in 24 h, n (%)	2 (7.4)	1 (3.7)	>0.999
Patient satisfaction score, mean $\pm$ SD	9.3 $\pm$ 1.1	8.5 $\pm$ 1.3	0.023*
Length of hospital stay (days), mean $\pm$ SD	12.0 $\pm$ 4.7	11.7 $\pm$ 4.9	0.821

*P-value <0.05

Table 3 Perioperative pain scores and time requirement during spinal anesthesia

	Block (n=27)	Control (n=27)	P-value
Pain during positioning for spinal anesthesia, mean $\pm$ SD	4.29 $\pm$ 0.66	7.55 $\pm$ 1.15	<0.001*
Time to perform spinal anesthesia (min), mean $\pm$ SD	6.4 $\pm$ 1.9	12.6 $\pm$ 4.6	<0.001*
Pain at rest, mean $\pm$ SD			
Postoperatively 24 h	2.6 $\pm$ 1.6	3.1 $\pm$ 1.3	0.198
Postoperatively 48 h	1.6 $\pm$ 1.4	2.2 $\pm$ 0.9	0.067
Pain on movement, mean $\pm$ SD			
Postoperatively 24 h	5.0 $\pm$ 1.2	5.8 $\pm$ 1.5	0.048*
Postoperatively 48 h	3.1 $\pm$ 1.1	3.9 $\pm$ 1.2	0.028*

*P-value <0.05

lower scores at 48 h compared to 24 h ($P < 0.001$). There was no significant group $\times$ time interaction. For pain during ambulation, the block group demonstrated significantly lower pain scores compared to the control group ($P = 0.009$). Pain also decreased significantly over time ($P < 0.001$). No significant group $\times$ time interaction was observed (Table 4).

Postoperative complications, including

hypotension, nausea, vomiting, shivering, and pruritus were not significantly different between groups. Patient satisfaction with anesthesia care was significantly higher in the FICB group ($P = 0.023$), while length of hospital stay was similar. No adverse events such as LAST, postoperative infection, muscle weakness, falls, or nerve injury were observed in both groups within 48 h after surgery.

Table 4 Mixed-effects model analysis of postoperative pain score

	Coefficient (β)	95% CI	P-value
Postoperative pain score at rest			
Intervention	-0.641	-1.327 to 0.044	0.067
Time: 48 h vs 24 h	-0.926	-1.310 to -0.542	<0.001*
Group $\times$ Time interaction	-0.074	-0.617 to 0.468	0.789
Postoperative pain score on movement			
Intervention	-0.873	-1.532 to -0.214	0.009*
Time: 48 h vs 24 h	-1.926	-2.353 to -1.499	<0.001*
Group $\times$ Time interaction	0.074	-0.530 to 0.678	0.810

*P-value <0.05

Discussion

Effective pain control in elderly patients undergoing surgical fixation of hip fractures continues to pose a considerable clinical challenge for anesthesiologists. Although opioids remain the conventional cornerstone of postoperative analgesia, their sedative and respiratory effects can impede early mobilization, which can be detrimental to postoperative recovery.^{12,13} In contrast, peripheral nerve blocks are known to be effective components of multimodal analgesia. They have been shown to reduce opioid consumption and pain intensity while facilitating early ambulation.^{14,15} The FICB is an effective technique due to its simplicity, safety, and efficacy in improving analgesia.^{15,16}

In this randomized controlled study, perioperative FICB significantly improved perioperative pain outcomes, particularly during positioning for spinal anesthesia and postoperative pain on movement, as

demonstrated by both descriptive analysis and mixed-effects modelling. In contrast to our initial hypothesis, total postoperative morphine consumption did not differ significantly between groups. This finding may be explained by a floor effect, as the overall opioid requirement in both groups was minimal (median 0-3 mg). This likely reflects the effectiveness of the multimodal analgesic regimen used, which may have obscured differences between groups. This highlights the idea that opioid consumption may not be a sensitive endpoint in settings where baseline analgesia is already effective. Moreover, patient-controlled analgesia (PCA) was not used due to institutional resource limitations. Instead, a nurse-administered morphine protocol was used as a pragmatic alternative in our setting, which may have limited the sensitivity in detecting differences in opioid consumption.

These results contrast with the study by Thompson et al.¹⁸ Their study showed that preoperative FICB significantly decreases

postoperative opioid consumption. This discrepancy may be attributable to divergent postoperative analgesic protocols. In our study, morphine was used as the primary rescue analgesic drug and was administered only when the patient's pain score exceeded four. This is consistent with the median pain scores in both groups, which ranged between 0 and 4. In contrast, Thompson et al.¹⁸ administered morphine only for severe pain and similarly found no difference in analgesic requirements in patients experiencing mild to moderate pain. This suggests that the difference in outcome is only apparent when pain intensity is high.

Importantly, clinically meaningful differences were observed in pain-related outcomes. Patients receiving FICB reported significantly lower pain scores during positioning for spinal anesthesia and during ambulation at both 24 and 48 h postoperatively. These findings are consistent with previous studies demonstrating that FICB provides effective analgesia for hip fracture patients, particularly during movement-related activities.^{7-11,15,16,19-21} From a clinical perspective, reduction in movement-related pain potentially facilitate early mobilization, reduce perioperative stress responses, and potentially improve functional recovery. FICB not only enhances procedural efficiency but also contributes to a more comfortable and safer anesthetic experience.

Several limitations of this prospective study should be considered. First, post hoc analysis suggests that the trial was underpowered to detect differences in pain-related

outcomes. The primary assumption of a 50% reduction in morphine consumption was probably overly optimistic. In practice, opioid requirements were lower than anticipated, possibly reflecting the effectiveness of the baseline multimodal analgesic regimen.

Second, this was a single-center study with a modest sample size conducted in Samut Songkhram province, which may limit generalizability. In addition, the absence of a sham needle puncture in the control group may have compromised blinding, allowing patients or assessors to infer group allocation. Moreover, rescue analgesia was administered using a nurse-driven protocol rather than PCA, which may have reduced the ability to detect differences in opioid consumption. Importantly, there was no standardized postoperative physical therapy program during the study period. As a result, pain scores during movement may have been assessed at different activity levels among patients (such as passive movement, sitting, or ambulation), potentially influencing the measured outcomes. Finally, this study focused on acute perioperative outcomes and did not evaluate important geriatric outcomes such as postoperative delirium, time to rehabilitation, and long-term functional recovery. Future multicenter randomized controlled trials with standardized protocols, sham controls, and comprehensive outcome measures are needed to further define the role of fascia iliaca compartment block in perioperative care.

Conclusion

In elderly patients undergoing hip fracture surgery under spinal anesthesia, perioperative FICB significantly reduced positioning pain during spinal anesthesia and improved movement-related pain without increasing complications. No significant differences in resting pain and opioid consumption were observed. These findings suggest that movement-related pain outcomes may better capture the clinical benefits of FICB within multimodal analgesia. With an ageing population, integrating effective regional anesthesia techniques such as FICB into the perioperative period may enhance patient outcomes.

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