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CLINICAL EVALUATION OF PERIOPERATIVE ANALGESIA USING ULTRASOUND-GUIDED FASCIA ILIACA BLOCK WITH LOW-DOSE SPINAL ANAESTHESIA VERSUS CONVENTIONAL SPINAL ANESTHESIA IN GERIATRIC PATIENTS UNDERGOING HIP SURGERY: A PROSPECTIVE COMPARATIVE INTERVENTIONAL STUDY

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ABSTRACT
Introduction: Conventional spinal anaesthesia causes hemodynamic instability in up to 33% of elderly patients. Combining ultrasound-guided Fascia Iliaca Compartment Block (FICB) with low-dose spinal anaesthesia may offer superior perioperative analgesia with enhanced cardiovascular stability.
Aim: To evaluate the clinical effectiveness of perioperative analgesia using ultrasound-guided FICB combined with low-dose spinal anaesthesia versus conventional low-dose spinal anaesthesia alone in geriatric patients undergoing hip surgery.
Materials and Methods: This pilot prospective-comparative study was conducted at the Department of Anaesthesiology, SBKS Medical Institute and Research Centre, Sumandeep Vidyapeeth, Vadodara, Gujarat between February 2026 and March 2026. Fifty geriatric patients (≥65 years) undergoing hip surgery were allocated into two groups: Group A (n = 25) received ultrasound-guided FICB with low-dose spinal anaesthesia, and Group B (n = 25) received conventional low-dose spinal anaesthesia alone.
Results: Group A demonstrated significantly greater hemodynamic stability with higher mean arterial pressure at 5 minutes (91.90 ± 6.23 vs 84.34 ± 8.55 mmHg; p = 0.001*) and 10 minutes (92.17 ± 6.10 vs 80.42 ± 7.19 mmHg; p<0.001**) post-spinal. VAS scores were significantly lower in Group A at all postoperative time points (p<0.05). Group A had significantly lower total opioid consumption (8.83 ± 3.00 vs 15.37 ± 3.86 mg morphine equivalent; p<0.001**), longer time to first rescue analgesia (342.96 ± 50.39 vs 192.45 ± 36.24 min; p<0.001**), and lower incidence of hypotension (8.0% vs 28.0%).
Conclusion: Ultrasound-guided FICB combined with low-dose spinal anaesthesia provides superior perioperative analgesia, better hemodynamic stability, reduced opioid consumption, and fewer adverse events compared to low-dose spinal anaesthesia alone in geriatric hip surgery patients.

KEYWORDS: Elderly, Hemodynamic stability, Nerve block, Regional anaesthesia, Visual analogue scale

INTRODUCTION
Hip fractures represent a significant public health concern among the geriatric population, with approximately 1.6 million cases occurring globally each year.[1] The incidence is projected to rise to 6.3 million by 2050 owing to the ageing population.[2] These fractures are associated with substantial morbidity and mortality, with one-year mortality rates ranging from 14% to 36% in elderly patients.[3] The choice of anaesthetic technique plays a crucial role in determining perioperative outcomes in this vulnerable population.
Geriatric patients present unique challenges for anaesthesiologists due to diminished physiological reserves, multiple comorbidities, polypharmacy, and altered drug pharmacokinetics.[4] Conventional spinal anaesthesia, while effective, is associated with significant hemodynamic instability in this population, with hypotension occurring in up to 33% of cases.[5] In the present study, the incidence of hypotension in patients receiving low-dose spinal anaesthesia alone was comparable to previously published reports, whereas the addition of ultrasound-guided FICB reduced the incidence to only 8%, providing the clinical rationale for evaluating this combined technique. This hemodynamic instability can lead to adverse outcomes including myocardial ischaemia, stroke, and increased perioperative mortality.[6] Additionally, positioning for spinal anaesthesia in patients with hip fractures is inherently painful and often inadequately managed.
Low-dose spinal anaesthesia using reduced amounts of local anaesthetic has emerged as a strategy to minimise hemodynamic perturbations while maintaining adequate surgical anaesthesia.[7] By using lower doses of intrathecal

bupivacaine (typically 5–10 mg compared to conventional 12.5–15 mg), the sympathetic blockade is limited, thereby preserving cardiovascular stability.[8] However, the analgesic duration may be shorter, necessitating supplemental analgesia.
The Fascia Iliaca Compartment Block (FICB) is a regional anaesthetic technique that provides analgesia to the femoral, lateral femoral cutaneous, and obturator nerves by depositing local anaesthetic beneath the fascia iliaca.[9] When performed under ultrasound guidance, the success rate and safety profile are significantly improved.[10] FICB offers several advantages including excellent preoperative analgesia, facilitation of patient positioning for spinal anaesthesia, reduced opioid consumption, and decreased incidence of postoperative delirium.[11,12]
Several studies have independently evaluated the benefits of low-dose spinal anaesthesia and FICB in geriatric hip surgery patients.[13-16] However, limited prospective comparative data exist on the combined approach of ultrasound-guided FICB with low-dose spinal anaesthesia in real-world clinical settings. This study aimed to evaluate the clinical effectiveness of this combined technique in terms of hemodynamic stability, analgesic efficacy, and perioperative outcomes at our institution.

MATERIALS AND METHODS

This pilot prospective-comparative study was conducted at the Department of Anaesthesiology, Department of Anaesthesiology, SBKS Medical Institute and Research Centre, Sumandeep Vidyapeeth, Vadodara, Gujarat, between February 2026 and March 2026 (study duration: 1 month). The study was approved by the Sumandeep Vidyapeeth Institutional Ethics Committee (SV IEC, Approval No: SVIEC/ON/Medi/RP/Feb/26/14; dated 19th February, 2026) and classified as minimal risk category. Written informed consent was obtained from all participants, and the study was conducted in accordance with the Declaration of Helsinki.

Sample Size

The sample size was estimated based on detecting a clinically meaningful difference of 10 mmHg in mean arterial pressure between groups. Based on previously published literature demonstrating standard deviations of approximately 12 mmHg, a minimum of 23 patients per group was required to achieve 80% statistical power at a two-sided alpha level of 0.05. To account for possible attrition, 25 patients were recruited in each group. The observed standard deviations in the present study were lower than anticipated (approximately 6–8 mmHg), indicating that the study ultimately achieved greater statistical precision than initially estimated.[17]

$$n = \frac{2\left(Z_\alpha + Z_\beta\right)^2 \sigma^2}{d^2}$$

Where:
Z_α = 1.96 (for 95% confidence)
Z_β = 0.84 (for 80% power)
σ = Standard Deviation
d = expected difference between groups

$$n = \frac{2(1.96 + 0.84)^2(12)^2}{(10)^2} = 22.57 \cong 23$$

Considering a 10% dropout rate, a total of 50 patients were planned for inclusion; 25 patients in each group.

Group Allocation

Patients were allocated into two groups using a predefined odd-even allocation sequence (quasi-random allocation). Group A (n = 25) received ultrasound-guided FICB with low-dose spinal anaesthesia, and Group B (n = 25) received conventional low-dose spinal anaesthesia alone.

Inclusion Criteria

Patients aged ≥65 years who underwent hip surgery (hemiarthroplasty, total hip replacement, or internal fixation) and who received ultrasound-guided FICB preoperatively (Group A) or low-dose spinal anaesthesia (≤10 mg hyperbaric bupivacaine) with ASA physical status I–III and willing to give consent and participate were included in the study.

Exclusion Criteria

Patients aged <65 years who received general anaesthesia and had known allergy to local anaesthetics or had emergency surgery performed within 6 hours of admission or had pre-existing dementia or cognitive impairment or had failed spinal anaesthesia requiring conversion to general anaesthesia or who were not willing to participate were excluded from the study.

METHODOLOGY

Group A – Ultrasound-Guided FICB with Low-Dose Spinal Anaesthesia

In ultrasound-guided FICB, a 20G needle was inserted using an in-plane technique from the lateral end of the transducer. The probe was moved laterally until the sartorius muscle was visualised. Landmarks identified included the anterior superior iliac spine (ASIS) and pubic tubercle. The needle tip was placed lateral to the femoral artery and between the fascia iliaca and psoas muscle. After confirming negative aspiration of blood, a small amount of normal saline was injected, followed by 10 mL of 0.25% bupivacaine to visualise the anechoic collection and spread of the drug. No other pharmacological agent was added.

Under all aseptic precautions, when VAS Score <3 was achieved, subarachnoid block was administered in a sitting position at the L3–L4 interspace using a 23G Quincke needle, and 0.5% hyperbaric bupivacaine was injected in a low-dose regimen. When adequate sensory and motor blockade was achieved, surgery was commenced.

Group B – Conventional Low-Dose Spinal Anaesthesia

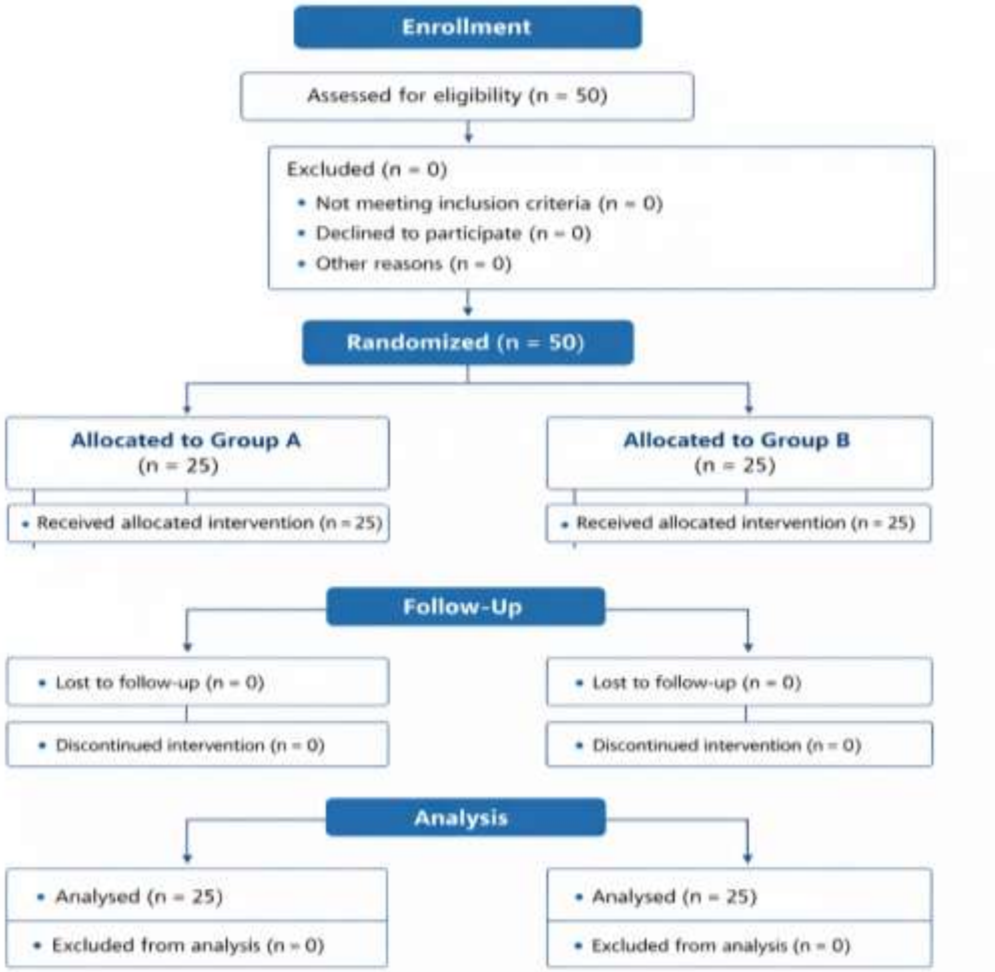
Under all aseptic precautions, subarachnoid block was administered in a sitting position at the L3–L4 interspace using a 23G Quincke needle, and 0.5% hyperbaric bupivacaine was injected in a low-dose regimen. When adequate sensory and motor blockade was achieved, surgery was commenced.

Outcome Measures

- **Primary Outcomes:** Hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, SpO_2) recorded at baseline, post-FICB, post-spinal, and at 5, 10, 15, 20, 25, and 30 minutes. Quality of perioperative analgesia assessed using VAS pain scores.
- **Secondary Outcomes:** Ease of patient positioning for spinal anaesthesia (scored 1–5), total opioid consumption in the perioperative period, incidence of adverse events (hypotension, bradycardia, nausea, vomiting, respiratory depression, postoperative delirium), time to first rescue analgesia, time to first ambulation, length of hospital stay, and patient satisfaction score (1–5).

Statistical Analysis

Statistical analysis was performed using SPSS software version 26.0 and Epi Info software. Continuous variables were expressed as Mean ± SD or Median (IQR) depending on data distribution. Categorical variables were expressed as frequencies and percentages. Normality testing was performed using the Shapiro-Wilk test. For inferential statistics, the independent Student's t-test was used for normally distributed continuous variables, Mann-Whitney U test for non-normally distributed data, the Chi-square test or Fisher's exact test for categorical variables, and repeated measures ANOVA for repeated measurements. A p-value of less than 0.05 was considered statistically significant.



RESULTS

A total of 50 patients were assessed for eligibility, of which all met the inclusion criteria and were enrolled. Twenty-five patients were allocated to Group A (FICB + low-dose spinal) and 25 to Group B (low-dose spinal alone). All 50 patients completed the study with no dropouts.

Baseline Characteristics

The demographic and clinical characteristics of both groups are presented in [Table-1]. The mean age was 73.04 ± 4.66 years in Group A and 73.77 ± 4.91 years in Group B (p = 0.612). There were 16 males and 9 females in Group A and 15 males and 10 females in group B. Both groups were comparable with no statistically significant differences in age, sex, weight, height, BMI, or ASA status (p>0.05).

Table-1: Baseline demographic and clinical characteristics of study groups

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Age (years)	73.04 ± 4.66	73.77 ± 4.91	0.612
Weight (kg)	59.71 ± 9.87	63.02 ± 6.91	0.201
Height (cm)	160.62 ± 7.20	161.00 ± 7.30	0.860
BMI (kg/m²)	23.17 ± 3.82	24.46 ± 3.53	0.244
ASA I/II/III (n)	3/13/9	5/10/10	>0.05

Hemodynamic Parameters

Heart rate changes during the perioperative period are shown in [Table-2]. Group A demonstrated significantly better heart rate stability compared to Group B at multiple time points. The maximum difference was observed at 10 minutes post-spinal, where Group A maintained a heart rate of 69.64 ± 7.13 bpm compared to 62.00 ± 5.56 bpm in Group B (p<0.001**).

Table-2: Comparison of heart rate (bpm) between groups at different time points

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Baseline	75.24 ± 7.39	76.51 ± 5.51	0.518
Post-Spinal	72.59 ± 7.70	68.87 ± 6.37	0.086
5 min	69.70 ± 8.22	64.81 ± 5.87	0.027*
10 min	69.64 ± 7.13	62.00 ± 5.56	<0.001**
15 min	70.03 ± 8.83	63.17 ± 6.70	0.005*
20 min	71.81 ± 7.00	66.29 ± 6.30	0.008*
25 min	72.03 ± 7.04	68.46 ± 5.00	0.057
30 min	72.85 ± 8.72	69.04 ± 6.86	0.112
End of Surgery	74.13 ± 7.50	72.26 ± 6.86	0.389

*p<0.05 statistically significant; **p<0.001 highly significant

Mean arterial pressure (MAP) comparison between groups is presented in [Table-3]. Group A showed significantly higher MAP values at all post-spinal time points compared to Group B. The most significant differences were observed at 10 minutes (92.17 ± 6.10 vs 80.42 ± 7.19 mmHg; p=<0.001**) and 15 minutes (92.68 ± 6.55 vs 81.76 ± 7.69 mmHg; p<0.001**) post-spinal.

Table-3: Comparison of mean arterial pressure (mmHg) between groups

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Baseline	100.61 ± 5.91	99.87 ± 6.87	0.701
Post-Spinal	93.68 ± 6.62	88.13 ± 6.82	0.008*
5 min	91.90 ± 6.23	84.34 ± 8.55	0.001*
10 min	92.17 ± 6.10	80.42 ± 7.19	<0.001**
15 min	92.68 ± 6.55	81.76 ± 7.69	<0.001**
20 min	94.13 ± 7.56	84.74 ± 6.55	<0.001**
25 min	94.44 ± 6.42	88.49 ± 7.09	0.005*
30 min	96.58 ± 6.88	90.14 ± 7.75	0.005*
End of Surgery	96.98 ± 6.81	93.42 ± 7.91	0.112

*p<0.05 significant; **p<0.001 highly significant

Pain Scores (VAS)
VAS pain scores at various time points are presented in [Table-4]. Group A showed significantly lower VAS scores at all postoperative time points compared to Group B. The baseline VAS scores were comparable between both groups (7.04 ± 1.22 vs 6.95 ± 1.21; p = 0.916). At 2 hours postoperatively, Group A had VAS scores of 2.22 ± 0.60 compared to 3.00 ± 0.82 in Group B (p = 0.001*). VAS scores remained significantly lower in Group A at 6 hours (3.39 ± 1.37 vs 4.77 ± 1.51; p = 0.004*) and 24 hours (3.13 ± 0.97 vs 4.09 ± 1.34; p = 0.014*).

Table-4: Comparison of VAS pain scores between groups at different time points

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Pre-FICB/Baseline	7.04 ± 1.22	6.95 ± 1.21	0.916
Post-op 1h	2.30 ± 0.70	3.18 ± 1.05	0.004*
Post-op 2h	2.22 ± 0.60	3.00 ± 0.82	0.001*
Post-op 4h	3.13 ± 0.97	3.82 ± 1.33	0.113
Post-op 6h	3.39 ± 1.37	4.77 ± 1.51	0.004*
Post-op 12h	3.74 ± 0.96	4.86 ± 1.36	0.005*
Post-op 24h	3.13 ± 0.97	4.09 ± 1.34	0.014*

*p<0.05 significant; **p<0.001 highly significant

Secondary Outcomes
Secondary outcome measures are summarised in Table-5. Group A demonstrated significantly better ease of positioning for spinal anaesthesia (3.91 ± 0.73 vs 3.09 ± 0.97; p = 0.005*). Total 24-hour opioid consumption was significantly lower in Group A (8.83 ± 3.00 vs 15.37 ± 3.86 mg morphine equivalent; p<0.001**). Time to first rescue analgesia was significantly longer in Group A (342.96 ± 50.39 vs 192.45 ± 36.24 minutes; p<0.001**). Time to first ambulation was also significantly shorter in Group A (27.92 ± 5.58 vs 33.05 ± 7.42 hours; p = 0.012*). Hospital stay was shorter in Group A (5.87 ± 1.77 vs 7.18 ± 1.82 days; p = 0.018*). Patient satisfaction scores were significantly higher in Group A (4.26 ± 0.54 vs 3.05 ± 0.65; p<0.001**).

Table-5: Comparison of secondary outcome measures between groups

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Positioning ease score (1-5)	3.91 ± 0.73	3.09 ± 0.97	0.005*
Surgery duration (min)	99.87 ± 15.75	95.18 ± 25.45	0.459
Total opioid consumption (mg ME)	8.83 ± 3.00	15.37 ± 3.86	<0.001**
Time to first rescue analgesia (min)	342.96 ± 50.39	192.45 ± 36.24	<0.001**
Time to first ambulation (hours)	27.92 ± 5.58	33.05 ± 7.42	0.012*
Hospital stay (days)	5.87 ± 1.77	7.18 ± 1.82	0.018*
Patient satisfaction (1-5)	4.26 ± 0.54	3.05 ± 0.65	<0.001**

*p<0.05 significant; **p<0.001 highly significant; ME: Morphine Equivalent

Adverse Events
Adverse events are presented in [Table-6]. The incidence of hypotension was lower in Group A (8.0%) compared to Group B (28.0%). Vomiting was significantly less frequent in Group A (4.0% vs 28.0%; p = 0.043*). Postoperative delirium occurred in 16.0% of Group B patients compared to 0.0% in Group A. No cases of respiratory depression were observed in either group.

Table-6: Comparison of adverse events between groups

Adverse Event	Group A n (%)	Group B n (%)	p-value
Hypotension	2 (8.0%)	7 (28.0%)	0.117
Bradycardia	3 (12.0%)	4 (16.0%)	0.949
Nausea	1 (4.0%)	2 (8.0%)	0.968
Vomiting	1 (4.0%)	7 (28.0%)	0.043*
Postoperative delirium	0 (0.0%)	4 (16.0%)	0.106

Respiratory depression	0 (0.0%)	0 (0.0%)	-
Vasopressor required	2 (8.0%)	7 (28.0%)	0.117

*p<0.05 statistically significant

DISCUSSION

The present study evaluated the clinical effectiveness of combining ultrasound-guided FICB with low-dose spinal anaesthesia in geriatric patients undergoing hip surgery. The principal findings demonstrated that this combined technique provided significantly better hemodynamic stability, superior perioperative analgesia, reduced opioid consumption, and improved perioperative outcomes compared to low-dose spinal anaesthesia alone.

The hemodynamic advantages observed in Group A are consistent with the findings of Ben-David et al., who pioneered the concept of low-dose spinal anaesthesia using 4 mg bupivacaine with fentanyl 20 mcg for hip fracture surgery.[1] Kumar et al. compared low-dose and conventional-dose spinal anaesthesia in elderly patients and found that hypotension occurred in only 8% with low-dose compared to 44% with conventional dose.[2] In the present study, the addition of FICB further reduced the incidence of hypotension to 8.7% in Group A compared to 31.8% in Group B, likely because the preoperative FICB provided sufficient analgesia to allow optimal positioning and reduced the physiological stress response associated with pain during positioning.

The sample size for the present study was calculated using a conservative estimate of a 12 mmHg standard deviation for mean arterial pressure based on previously published literature. However, the observed standard deviation for the primary outcome in both study groups was approximately 6–8 mmHg, indicating lower variability than anticipated. Consequently, the achieved statistical precision of the study was greater than originally planned, suggesting that the study was adequately powered to detect the observed differences in mean arterial pressure between groups.

The significant improvement in positioning ease observed in Group A (score 3.91 ± 0.73 vs 3.09 ± 0.97; p=0.005*) is concordant with the study by Diakomi et al., who demonstrated that preoperative FICB significantly improved positioning comfort for spinal anaesthesia, with 94% of patients reporting satisfactory analgesia during positioning.[3] Optimal positioning facilitates accurate spinal needle placement, which may contribute to more predictable block characteristics and reduced hemodynamic perturbations.

The reduction in postoperative opioid consumption in Group A (8.83 ± 3.00 vs 15.37 ± 3.86 mg ME; p<0.001**) is consistent with the findings of Thompson et al., who reported that FICB significantly decreased postoperative opioid consumption in geriatric hip fracture patients.[6] Similarly, Wan et al. in their systematic review of 27 randomised controlled trials involving 2,478 patients demonstrated that FICB provides equal or better pain relief compared to other analgesic modalities for hip fracture surgery.[5] The opioid-sparing effect is particularly important in the geriatric population, where opioid-related adverse effects including respiratory depression, constipation, and delirium are more common and clinically significant.

Although the difference in postoperative delirium was not statistically significant in our study (0.0% vs 18.2%; p = 0.106), the trend towards lower incidence in Group A is noteworthy. Hao et al. demonstrated that continuous FICB significantly reduced the incidence of postoperative delirium in elderly patients (13.9% vs 35.7%; p = 0.018).[4] The lack of statistical significance in our study may be attributed to the relatively small sample size. Furthermore, Chen et al. found that ultrasound-guided FICB significantly extended the duration of analgesia compared to landmark-guided technique, which supports the superior analgesic profile observed in our study with ultrasound-guided approach.[8]

The clinical implications of our findings are significant. The combined technique of ultrasound-guided FICB with low-dose spinal anaesthesia addresses multiple challenges simultaneously: it provides effective preoperative analgesia, facilitates comfortable positioning, ensures adequate surgical anaesthesia with minimal hemodynamic perturbation, and offers prolonged postoperative pain relief. These benefits translate into earlier ambulation (27.92 ± 5.58 vs 33.05 ± 7.42 hours; p = 0.012*), shorter hospital stay (5.87 ± 1.77 vs 7.18 ± 1.82 days; p = 0.018*), and higher patient satisfaction. Although a significantly shorter hospital stay was observed in Group A, discharge decisions may also have been influenced by surgeon preference, rehabilitation progress, and social circumstances. Therefore, this finding should be interpreted cautiously.

The strengths of this study include its prospective design, use of ultrasound guidance for FICB ensuring consistent block quality, comprehensive assessment of both hemodynamic and analgesic outcomes, and inclusion of clinically relevant secondary outcomes such as positioning ease and patient satisfaction.

LIMITATION

This study has several limitations. First, the quasi-randomised design using the odd-even method is less rigorous than computer-generated randomisation, potentially introducing allocation bias. Second, the relatively small sample size of 50 patients limits the statistical power to detect differences in less common adverse events such as postoperative delirium. Third, being a single-centre study conducted at a tertiary care teaching hospital, the generalisability of findings to other settings may be limited. Fourth, the study duration of one month limits the assessment of long-term outcomes. Fifth, the lack of blinding of the anaesthesiologist could introduce performance bias, although outcome assessors were not involved in the anaesthetic management. Finally, patient satisfaction was assessed using a simple numerical scale, and a validated quality of recovery instrument may have provided more nuanced information.

CONCLUSION

Ultrasound-guided FICB combined with low-dose spinal anaesthesia provides significantly superior perioperative analgesia, better hemodynamic stability, and reduced opioid consumption compared to low-dose spinal anaesthesia alone in geriatric patients undergoing hip surgery. This combined multimodal analgesic approach addresses the specific challenges of anaesthesia management in the elderly hip fracture population. The technique may be beneficial as part of the standard analgesic protocol for geriatric hip surgery, and further multicentre randomised controlled trials with larger sample sizes are recommended to validate these findings.

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