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Original Research Article

Comparative study of the infrainguinal and suprainguinal approaches of fascia iliaca compartment block for postoperative analgesia in hip surgeries

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Abstract

Background: Patients with hip fractures often experience severe pain, making effective analgesic treatment crucial in the postoperative period. Fascia iliaca compartment block (FICB) is commonly used as part of a multimodal approach to reduce intravenous analgesic requirements.
Materials and Methods: This study compared the analgesic efficacy of two FICB techniques. Eighty patients were randomized to receive FICB via the suprainguinal approach (Group S) or infrainguinal approach (Group I) with 30 mL of 0.25% bupivacaine. Emergency analgesia included 50 mg of tramadol. Demographic profiles, time to first rescue analgesic, visual analogue scale (VAS) scores, and adverse events such as nausea, vomiting, hypotension, and bradycardia were recorded.
Results: Time to first rescue analgesic was significantly longer in Group S (284.89 ± 6.09 minutes) compared to Group I (189.01 ± 12.78 minutes; p=0.009). Postoperative tramadol consumption was significantly lower in Group S at 6, 12, and 24 hours, with cumulative consumption (14.15 ± 3.09 vs. 24.15 ± 8.96 mg; p=0.011) also reduced. Group S demonstrated superior VAS score reductions at 4–6 hours post-block compared to Group I, but there was no significant difference in VAS at 12 and 24 hours.
Conclusion: The suprainguinal FICB approach provides superior analgesic efficacy and lower tramadol consumption within 24 hours compared to the infrainguinal approach.

Keywords: Fascia iliaca compartment block, Infrainguinal access, Postoperative analgesia, Suprainguinal approach, VAS score.

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1. Introduction

Regional anaesthesia offers effective pain relief and reduces systemic analgesic side effects, which is particularly beneficial for elderly hip fracture patients with limited cardiopulmonary reserves.[1-4] Therefore, medications and techniques that have fewer side effects and better tolerance are ideal for postoperative analgesia.[5-6] Fascia iliaca compartment block (FICB), first described by Dalens et al. in 1989, is widely used in hip and femur surgeries as a simpler alternative to lumbar plexus and femoral nerve blocks.[7] The FICB targets the femoral, obturator, and lateral cutaneous nerves by injecting a local anaesthetic under the fascia iliaca, which can be viewed as an anterior approach to the lumbar plexus. The FICB offers a safe and reasonably easy substitute for lumbar and femoral plexus blocks in clinical practice.[8] Although the suprainguinal and infrainguinal approaches differ anatomically, their comparative efficacy remains understudied.[9,10] This study addresses this gap by evaluating their postoperative analgesic performance.

2. Materials and Methods

This prospective randomised clinical trial was conducted in the Department of Anaesthesia at a tertiary research centre after obtaining approval from the Institutional Ethical Committee (TMMC&RC/IEC/18-19/006). The trial was registered with the Clinical Trials Registry of India (CTRI2021/02/031209). Written informed consent was

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obtained from all patients or their caregivers prior to the procedure. Clinicians unaware of group allocation recorded VAS scores and administered rescue analgesia. Randomization was achieved using a computer-generated table, with the chit-and-box method for group assignments.

2.1. Sample size calculation

The sample size was calculated based on the formula derived from Kumar et al.[11]

$$n=[(Z_{\alpha/2}+Z_{\beta})^2\times 2\times\sigma^2]/d2$$

Where:

σ=population standard deviation,

d=difference of means between groups, d = (m1−m2)

$Z_{\alpha/2} = 1.96$, $Z_{\beta} = 0.84$, $\sigma = [S_1+S2]/2$, $S_1=9.2$, $S_2 = 11.7$, $m_1 = 3.5$, $m_2 = 67$, $d = 6.5$

The calculated minimum sample size was 39 participants per group (78 total). To ensure robustness, 40 patients were recruited in each group. Participants were divided into two groups of 40 patients each using computer-generated random numbers. A 30 mL volume of 0.25% bupivacaine was chosen based on previous studies, balancing optimal spread and minimising the risk of toxicity. Group S received a fascia iliaca compartment block (FICB) via the suprainguinal approach, while Group I received FICB via the infrainguinal approach.

Patients aged 18–60 years undergoing elective hip surgeries, including total hip replacement, unipolar or bipolar hemiarthroplasty, proximal femoral nailing, dynamic hip screws, and core decompression lasting 90–120 minutes under lumbar subarachnoid block, were included. Exclusion criteria consisted of patients with an ASA grade of 3 or higher, those on chronic analgesics, those with allergies to local anaesthetics, those with infections at the site of the block, patients with neurological impairments in the lower limbs, or those unable to comprehend or provide a VAS score. A comprehensive physical examination, detailed medical history, and routine pre-anaesthesia evaluations were conducted for all participants. During the pre-anaesthesia checkup, the VAS score was explained to each patient (**Figure 1**).

All patients were premedicated with intravenous midazolam (0.25 mg/kg) and received lumbar subarachnoid blockade with hyperbaric 0.5% bupivacaine (2 mL) in the lateral position. Patients were preloaded with 10 mL/kg of lactated Ringer's solution, and the table was tilted to achieve a block height around the T6 level. Afterward, patients were placed in the supine position and administered FICB according to their assigned groups. Group I patients received FICB via the traditional infrainguinal method described by Dalens.[7] The block was performed by inserting the needle at a point 1 cm below the intersection of the middle and outer thirds of the line connecting the pubic tubercle and the anterior superior iliac spine (ASIS). The needle was inserted at a right angle until the first "pop" or loss of resistance (fascia lata) was felt. Following a negative aspiration test, 30 mL of 0.25% bupivacaine was injected while applying firm compression below the injection site. Group S patients received FICB via a modified suprainguinal approach as described by Stevens.[12] The needle was inserted 1 cm above the midpoint between the pubic tubercle and ASIS, advancing until the second "pop" (iliac fascia) was felt. Similar to Group I, 30 mL of 0.25% bupivacaine was administered after confirming the absence of vascular puncture through aspiration testing.

Standard intraoperative care was provided to all patients, including intravenous antibiotics and other medications as per protocol. Sedation was maintained with titrated doses of midazolam. Blood loss during surgery was monitored and replaced with appropriate volumes of balanced salt solutions. Episodes of intraoperative bradycardia (heart rate <50 beats per minute) or hypotension (>20% below baseline) were managed with atropine (0.3–0.6 mg) and fluid boluses of 250 mL balanced salt solution, with mephentermine (6 mg) administered if necessary. Postoperatively, patients were monitored in the recovery area with routine ECG, NIBP, and SpO2 checks. The duration of analgesia was recorded as the time from block administration to the first postoperative complaint of pain (VAS >4). Pain scores and hemodynamics were assessed at baseline, 5, 10, 15, 30, and 60 minutes, and at 2, 4, 6, 18, and 24 hours post-surgery.

Postoperative care included low-molecular-weight heparin and intravenous antibiotics following institutional protocols. Patients requiring additional analgesia were administered tramadol (100 mg) by a blinded clinician when their VAS score exceeded 4. Both groups had the block puncture sites covered with sterile dressings. Data from each patient were meticulously documented in pre-prepared sheets attached to their medical records. To ensure blinding, neither the patients nor the surgeons were informed about the group assignments.

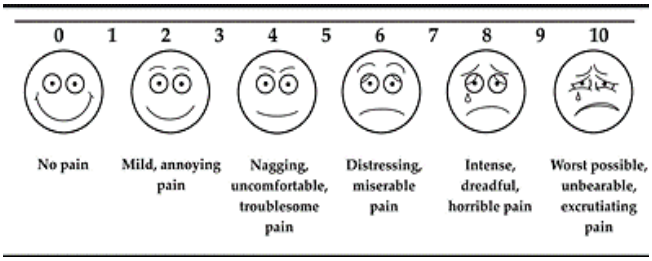

Figure 1: VAS score

Patient demographics for both groups were recorded. Assessed parameters included the time of the initial administration of a rescue analgesic, the total amount of tramadol consumed in a 24-hour period, the visual analogue score (VAS) for pain, and any adverse events, such as bradycardia, hypotension, nausea, or vomiting. Data were

imported into Microsoft Excel, and SPSS version 21.0 statistical software was used to conduct statistical analysis. The means of continuous variables were compared between the two groups using the Student's t test. To compare categorical variables between the two groups, including gender and adverse events, the chi-square test was employed. A significant p-value was defined as less than 0.05.

3. Results

The mean age of the study population was 40.73 ± 15.99 years in Group I and 38.07 ± 15.58 years in Group S (**Table 1**). Gender distribution showed that Group S comprised 73% males and 26% females, while Group I included 68% males and 31% females. The mean BMI of participants was 21.70 ± 0.98 kg/m² in Group S and 21.73 ± 0.99 kg/m² in Group I.

Group S demonstrated a significantly longer average duration (in minutes) for the first administration of rescue analgesic compared to Group I. Specifically, the time to first rescue analgesic was longer in Group S (284.89 ± 6.09 minutes) than in Group I (189.01 ± 12.78 minutes, p=0.009) (**Table 2**, **Figure 2**). Cumulative tramadol consumption over 24 hours was significantly lower in Group S (14.15 ± 3.09 mg) compared to Group I (24.15 ± 8.96 mg, p=0.011) (**Table 2**, **Figure 3**). Group S also showed superior reductins in VAS scores at 4 and 6 hours postoperatively, although these differences diminished by 12 and 24 hours (**Table 3**, **Figure 4**).

The incidence of nausea and vomiting was higher in Group I compared to Group S, with significant differences (p=0.001 and p<0.001, respectively) (**Table 4**).

Table 1: Distribution of demographic variables

Demographic variables	**Group S Mean ± S.D**	**Group I Mean ± S.D**
Age (Years)	38.07 ± 15.58	40.73 ± 15.99
Sex % (M/F)	78/ 22	68/ 32
B.M.I (kg/m2)	21.70 ± 0.99	21.73 ± 0.98
Surgical time in mins	113.52± 10.92	115.76± 10.84

Table 2: Time for first rescue analgesia, duration of analgesia and total doses of tramadol given in the study population

	Group S		**Group I**		**t-test value**	**p-value**
	Mean	Std. Deviation	Mean	Std. Deviation		
Time of first rescue analgesic given (minutes)	284.89	6.09	189.01	12.78	4.890	0.009*
Number of doses of Tramadol (in 24 hrs)	14.15	3.09	24.15	8.96	3.996	0.011*

Table 3: VAS score comparison in both groups

	Group S		**Group I**		**p-value**
VAS score	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	
Baseline	3.76	4.73	3.93	4.16	0.24
5 minutes	0.00	0.00	0.00	0.00	0.00
10 minutes	0.00	0.00	0.00	0.00	0.00
15 minutes	0.00	0.00	0.00	0.00	0.00
30 minutes	0.00	0.00	0.00	0.00	0.00
60 minutes	0.00	0.00	0.00	0.00	0.00
2 hours	0.00	0.00	0.00	0.00	0.00
4 hours	0.00	0.00	1.92	2.85	0.015
6 hours	1.99	2.98	2.73	3.56	0.005
18 hours	2.76	3.52	3.23	4.46	<0.001
24 hours	2.92	3.84	3.61	4.22	<0.001

Table 4: Distribution of adverse effects between Group S and Group I

	Group S	Group I	p-value
Nausea	4	22	0.001*
Vomiting	1	9	< 0.001*
Hypotension	3	7	0.039*
Urinary retention	13	12	0.928
Bradycardia	1	2	0.425

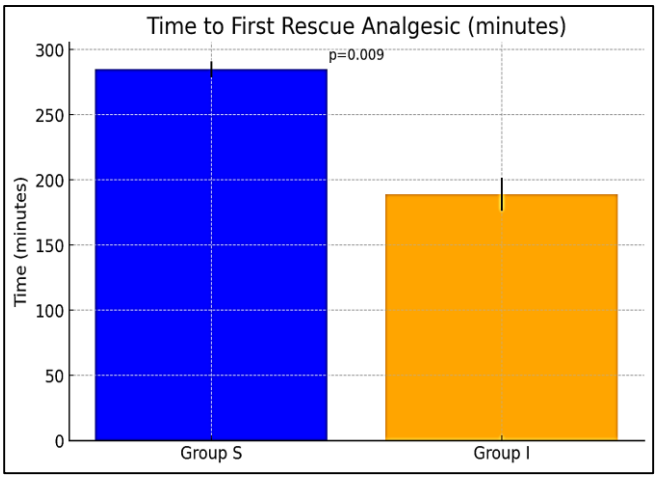

Figure 2: Time of first rescue analgesic

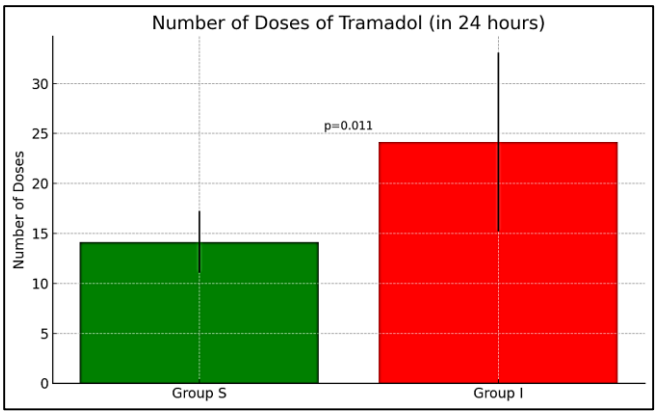

Figure 3: Number of doses of Tramadol administered over 24 hour

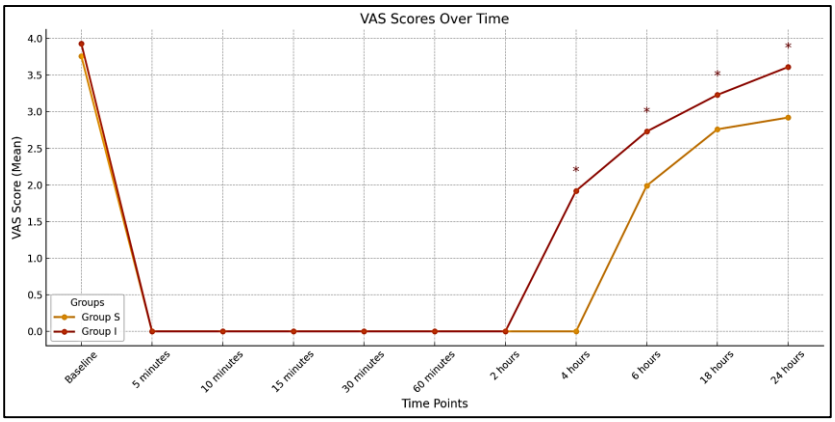

Figure 4: VAS scores over time for Group S and Group I. (Significant time points, where p-values were less than 0.05, are marked with red asterisks)

4. Discussion

Postoperative analgesia not only improves patient outcomes but also reduces postoperative morbidity, accelerates recovery, and facilitates rehabilitation.[13,14] The hip joint is innervated by multiple nerves, making regional lumbar plexus block techniques such as fascia iliaca compartment block (FICB), psoas compartment block, and 3-in-1 block highly effective options for postoperative pain management following hip surgeries. Among these, FICB is particularly advantageous due to its simplicity, effectiveness, and low risk. Our findings align with previous studies demonstrating the analgesic efficacy of FICB after hip surgery.

Goitia et al. conducted a prospective observational study on 41 patients undergoing total hip replacement surgery and found that FICB effectively reduced early postoperative pain.[15] Bullock et al. studied the suprainguinal iliac fascia technique and reported complete blockade of the lateral femoral cutaneous nerve.[16] This aligns with Hebbard et al.'s findings, which demonstrated successful analgesia during hip surgeries in over 150 patients using a suprainguinal needle position with a parasagittal transducer orientation.[9] According to a Spanish study, FICB was particularly beneficial for pain relief in total hip replacement surgeries during the first six hours following the block, although no significant differences in VAS scores were observed over the next 24 hours. Similarly, Biboulet et al.[17] found that psoas compartment block was more effective than placebo and superior to femoral nerve block for total hip arthroplasty. They suggested that the superiority of the psoas compartment block over the femoral nerve block could be attributed to its enhanced access to the lumbar plexus.

Hebbard et al. also demonstrated that a modified suprainguinal iliac fascia block provided better cephalic spread of local anesthetics compared to traditional infrainguinal techniques, as shown through dye injections in cadaveric studies.[9] Kumar et al. compared the analgesic efficacy of the infrainguinal (traditional FICB) and suprainguinal (modified FICB) approaches. Their findings showed significantly lower morphine consumption within the first 24 hours and superior postoperative analgesic outcomes with the suprainguinal approach. They reported a 34% higher morphine-sparing effect with the suprainguinal technique, supporting Stevens' hypothesis[12] that the suprainguinal approach achieves more effective lumbar plexus blockade due to greater cephalic spread of the local anesthetic.[11]

In our study, Group S had a significantly longer time to the first administration of rescue analgesia compared to Group I. Specifically, Group S demonstrated a longer duration of analgesia (284.89 ± 6.09 minutes) compared to Group I (189.01 ± 12.78 minutes). This reinforces the findings of Kumar et al.[11] and supports the theory that suprainguinal FICB provides better lumbar plexus coverage and longer-lasting analgesia. Similarly, Foss et al. reported that resting Numerical Rating Scale (NRS) pain scores in the FICB group decreased significantly (from 5 to 2 points) within 60 minutes of administration, compared to patients receiving intramuscular morphine or a sham block.[17]

Shariat et al. conducted a study comparing standard infrainguinal FICB with a sham block and observed that local anaesthetic spread medially rather than cephalad, resulting in no significant morphine-sparing effect.[18] However, these findings complement our study, as the suprainguinal FICB in Group S was found to have a superior cephalic spread, yielding better analgesic outcomes compared to the infrainguinal approach. The cadaveric study by Hebbard et al. corroborates this, showing that deposition of the local anaesthetic over the inguinal ligament enhances its cephalic distribution.[9]

Krych et al. found that FICB significantly reduced opioid consumption while providing excellent pain relief and high patient satisfaction in hip surgery patients. Patients receiving FICB consumed significantly less tramadol at 2, 4, 6, and 24 hours postoperatively compared to control groups.[19] Specifically, the FICB group consumed 33 mg less tramadol over 24 hours compared to the control group, while the 3-in-1 block group consumed 27 mg less.[19] These findings support the morphine-sparing and analgesic effects observed in Group S of our study.

Our findings, consistent with those of Kumar et al. and Stevens et al., demonstrate that the suprainguinal FICB is more effective than the infrainguinal approach for postoperative analgesia.[11,12] The suprainguinal approach achieves a greater cephalic spread of the local anaesthetic, resulting in superior lumbar plexus blockade. This leads to longer-lasting pain relief, reduced opioid consumption, and overall enhanced postoperative outcomes. The cadaveric evidence provided by Hebbard et al. further supports the anatomical advantage of the suprainguinal technique, confirming its ability to achieve broader spread and coverage.[9] Additionally, the significant reductions in cumulative tramadol requirements and superior analgesic efficacy observed in our study reinforce the potential of the suprainguinal FICB as a reliable and efficient technique for postoperative pain management following hip surgeries.

Despite the promising results, this study has some limitations. First, the sample size, although adequate for the statistical power of the study, was relatively small and derived from a single centre, which might limit the generalizability of the findings. Second, while rescue analgesia and cumulative opioid consumption were recorded, other subjective measures such as patient satisfaction or functional recovery scores were not included, which could provide additional insights into the quality of recovery. Third, although the study was randomised, the absence of ultrasound-guided verification during the administration of the block may have introduced variability in block efficacy between practitioners. Future multicenter trials with larger

sample sizes and longer follow-up periods are needed to validate and expand upon these findings.

5. Conclusion

The fascia iliaca compartment block serves as an essential component of multimodal analgesia for managing postoperative pain following hip replacement surgery. These techniques provide a safe and effective method for achieving pain relief. The suprainguinal approach offers significant advantages by lowering postoperative tramadol consumption and enhancing overall pain management. Further research focusing on continuous administration techniques and determining the optimal dosing regimen is recommended to enhance its clinical efficacy.

6. Source of Funding

None.

7. Conflict of Interest

None.

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