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COMPARATIVE STUDY BETWEEN 0.25% LEVOBUPIVACAINE AND 0.375% ROPIVACAINE IN LANDMARK GUIDED FASCIA ILIACA BLOCK FOR FRACTURE FEMUR SURGERIES

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ABSTRACT

Background: Effective perioperative pain management is essential for orthopedic procedures like femur fracture surgeries. The fascia iliaca compartment block (FICB) is a promising technique for regional anesthesia. This study compares the efficacy and safety of 0.25% levobupivacaine and 0.375% ropivacaine in landmark-guided FICB for these surgeries.

Methodology: This study was conducted over 18 months, including 80 ASA I/II patients aged 20–65. Patients were divided into two groups: Group L received 30 mL of 0.25% levobupivacaine, and Group R received 30 mL of 0.375% ropivacaine. Pain relief, onset and duration of sensory and motor blocks, hemodynamic stability, and patient satisfaction were assessed. Visual Analogue Scale (VAS) scores and vital parameters were recorded intra- and postoperatively.

Results: Demographic characteristics were comparable between groups. Group L demonstrated a longer duration of analgesia and lower heart rates at most time points compared to Group R ($p < 0.05$). Significant differences in diastolic blood pressure were observed during intra-operative monitoring, with Group L showing relatively stable parameters. Postoperative VAS scores indicated better pain relief in Group L, delaying the need for rescue analgesia. Both groups had similar safety profiles without significant adverse effects.

Conclusion: 0.25% levobupivacaine in landmark-guided FICB offers superior pain relief, prolonged analgesic duration, and better hemodynamic stability than 0.375% ropivacaine in femur fracture surgeries. It is a safer and more effective option for perioperative pain management.

Keywords: Fascia iliaca block, femur fracture surgery, levobupivacaine, ropivacaine, regional anesthesia, perioperative pain management

INTRODUCTION

Effective pain management is a cornerstone of perioperative care, particularly in orthopedic procedures such as fracture femur surgeries, where severe pain can significantly affect patient outcomes and recovery.[1] Regional anesthesia techniques, like the fascia iliaca compartment block (FICB), are gaining popularity for their ability to provide targeted, long-lasting analgesia while

minimizing systemic side effects.[2] The FICB, particularly when performed using landmark-guided methods, is a simple and effective approach to blocking the femoral and lateral femoral cutaneous nerves, offering substantial pain relief.[3]

Levobupivacaine, a pure S-enantiomer of bupivacaine, has gained attention due to its superior safety profile, reduced cardiotoxicity, and effective analgesic properties.[4] Similarly, ropivacaine, another long-acting amide local anesthetic, is used for regional blocks owing to its favorable sensory-motor differentiation and lower potential for systemic toxicity.[5] However, there is limited comparative evidence on their efficacy and safety in FICB for fracture femur surgeries.

This study aims to compare 0.25% levobupivacaine and 0.375% ropivacaine in landmark-guided FICB for fracture femur surgeries, focusing on key parameters such as analgesic efficacy, onset and duration of sensory and motor block, hemodynamic stability, and patient satisfaction. The findings will help identify the optimal local anesthetic for enhancing perioperative pain management and improving patient outcomes.

METHODOLOGY

The study was conducted at a tertiary care center in Barabanki as a prospective, randomized comparative study over 18 months following approval from the institutional human ethics committee. The study population included patients reporting to the operation theater for femur fracture surgeries. Individuals aged 20–65 years, with an American Society of Anesthesiologists (ASA) physical status of I or II, a BMI of less than 40, and no contraindications to anesthesia were included. Exclusion criteria included patients with ASA status III or IV, those outside the age range, and individuals with conditions such as diabetic neuropathy, peripheral neuropathy, allergies to local anesthetics, coagulopathy, or infection at the block site. Pregnant women, patients on beta-blockers, and individuals with prior femoral bypass surgery, inguinal hernia, or morbid obesity were also excluded.

A total of 80 ASA Grade I/II patients scheduled for elective femur surgeries were randomly assigned into two groups of 40 each using the chit-and-box method, with Group L receiving 30 mL of 0.25% levobupivacaine and Group R receiving 30 mL of 0.375% ropivacaine. Medications were prepared in identical 10-mL syringes by a paramedic involved in the study, ensuring blinding. All patients provided written informed consent and underwent a pre-anesthetic clearance. Sensitivity testing for local anesthetics was performed on the forearm using a subcutaneous test dose, with a 5-mm wheal assessed after 15 minutes. The technique was performed as illustrated in figures from (Figure 1-4).

On the night before surgery, patients were administered 0.25 mg of oral alprazolam and instructed to fast from midnight. Intravenous access was achieved with an 18G cannula, and patients were preloaded with 10 mL/kg of intravenous fluids. Standard intraoperative monitoring included non-invasive blood pressure (NIBP), heart rate (HR), electrocardiography (ECG), respiratory rate (RR), and oxygen saturation (SpO_2). The patients received premedication consisting of intravenous pantoprazole 40 mg and ondansetron 4 mg.

The pain was assessed using a 10-point Visual Analogue Scale (VAS), where 0 indicated no pain and 10 indicated unbearable pain. Scores of 7–10 were classified as severe, 4–6 as moderate, and 1–3 as minimal, with moderate and severe pain considered major pain. Postoperatively, VAS scores were recorded every 3 hours for 24 hours, and the timing of rescue analgesia administration was noted.

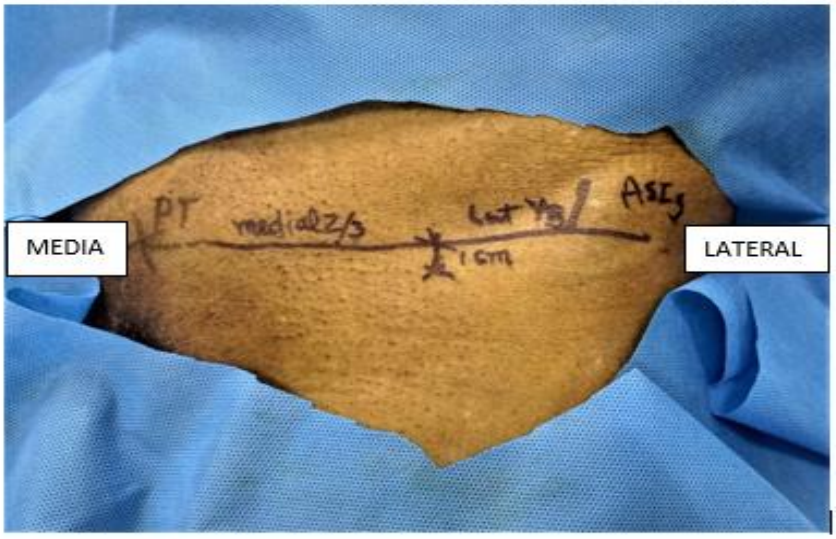

Figure 1: landmark of FICB at Hind Institute of medical sciences

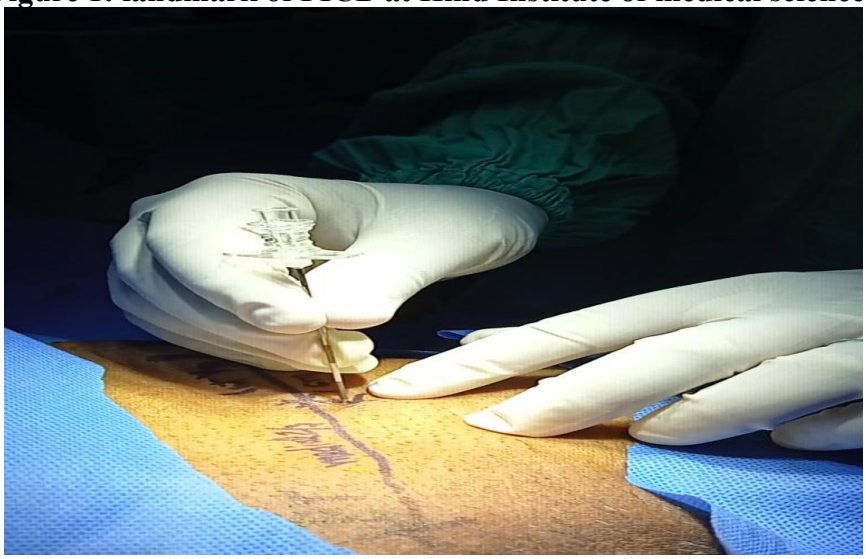

Figure 2. Needle insertion

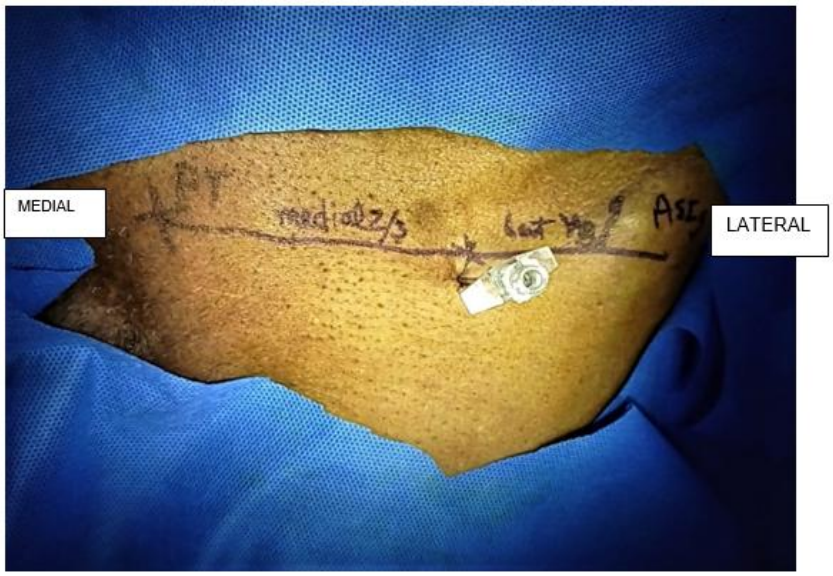

Figure 3. Aerial view of the needle at the point of insertion

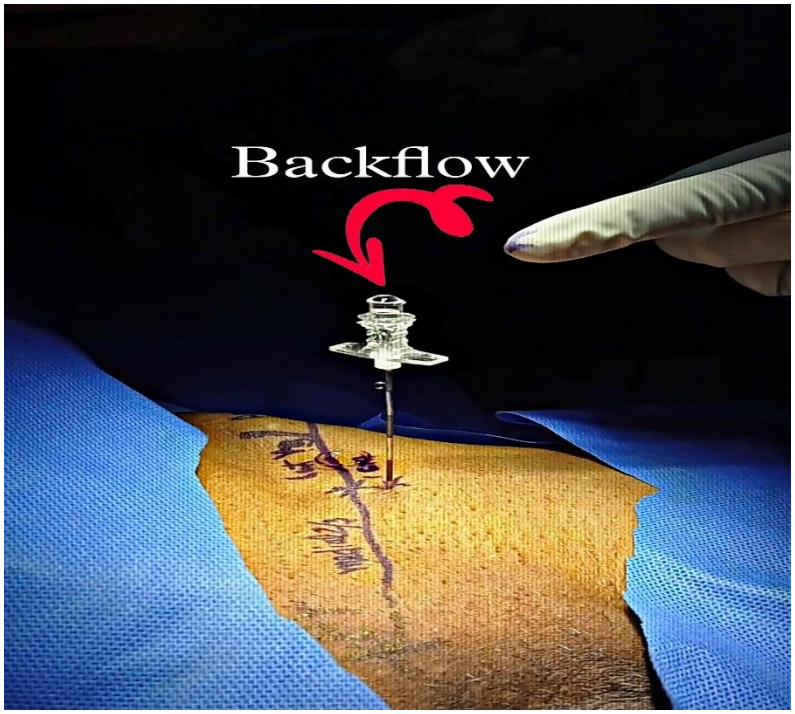

Figure 4. Backflow of the drug showing confirmation of compartment block

OBSERVATION AND RESULTS

Table 1: Demographic characteristics of the enrolled patients among the groups

Variables	**Group-L (Levo-bupivacaine)**		**Group-R (Ropivacaine)**		**P-Value**
	N/%/(Mean ± SD)		**N/%/(Mean ± SD)**		
Age	44.25 ± 14.05		46.32 ± 14.50		t=0.65, p=0.52
Gender					
Female	17	42.50%	15	37.50%	X=0.21, p=0.65
Male	23	57.50%	25	62.50%	
Height (cm)	168.49 ± 4.58		169.84 ± 5.04		t=1.25, p=0.21
Weight (Kg)	67.48 ± 12.41		65.89 ± 10.15		t=0.63, p=0.53
BMI (Kg/m2)	27.21 ± 2.65		26.84 ± 1.89		t=0.72, p=0.47

The demographic characteristics were similar between the levobupivacaine (Group L) and ropivacaine (Group R) groups. Mean age was 44.25 ± 14.05 years for Group L and 46.32 ± 14.50 years for Group R (p=0.52). Gender distribution showed 42.5% females in Group L and 37.5% in Group R (p=0.65). Average height was 168.49 ± 4.58 cm in Group L versus 169.84 ± 5.04 cm in Group R (p=0.21), while mean weight and BMI were also comparable at 67.48 ± 12.41 kg and 27.21 ± 2.65 kg/m² in Group L, and 65.89 ± 10.15 kg and 26.84 ± 1.89 kg/m² in Group R ($p > 0.05$ for both). (Table 1)

Table 2: Heart rate among the groups at different follow-up

Heart Rate	**Group-L (Levo-bupivacaine)**	**Group-R (Ropivacaine)**	**p-value**
Intra-op			
Immediate after FICB	96.02±11.33	73.56±8.49	t=10.03, p<0.0001*
15 mins after FICB	89.04±13.97	95.48±12.80	t=2.150, p=0.0347*
Immediate after SAB	85.68±5.84	66.47±13.99	t=8.014, p<0.0001*

5 mins after SAB	84.26±5.09	64.06±11.64	t=10.06, p<0.0001*
10 mins after SAB	60.20±6.61	81.95±11.92	t=10.09, p<0.0001*
15 mins after SAB	86.08±7.24	88.49±7.37	t=1.475, p=0.1441
30 mins after SAB	73.02±12.46	85.99±13.49	t=4.467, p<0.0001*
60mins after SAB	86.30±10.68	63.75±8.68	t=10.36, p<0.0001*
90 min after SAB	70.61±7.44	98.92±8.93	t=15.40, p<0.0001*
Post-op			
Immediate	74.71±11.32	85.34±10.36	t=4.38, p<0.0001*
3 hours	63.61±13.35	72.83±6.87	t=3.88, p=0.0002*
9 hours	61.63±10.91	87.10±5.17	t=13.84, p<0.0001*
12 hours	80.48±7.26	85.81±6.74	t=3.40, p=0.0010*
15 hours	87.64±8.87	97.47±6.38	t=5.69, p<0.0001*
18 hours	73.64±6.13	96.99±13.77	t=9.79, p<0.0001*
21 hours	70.32±11.60	92.69±10.55	t=9.02, p<0.0001*
24 hours	81.19±7.42	73.72±13.97	t=2.98, p=0.0038*

Heart rates differed significantly between the levobupivacaine (Group L) and ropivacaine (Group R) groups, with Group L generally showing lower rates. After the initial FICB, Group L's heart rate was higher, but following SAB, Group R consistently had higher rates, particularly at 90 minutes post-SAB and throughout the post-operative period.

Significant differences were observed at almost all follow-up points, with Group L maintaining lower heart rates overall ($p < 0.05$). (Table 2)

Table 3: SPB and DBP of the enrolled patients among the groups at Post- and post-op.

DBP	**Group-L (Levo-bupivacaine)**	**Group-R (Ropivacaine)**	**p-value**
Intra-op			
Immediate after FICB	76.66±4.41	74.23±3.20	t=2.82, p=0.0061*
15mins after FICB	74.75±3.95	75.20±3.87	t=0.51, p=0.61
Immediate after SAB	71.96±4.23	73.05±3.09	t=1.32, p=0.19
5mins after SAB	71.24±4.25	75.09±4.71	t=3.83, p=0.0003*
10 mins after SAB	79.76±3.33	81.12±4.28	t=1.59, p=0.12
15 mins after SAB	85.80±4.17	83.21±4.15	t=2.78, p=0.0067*
30 mins after SAB	71.65±4.29	73.75±4.09	t=2.24, p=0.028*
60mins after SAB	71.24±3.77	73.84±4.81	t=2.69, p=0.0087*
90 min after SAB	75.87±3.14	73.02±3.04	t=4.12, p<0.0001*
120 min after SAB	72.83±4.37	73.14±3.64	t=0.34, p=0.73
Post-op			
Immediate	77.95±7.74	77.96±4.38	t=0.0071, p=0.99
3 hours	71.88±8.38	74.56±9.32	t=1.35, p=0.18

9 hours	75.79 ± 8.28	76.41 ± 7.37	t=0.35, p=0.72
12 hours	72.41 ± 7.14	71.41 ± 4.15	t=0.76, p=0.44
15 hours	71.47 ± 7.82	69.72 ± 7.05	t=1.05, p=0.29
18 hours	68.74 ± 6.46	70.33 ± 5.37	t=1.19, p=0.23
21 hours	71.35 ± 4.97	72.95 ± 8.85	t=0.99, p=0.32
24 hours	73.07±8.82	74.80±9.36	t=0.85, p=0.39

During intra-operative monitoring, significant differences in diastolic blood pressure (DBP) were observed between groups, with Group L (levobupivacaine) generally showing higher DBP immediately after FICB and at certain times after SAB ($p < 0.05$). However, post-operatively, DBP levels between the groups were similar, with no significant differences at any time point ($p > 0.05$). (Table 3)

Table 4: Total duration of analgesia, time to rescue analgesia, onset, and duration of sensory and motor block among the groups.

Variables	**Group-L (Levo-bupivacaine)**	**Group-R (Ropivacaine)**	**P-Value**
	Mean ± SD	**Mean ± SD**	
Total duration of analgesia (in hr)	10.13 ± 2.13	7.32 ± 1.10	t=7.4, p<0.0001*
Time of Rescue analgesia (in hr)	11.78 ± 2.56	8.33 ± 1.10	t=7.83, p<0.0001*
Onset of sensory block	10.54 ± 2.51	12.84 ± 4.84	t=8.47, p~0.08
Duration of sensory block	308.32 ± 23.85	318.84 ± 24.51	t=1.95, p=0.055
Onset motor block	18.52 ± 3.54	7.84 ± 2.18	t=16.25,p<0.0001*
Duration motor block	348.84 ± 15.18	248.54 ± 10.84	t=34.01,p<0.0001*

Group L (levobupivacaine) had a significantly longer total duration of analgesia (10.13 hours vs. 7.32 hours, $p<0.0001$) and time to rescue analgesia (11.78 hours vs. 8.33 hours, $p<0.0001$). Sensory block onset was faster in Group R, but the duration was similar. Group L had a slower onset of motor block but a longer duration (348.84 minutes vs. 248.54 minutes, $p<0.0001$). (Table 4)

Table 5: VAS score at different follow-ups among the groups.

VAS Score	**Group-L (Levo-bupivacaine)**	**Group-R (Ropivacaine)**	**P-Value**
	Mean ± SD	**Mean ± SD**	
Before FICB	6.83 ± 0.98	7.10 ± 1.01	t=1.21, p=0.23
15 min after FICB	4.00 ± 0.91	4.83 ± 1.03	t=3.82, p=0.0003*
Before SAB	2.53 ± 0.88	3.48 ± 1.20	t=4.04, p=0.0001*

Before the FICB, the VAS scores were similar between the levobupivacaine (Group L) and ropivacaine (Group R) groups (6.83 vs. 7.10, p=0.23). However, 15 minutes after FICB, Group L showed a significantly lower VAS score (4.00 ± 0.91) compared to Group R (4.83 ± 1.03, p=0.0003). Similarly, before spinal anesthesia (SAB), Group L had a significantly lower VAS score (2.53 ± 0.88) than Group R (3.48 ± 1.20, p=0.0001). (Table 5)

Table 6: Quality of the positioning in the enrolled patients among the groups.

Quality of positioning	Group-L (Levo-bupivacaine)		Group-R (Ropivacaine)		P-Value
	N	%	N	%	
Satisfactory	12	30.00%	0	0.00%	X=18.55 p<0.0001*
Good	23	57.50%	23	57.50%	
Optimal	5	12.50%	17	42.50%	

The quality of positioning was significantly better in the levobupivacaine group (Group L). In Group L, 30% of patients had satisfactory positioning, compared to 0% in Group R ($p<0.0001$). Both groups had 57.5% of patients with good positioning, but a higher proportion in Group R (42.5%) had optimal positioning compared to Group L (12.5%). (Table 6)

Table 7: Post-operative VAS (visual analog scale) among the groups

VAS Score	Group-L (Levo-bupivacaine)	Group (Ropivacaine)	P-Value
	Mean ± SD	Mean ± SD	
0 Hrs	0.00 ± 0.00	0.00	-
3 Hrs	1.38 ± 1.08	2.32 ± 1.12	t=3.82,p=0.0003*
6 Hrs	2.55 ± 1.20	4.53 ± 0.96	t=8.14,p<0.0001*
9 Hrs	3.68 ± 1.72	5.22 ± 1.29	t=4.53,p<0.0001*
12 Hrs	3.97 ± 1.90	4.03 ± 0.80	t=0.18, p=0.85

Post-operatively, Group L (levobupivacaine) had significantly lower VAS scores compared to Group R (ropivacaine) at 3, 6, and 9 hours. At 3 hours, Group L's VAS score was 1.38 ± 1.08, while Group R's was 2.32 ± 1.12 ($p=0.0003$). At 6 hours, Group L's score was 2.55 ± 1.20, compared to 4.53 ± 0.96 in Group R ($p<0.0001$). At 9 hours, Group L had a score of 3.68 ± 1.72, while Group R's was 5.22 ± 1.29 ($p<0.0001$). At 12 hours, no significant difference was observed. (Table 7)

Statistical analysis:

Data were collected and analyzed using SPSS version 26.0. The results were presented as mean ± standard deviation (SD) or as counts and percentages. To compare data between the two groups, a one-way analysis of variance (ANOVA) was used, and intergroup differences were assessed using the t-test. A p-value of less than 0.05 was considered statistically significant.

DISCUSSION

Regional anesthesia techniques have gained popularity for their superior pain control, reduced side effects, and shorter recovery times compared to general anesthesia. Among local anesthetics, levobupivacaine and ropivacaine have been extensively studied for their efficacy and safety. Levobupivacaine, the S (-) isomer of bupivacaine, offers similar block intensity and duration but with reduced cardiotoxicity and neurotoxicity risks due to its faster protein binding. However, its delayed onset and shorter block duration compared to ropivacaine may limit its applicability in certain settings. Ropivacaine, though more expensive, may provide clinical advantages, particularly in prolonged procedures. The present study provides insights into the comparative effects of these anesthetics in a resource-limited setting like India, where economic factors play a significant role in clinical decision-making.

In line with previous study by **Malav et al.,**[6] the present study showed no significant differences in the mean ages of participants, with mean ages of 44.25 ± 14.05 years in Group-L (levobupivacaine) and 46.32 ± 14.50 years in Group-R (ropivacaine) ($p = 0.5186$). But it was contradictory with **Tsui et al.,**[7] where older populations were examined. Given that older individuals may exhibit altered sensitivity to nerve blocks due to physiological changes in peripheral nerves, further age-specific studies are warranted.

Anthropometric characteristics, including height, weight, and BMI, were comparable between groups. The mean BMI was slightly higher in Group L (27.21 ± 2.65) compared to Group R (26.84 ± 1.89). These results align with **Stasiowski et al.,**[8] who reported that while anthropometric variables minimally impacted sensory block duration, they did influence motor block outcomes. Such findings underscore the importance of tailoring anesthetic regimens to individual patient characteristics.

Gender distribution was balanced across both groups, with no statistically significant differences ($p = 0.6481$). Group L included 42.50% females and 57.50% males, while Group R comprised 37.50% females and 62.50% males. These findings are consistent with studies such as those by **Garcia et al.,**[9] which emphasized the potential influence of gender differences in drug metabolism and response, particularly in elderly populations.

In terms of hemodynamic parameters, Group L demonstrated slightly lower systolic blood pressure (SBP) immediately post-operatively compared to Group R (122.23 ± 5.24 vs. 125.82 ± 6.77, $p = 0.0097$). However, subsequent time points showed no significant differences. These results align with findings by **Dolma et al.,**[10] who reported stable SBP across groups, although **Cheng et al.**[11] documented significant SBP variations. Post-operative diastolic blood pressure (DBP) also exhibited minimal differences, except for a slightly higher immediate post-operative DBP in Group L (76.66 ± 4.41 vs. 74.23 ± 3.20, $p = 0.0061$). Such variations suggest that procedural factors and patient-specific variables may play a role in influencing hemodynamic outcomes.

Heart rate (HR) differed significantly between groups, with Group L demonstrating lower HR at all post-operative time points compared to Group R (immediate post-operative HR: 74.71 ± 11.32 vs. 85.34 ± 10.36, $p < 0.0001$). This trend persisted intra-operatively, with Group-L showing higher HR after the fascia iliaca block but lower HR following the spinal anesthesia block. Similar trends were shown by **Maheshwari et al.** and **Gupta et al.,**[12] where initial HR reductions were observed but equalized at later intervals. These findings highlight the need for vigilant monitoring of hemodynamic parameters to optimize anesthesia management based on patient needs.

The study contributes valuable data on the comparative effects of levobupivacaine and ropivacaine, particularly in the Indian healthcare setting, where cost considerations are critical. While both agents demonstrated effective anesthesia, their distinct hemodynamic profiles may guide anesthetic selection based on patient characteristics and procedural requirements. The study's strengths lie in its detailed analysis of hemodynamic parameters; however, its limitations include a relatively small sample size and single-center design, which may limit generalizability. Additionally, factors such as patient satisfaction, block success rates, and long-term outcomes were not evaluated.

CONCLUSION

This study highlights key differences between levobupivacaine (Group-L) and ropivacaine (Group-R) in anesthesia and analgesia management. Group L participants had a significantly longer duration of analgesia, delayed rescue analgesia requirement, faster onset of sensory and motor block, and lower VAS scores, indicating superior pain relief compared to Group R (all $p < 0.0001$). Hemodynamic parameters showed some significant variations, with Group-L generally exhibiting lower heart rate and diastolic blood pressure post-operatively.

Anthropometric characteristics and gender distribution were comparable between groups, while age distribution differences were not statistically significant. Importantly, more participants in Group L reported satisfactory positioning during the procedure ($p < 0.0001$).

Overall, levobupivacaine demonstrated superior analgesic efficacy and patient satisfaction, offering potential advantages over ropivacaine in similar procedural settings. These findings provide valuable insights to guide perioperative care and improve patient outcomes.

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