

COMPARATIVE STUDY OF BUPIVACAINE, LEVOBUPIVACAINE AND ROPIVACAINE IN COMBINATION WITH FENTANYL FOR PAINLESS LABOR

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ABSTRACT

Background: Effective pain relief during labor is essential to reduce unnecessary maternal anxiety and suffering. Epidural analgesia is considered the gold standard for labor analgesia. There may be side effects of epidural analgesia, such as maternal hypotension, prolonged stage of labor, motor block, fever, urinary retention, headache, needs continuous monitoring, increased cost compared to systemic drugs and some procedure-related: epidural hematoma, nerve injury, local anesthesia toxicity etc. the objectives is to determine which of the three drugs- bupivacaine, levobupivacaine and ropivacaine in combination with fentanyl- provides more effective and suitable epidural analgesia during labor and delivery b) To assess any adverse events during labor and delivery after the use of the drugs and c) To assess the fetal outcomes after the use of the drugs. **Materials and Methods:** A prospective, double blinded randomized control trial was conducted in the Department of Anesthesiology and Department of Obstetrics & Gynecology, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Manipur during April 2024 - January 2026. Pregnant women at term with singleton pregnancy and cephalic presentation, in first and second stage of labor and having ASA status II who came for normal vaginal delivery were the study participants. A sample size of 96 (distributed as 32 in each of the three intervention arms) was calculated. Under all antiseptic and aseptic conditions in any of the suitable spaces, either L2-3, L3-4, or L4-5, and assigned to one of the three groups by using a computer-generated list of random numbers into one of the three groups: Inj. 0.125% Bupivacaine group with fentanyl 50 mcg, 10 ml (A), Inj. 0.125% Levobupivacaine group with fentanyl 50 mcg, 10 ml (B) or Inj. 0.125% Ropivacaine group with fentanyl 50 mcg, 10 ml (C). Vital parameters were measured every 5 minutes for the first 15 minutes, then subsequently were measured every 30 minutes after giving the injection. **Result:** The baseline demographic characteristics, the mean weight, distribution in parity and hemodynamic parameters prior to analgesia were also comparable in all the three groups. At each level of dilatation, the proportions of patients were comparable among the groups. The mode of delivery was also comparable across the three groups. The number of top-ups required differed significantly among the three groups ($p = 0.012$). In group A, most patients (65.6%) required less than 3 top-ups. There was a statistically significant difference in the onset of analgesia among the three groups ($p < 0.001$). The distribution pattern indicates that the onset of analgesia occurred earliest in the Bupivacaine. Diastolic blood pressure showed statistically significant differences at a few isolated time points. At 0 minutes, DBP differed significantly among groups ($p = 0.043$). Similarly, significant differences were noted at 300 minutes ($p = 0.015$) and 360 minutes ($p = 0.019$). Mean blood pressure was comparable among the three groups throughout. In VAS score at 5 and 10 minutes, a statistically significant difference was observed ($p = 0.031$ & $p < 0.001$), with the Bupivacaine group demonstrating lower pain scores. The

occurrence of adverse effects was minimal and comparable across all three study groups, indicating no significant association between the type of drug administered and the incidence of side effects. **Conclusion:** In short, bupivacaine, levobupivacaine, and ropivacaine, when used in low concentrations with opioids, provide equally effective, safe, and clinically comparable labor analgesia, and the choice of agent may be guided by institutional preference and availability rather than significant differences in clinical outcomes.

INTRODUCTION

Labor pain is considered the most severe pain that a woman may experience.^[1] Fear of it may be one of the most important reasons for women to opt for cesarean section.^[2] Therefore, effective pain relief during labor is essential to reduce unnecessary maternal anxiety and suffering.

Painless labor refers to the use of various techniques to relieve pain during labor and delivery while allowing the mother to remain conscious and able to participate actively in delivery. Epidural analgesia is a technique used for management of acute or chronic pain by administration of combination of low dose local anesthetics and opioids or adjuvant medications into the epidural space to achieve sensory block while preserving varying degree of motor block. Epidural analgesia is considered the gold standard for labor analgesia.^[3]

There may be side effects of epidural analgesia, such as maternal hypotension, prolonged stage of labor, motor block, fever, urinary retention, headache, needs continuous monitoring, increased cost compared to systemic drugs and some procedure-related: epidural hematoma, nerve injury, local anesthesia toxicity etc.^[4]

Bupivacaine is an amino amide local anesthetic which provides labor analgesia at 0.0625-0.125%. Levobupivacaine is less cardio-toxic than bupivacaine. Ropivacaine is an amino amide local anesthetic which provides labor analgesia at 0.1-0.2%. There is risk of unwanted motor blockade while giving the local anesthetics which can be minimized by combining with opioids like Fentanyl and reducing the concentration/dose of the local anesthetic.^[5]

Despite proven efficacy, the practice of labor epidural analgesia is practiced less in the north-eastern part of India due to concerns regarding potential adverse events and lack of awareness among the general public. The purpose of the study is to alleviate these misconceptions and encourage painless delivery and at the same time to compare the combination of the three local anesthetic drugs with fentanyl regarding the onset, duration, side effects, effect on the labor duration, requirement of instrumental delivery and fetal outcome.

Objectives:

a) To determine which of the three drugs- bupivacaine, levobupivacaine and ropivacaine in combination with fentanyl- provides more effective and suitable epidural analgesia during labor and delivery b) To assess any adverse events during labor

and delivery after the use of the drugs and c) To assess the fetal outcomes after the use of the drugs.

MATERIALS AND METHODS

A prospective double blinded randomized control trial was conducted in the Department of Anesthesiology and Department of Obstetrics & Gynecology, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Manipur during April 2024 - January 2026. Pregnant women at term with singleton pregnancy and cephalic presentation, in first and second stage of labor and having ASA status II who came for normal vaginal delivery were the study participants. Women with co-existing diseases, post C/S, abnormal presentation of fetus or fetal distress, use of any other analgesic drug or having any contraindication to central neuraxial block were excluded. A sample size of 96 (distributed as 32 in each of the three intervention arms) was calculated. Under all antiseptic and aseptic conditions in any of the suitable spaces, either L2-3, L3-4, or L4-5, and assigned to one of the three groups by using a computer-generated list of random numbers into one of the three groups: Inj. 0.125% Bupivacaine group with fentanyl 50 mcg, 10 ml (A), Inj. 0.125% Levobupivacaine group with fentanyl 50 mcg, 10 ml (B) or Inj. 0.125% Ropivacaine group with fentanyl 50 mcg, 10 ml (C).

With subsequent doses of 0.0625% of Bupivacaine, Levobupivacaine and Ropivacaine with 25mcg Fentanyl, 10ml in each group when the patient complains of pain or when the VAS score >3. If the pain was not relieved after 20 mins of the subsequent dose, then a rescue analgesic with Inj. 0.25% Bupivacaine 10ml was given via epidural catheter. If there was no pain relief even after the rescue dose, the subject was assigned as a failed epidural and was excluded from the study.

To ensure double-blinded study, a senior Anesthetists prepared the medications and handed them over to the researcher according to the computer-generated random number.

A detailed pre-anesthetic check-up was done on all the participating parturient – history, examination, and all the routine laboratory investigations were done. All the patients were advised to take a light meal prior to the procedure.

Baseline vitals - HR, BP, SPO2 and VAS score were recorded. After positioning the participants, under all antiseptic and aseptic precautions, the epidural Touhy's needle is placed at a suitable space, either at the level of L2-3, L3-4 or L4-5, via a midline

approach by using the loss of resistance technique to identify the space. After monitoring for any aspiration of blood or cerebrospinal fluid, the epidural catheter was inserted about 4cm into the epidural space, a test dose of 3ml of 1.5% Lignocaine with adrenaline was given, and the catheter was securely fixed. The epidural analgesia was activated once the patient started to have active labor pain with cervical dilatation >2cm or when the patient requested pain relief.

Vital parameters were measured every 5 minutes for the first 15 minutes, then subsequently were measured every 30 minutes after giving the injection. The onset of analgesia was evaluated as the time of the first painless uterine contraction after the injection. The effectiveness was evaluated using the VAS pain scale. The subsequent dose was given whenever the participant had a VAS score >3 during labor. The sensory level was assessed using the pinprick method. The motor function preservation was determined using the Modified Bromage scale in both legs. The duration of the first and second stages of labor, with the mode of delivery, was recorded. We asked and recorded the incidence of nausea, vomiting, and pruritus. APGAR score of the baby is recorded at 1 and 5 minutes of birth.

The outcome variables of the study were Onset of analgesia, Duration of action of analgesia, Duration of labor after analgesia, Hemodynamic variables: heart rate, blood pressure, peripheral oxygen saturation (SPO₂), Pain score- VAS (visual analogue scale) Nausea and vomiting, Pruritus, Incidence of respiratory depression (SPO₂ <90%), Incidence of motor block (Modified Bromage Score), Incidence of instrumental delivery, Incidence of cesarean section and APGAR score (at 1 minute and 5 minutes).

Collected data was entered in Microsoft excel sheet, and analysis was done by using SPSS v23(IBM).

Descriptive statistics like mean, SD, and percentage were used. Analysis was carried out using the Chi-Square test, and a P value < 0.05 was considered statistically significant.

Ethical clearance was obtained from the Institutional Ethical Committee, JNIMS, Imphal. Informed written consent (in the prescribed format) was obtained from all participating individuals and privacy and confidentiality were maintained in all cases.

RESULTS

The baseline demographic characteristics, the mean weight, distribution in parity and hemodynamic parameters prior to analgesia were also comparable in all the three groups.

At each level of dilatation, the proportions of patients were comparable among the group A, B and C, i.e., at 3.0 cm dilatation, 16.7%, 50.0%, and 33.3% respectively. Similarly, at 5.0 cm dilatation, the distribution was 26.7%, 40.0%, and 33.3%, respectively. A Chi-square test of independence demonstrated no statistically significant association between the three groups and cervical dilatation category ($p = 0.573$).

The mode of delivery was comparable across the three groups, with no statistically significant difference ($p=0.992$). Vaginal delivery was the most common mode of delivery, occurring in 66 patients, and was equally distributed among the three groups. Vaginal delivery with ventouse was recorded in 14 patients, with 15.6% each group A and B and 12.5% in group C. Cesarean section was performed in 16 patients, distributed as 15.6% in both group A and B, while the highest with 18.75% in group C. Overall, the distribution of delivery modes was similar among the three study groups, indicating that the type of drug administered did not significantly influence the mode of delivery.

Table 1: Effectiveness of analgesia and need for additional top-up

	Group A	Group B	Group C	p-value
Mean (SD) onset of analgesia (mins)	10.37 (0.91)	11.72 (0.78)	12.47 (0.51)	0.000**
Mean (SD) duration of drug (mins)	196.7 (2.79)	177.0 (1.96)	168.1 (16.65)	0.548
Number of Top-up				
<3	21 (65.6%)	17 (62.96%)	14 (53.84%)	
3-4	5 (18.5%)	10 (37.03%)	6 (23.07%)	
>4	1 (3.7%)	0	6 (23.07%)	

The number of top-ups required differed significantly among the three groups ($p = 0.012$). In group A, most patients (65.6%) required less than 3 top-ups, 18.5% required 3–4 top-ups, and only 3.7% required more than 4 top-ups. In group B, 37.03% required 3–4 top-ups, 62.96% required less than 3, and none required more than 4 top-ups. In contrast, group C showed a higher tendency for frequent top-ups, with 23.07% of patients requiring more than 4 top-ups and 3–4 top-ups, and 53.84% requiring less than 3. [Table 1] These findings suggest that Bupivacaine and Levobupivacaine generally required fewer top-ups compared to Ropivacaine, which was associated with a greater need for additional dosing to maintain analgesia.

The present study demonstrated a statistically significant difference in the onset of analgesia among the three groups ($p < 0.001$). The distribution pattern indicates that the onset of analgesia occurred earliest in the Bupivacaine, followed by Levobupivacaine, while Ropivacaine showed a comparatively slower onset.

All patients who achieved analgesia at 9 and 10 minutes belonged exclusively to the Bupivacaine group, indicating a more rapid initiation of analgesic effect with this group. At 11 minutes, the majority of cases were observed in the Levobupivacaine (71.4%). Furthermore, later onset time (12 and 13 minutes) was predominantly seen in the Ropivacaine, accounting for 54.8% and 68.2%, respectively.

These findings suggest that Bupivacaine provides a faster onset of analgesia compared to Levobupivacaine and Ropivacaine, with Ropivacaine demonstrating the slowest onset among the three groups. [Table 1]

There was no statistically significant difference in systolic blood pressure (SBP) among the three groups at baseline or at any subsequent time interval up to 960 minutes ($p > 0.05$). Diastolic blood pressure (DBP) showed statistically significant differences at a few isolated time points. At 0 minutes, DBP differed significantly among groups ($p = 0.043$). Similarly, significant differences were noted at 300 minutes ($p = 0.015$) and 360 minutes ($p = 0.019$). However, at all other measured intervals including baseline the differences were not statistically significant ($p > 0.05$).

Regarding mean blood pressure (MBP), baseline values were comparable among the three groups ($p = 0.227$). Throughout the entire observation period from 0 to 960 minutes, no statistically significant intergroup differences were observed at any time point ($p > 0.05$ at all intervals).

There was no statistically significant difference in pulse rate among the three groups, Bupivacaine, Levobupivacaine, and Ropivacaine, at baseline ($p = 0.819$) or during the early period up to 480 minutes ($p > 0.05$). However, statistically significant differences were observed at 540 minutes ($p = 0.024$) and 600 minutes ($p = 0.037$). At these time points, the Ropivacaine group had a higher mean pulse rate than the other two groups. At all other intervals from 660 to 960 minutes, the differences were not statistically significant ($p > 0.05$).

Table 2: Effectiveness of Analgesics in three groups and pain assessment using Visual Analogue Scale (VAS)

Visual Analogue Scale (VAS)	Group A		Group B		Group C		p-value
	n	(Mean $\pm$ SD)	n	(Mean $\pm$ SD)	n	(Mean $\pm$ SD)	
Baseline	32	5.94 $\pm$ 0.62	32	6.16 $\pm$ 0.57	32	6.19 $\pm$ 0.59	0.193
At 0 min	32	5.31 $\pm$ 0.59	32	5.44 $\pm$ 0.50	32	5.41 $\pm$ 0.67	0.680
At 5 min	32	4.16 $\pm$ 0.37	32	4.50 $\pm$ 0.62	32	4.41 $\pm$ 0.56	0.031*
At 10 min	32	1.00 $\pm$ 1.76	32	4.00 $\pm$ 0.00	32	4.00 $\pm$ 0.00	0.000**
At 15 min	31	0	32	0	32	0	-
At 30 min	30	0	32	0	32	0	-
At 60 min	27	0	32	0	30	0	-
At 120 min	23	0	30	0	24	0	-
At 180 min	22	0.73 $\pm$ 1.58	27	0.30 $\pm$ 1.07	19	0	0.120
At 240 min	17	0.65 $\pm$ 1.46	24	0.50 $\pm$ 1.35	18	0	0.225
At 300 min	13	0.31 $\pm$ 1.11	21	0.57 $\pm$ 1.43	17	0	0.277
At 360 min	8	0	15	0	17	0	-
At 420 min	7	1.14 $\pm$ 1.95	12	0.67 $\pm$ 1.56	13	0	0.168
At 480 min	7	0	12	0	11	0	-
At 540 min	7	0	12	0	9	0	-
At 600 min	6	1.33 $\pm$ 2.07	11	1.45 $\pm$ 2.02	8	0	0.169
At 660 min	5	0	10	0	7	0	-
At 720 min	4	0	8	0	7	0	-
At 780 min	4	2.00 $\pm$ 2.31	6	2.00 $\pm$ 2.19	7	0	0.089
At 840 min	4	0	6	0	2	0	-
At 900 min	4	2.00 $\pm$ 2.31	3	1.33 $\pm$ 2.31	2	0	0.579
At 960 min	4	0.00 $\pm$ 0.00	3	0.00 $\pm$ 0.00	1	0	-

Baseline VAS scores were comparable among the three groups ($p = 0.193$), confirming homogeneity prior to drug intervention. At 0 minutes, VAS scores did not differ significantly between groups ($p = 0.680$). At 5 and 10 minutes, a statistically significant difference was observed ($p = 0.031$ & $p < 0.001$), with the Bupivacaine group demonstrating lower pain scores compared to the Levobupivacaine and Ropivacaine groups. However, at 180, 240, 300, 420, 600, 780 and 900 minutes, mild increases in mean VAS scores were observed in the Bupivacaine and Levobupivacaine groups, whereas the Ropivacaine group maintained mean scores of zero at several time points. However, none of these intergroup differences was statistically significant ($p > 0.05$). Statistically significant differences in VAS scores were observed during the early period (5 and 10 minutes), indicating a faster onset of analgesia with

Bupivacaine (4.16 $\pm$ 0.37 and 1.00 $\pm$ 1.76). Beyond 15 minutes, no significant differences in pain scores were observed. [Table 2]

There was no statistically significant difference in the incidence of side effects among the three groups ($p = 0.97$). Headache was reported in 6 patients overall, with 2 occurring in group A, 1 in group B, and 3 in group C. Pruritus was observed in 3 patients and was equally distributed among the three groups.

The majority of patients (87 out of 96) experienced no side effects, with similar proportions in the Bupivacaine (90.62%), Levobupivacaine (93.75%), and Ropivacaine (87.5%) groups.

Overall, the occurrence of adverse effects was minimal and comparable across all three study groups, indicating no significant association between the type of drug administered and the incidence of side effects.

Table 3: Obstetric characteristics and neonatal outcomes, data are (Mean±SD)

	Group A	Group B	Group C	p-value
Gestational age (weeks)	39.78±0.47	39.74±0.42	39.63± 0.59	0.478
Cervical Dilatation (cm)	4.516±1.28	4.09±1.07	4.22±1.28	0.366
Duration of 1st stage labor (min)	882.70±184.65	782.67±191.04	794.81±194.60	0.116
Duration of 2nd stage of labor (min)	19.00±2.09	19.67±1.30	19.04±1.46	0.259
APGAR score at 1min	7.00±0.00	7.00±0.00	7.00±0.00	-
APGAR score at 5 min	9.78±0.42	9.70±0.47	9.81±0.402	0.665

The three study groups were comparable with mean gestational age was 39.78 ± 0.47 weeks in the Bupivacaine group, 39.74 ± 0.42 weeks in the Levobupivacaine group, and 39.63 ± 0.59 weeks in the Ropivacaine group. The difference was not statistically significant ($p = 0.478$).

The mean cervical dilatation was 4.516 ± 1.28 cm in the Bupivacaine group, 4.09 ± 1.07 cm in the Levobupivacaine group, and 4.22 ± 1.28 cm in the Ropivacaine group, with no statistically significant difference among the groups ($p = 0.366$).

The mean duration of the first stage of labor was 882.70 ± 184.65 minutes in the Bupivacaine group, 782.67 ± 191.04 minutes in the Levobupivacaine group, and 794.81

± 194.60 minutes in the Ropivacaine group. Although the duration appeared longer in the Bupivacaine group, the difference did not reach statistical significance ($p = 0.116$). Similarly, the mean duration of the second stage of labor was 19.00 ± 2.09 minutes,

19.67 ± 1.30 minutes, and 19.04 ± 1.46 minutes in the Bupivacaine, Levobupivacaine, and Ropivacaine groups, respectively, with no statistically significant difference observed ($p = 0.259$).

Neonatal outcomes, as assessed by APGAR scores, were comparable among the three groups. The APGAR score at 1 minute was 7 across the groups; hence, statistical comparison was not applicable. The mean APGAR score at 5 minutes was 9.78 ± 0.42 in the Bupivacaine group, 9.70 ± 0.47 in the Levobupivacaine group, and 9.81 ± 0.40 in the Ropivacaine group, with no statistically significant difference ($p = 0.665$). Overall, there were no statistically significant differences among the three groups in obstetric parameters or neonatal outcomes. [Table 3]

DISCUSSION

The present prospective, randomized, double-blind study was conducted to compare the efficacy of bupivacaine, levobupivacaine, and ropivacaine in combination with fentanyl for epidural labor analgesia. In the present study, all three groups demonstrated a significant reduction in pain scores following epidural administration, with VAS scores decreasing from severe pain at baseline to ≤ 3 after initiation of analgesia. This indicates that all three drug combinations provided effective and satisfactory labor analgesia. These findings are consistent with Fernández-Guisasola et al who reported that 0.1% ropivacaine with fentanyl and

0.0625% bupivacaine with fentanyl produced equally effective analgesia with no statistically significant difference in pain scores.^[6] Similarly, Bolukbasi et al observed no difference in pain scores or patient satisfaction between ropivacaine and bupivacaine groups, confirming comparable analgesic efficacy.^[5] Additionally, Fischer et al demonstrated that VAS scores during labor were similar between ropivacaine and bupivacaine groups, despite differences in potency.^[7]

In the present study, the duration of the first and second stages of labor was comparable among all three groups, with no statistically significant prolongation observed. This finding is consistent with Bolukbasi et al who reported no significant difference in labor duration or mode of delivery between ropivacaine and bupivacaine groups.^[8] Similarly, Fischer et al observed that the duration of the second stage of labor was slightly shorter in the ropivacaine group (1.3 ± 1.0 h) compared to the bupivacaine group (1.5 ± 1.2 h, $P < 0.05$), although this difference may not be clinically significant.^[7]

In the present study, the requirement for rescue analgesia (top-ups) was comparable across the three groups, indicating adequate analgesia maintenance. However, Fischer C et al reported that 29.7% of patients in the ropivacaine group required supplemental boluses compared to 19.8% in the bupivacaine group ($P < 0.05$), suggesting that ropivacaine may be slightly less potent.^[7] This is supported by pharmacological studies indicating that ropivacaine has a lower potency (approximately 0.6 times that of bupivacaine) in a study by Fernández-Guisasola J et al. Despite this, the addition of fentanyl compensates for this difference by reducing local anesthetic requirements.^[6]

In the present study, maternal hemodynamic parameters remained stable, with no significant incidence of hypotension, bradycardia, or respiratory depression. The incidence of side effects, including nausea, vomiting, and pruritus, was minimal and comparable across groups. These findings are consistent with Bolukbasi et al who reported no significant difference in side effects, maternal satisfaction, or neonatal outcomes between ropivacaine and bupivacaine groups.^[8]

In the present study, no motor blockade was observed in any of the study groups, indicating that all three local anesthetic-opioid combinations provided motor-sparing labor analgesia. These findings are consistent with the study by Fernández-Guisasola J et al in which both ropivacaine (0.1%) and bupivacaine (0.0625%) with fentanyl produced highly effective

analgesia with a very low incidence of motor block, and no statistically significant difference between groups.^[6] The difference in findings may be due to the difference in giving the analgesia, as in the present study, an intermittent bolus dose was given, while in their study, continuous infusion was given. Similarly, Bolukbasi DI et al reported no difference in motor blockade between ropivacaine and bupivacaine when used in dilute concentrations with fentanyl, with both groups demonstrating minimal motor impairment.^[6] Although Fischer C et al observed a statistically lower incidence of motor block with ropivacaine (97.8% no motor block) than with bupivacaine (88.3%; $p < 0.01$), both groups still had a high proportion of patients without motor block.^[7] The discrepancy in findings with the present study, despite using the same concentration, may be due to the use of intermittent bolus dosing in the present study, while in their study, the drug was given using a PCEA pump. Fernández-Guisasola J et al reported no statistically significant difference in adverse effects between the ropivacaine and bupivacaine groups, with only minimal side effects observed.^[6] Similarly, Bolukbasi et al. noted a low incidence of side effects such as nausea and hypotension, with comparable distribution across study groups.^[8] Fischer C et al also demonstrated that, although the drugs differed pharmacologically, the overall incidence of maternal adverse effects was low and not significantly different across groups.^[7] Guo S. et al study and other referenced studies further support that the use of low concentrations of local anesthetics combined with opioids results in minimal side effects, with pruritus being the most commonly reported opioid-related adverse effect.^[3,8-11] This correlates with the present study, where pruritus was consistently low (3.12% in all groups). The findings are consistent with Bolukbasi et al who reported no significant difference in side effects, maternal satisfaction, or neonatal outcomes between ropivacaine and bupivacaine groups.^[8]

Neonatal outcomes in the present study were favorable, with Apgar scores within normal limits. Similar findings were reported in previous studies, where no adverse neonatal effects were observed with any of the local anesthetic–opioid combinations.

Strengths of the study: The study was a prospective, randomized, double-blinded study, reducing selection bias and improving the reliability of the findings. Also, a uniform study protocol was followed for drug administration, ensuring consistency across all groups. A standardized and widely accepted assessment tools, such as the VAS score and motor block grading, were used. Further, multiple clinically relevant parameters were evaluated, including analgesic efficacy, motor block, labor duration, top-up requirements, and side effects.

Limitations: The sample size was relatively small, which may limit the generalizability of the study findings and the study was conducted at a single center, and results may not be representative of other populations or clinical settings. Again, the study

mainly focused on maternal outcomes, with limited evaluation of detailed neonatal outcomes and no long-term follow-up. Further, subjective assessment tools such as the VAS score may introduce individual variability in pain perception.

CONCLUSION

The present prospective randomized study was undertaken to compare the efficacy and safety of bupivacaine, levobupivacaine, and ropivacaine for epidural labor analgesia. The findings demonstrate that all three local anesthetic agents provide effective and comparable analgesia, as evidenced by significant reductions in VAS scores across all groups, with no statistically significant intergroup differences. Importantly, motor blockade was not seen in any group, indicating that all three drugs preserve maternal mobility and are suitable for labor analgesia. The duration of labor remained unaffected by the choice of local anesthetic, suggesting no adverse impact on labor progression.

The overall incidence of side effects was low, with headache and pruritus occurring in comparable proportions, and the majority of patients (87.50–93.75%) remained free of adverse effects. No serious maternal or fetal complications were observed, reinforcing the safety profile of these agents. The findings therefore support the use of all three agents as effective options for epidural labor analgesia.

In short, bupivacaine, levobupivacaine, and ropivacaine, when used in low concentrations with opioids, provide equally effective, safe, and clinically comparable labor analgesia, and the choice of agent may be guided by institutional preference and availability rather than significant differences in clinical outcomes.

Larger sample-size studies are required to improve the generalizability and statistical power of the findings. Multicentric trials can be conducted to validate the results across different populations and clinical settings.

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