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COMPARISON OF THE EFFECT OF EPIDURAL LEVOBUPIVACAINE 0.5% 20 ML AND ROPIVACAINE 0.75%, 20 ML IN LOWER LIMB SURGERIES

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ABSTRACT

Background
Epidural anesthesia is extensively employed in lower limb procedures owing to its efficacy in sensory and motor blockage, as well as its capacity to deliver extended postoperative analgesia. Levobupivacaine and ropivacaine, both long-acting amide local anesthetics, exhibit advantageous safety profiles with decreased cardiotoxicity relative to bupivacaine.
Objective: The objective is to assess the clinical efficacy and safety of 0.5% levobupivacaine (20 mL) with 0.75% ropivacaine (20 mL) when delivered epidurally to adult patients having elective lower limb operations.

Methods
This prospective, randomized, double-blind trial was performed over a duration of 10 months at Patna Medical College & Hospital. Ninety patients classified as ASA grade I and II, scheduled for elective lower limb procedures, were randomly assigned to two groups (n=45 each):
Group L: Administered 20 mL of 0.5% levobupivacaine via epidural route
Group R: Administered 20 mL of 0.75% ropivacaine via epidural injection
The parameters monitored comprised the onset time and duration of sensory and motor blockade, the quality of surgical anesthesia, the length of postoperative analgesia, and the incidence of adverse events.

Results
The initiation of sensory and motor blockade occurred more rapidly in Group R than in Group L, with mean sensory onset periods of 9.2 ± 1.1 minutes and 11.3 ± 1.4 minutes, respectively. Group L demonstrated an extended duration of motor blockade and postoperative analgesia. Hemodynamic parameters remained steady in both cohorts, and no substantial detrimental effects were seen.

Conclusion
Both levobupivacaine 0.5% and ropivacaine 0.75% are efficacious for epidural anesthesia in lower extremity procedures. Ropivacaine facilitates a more rapid onset of anesthesia, whilst levobupivacaine delivers an extended duration of analgesia. The selection of the agent can be customized according to the length of the surgery and the intended postoperative analgesic outcome.

Keywords: *Epidural anaesthesia, Levobupivacaine, Ropivacaine, Lower limb surgery, Sensory block, Motor block, Postoperative analgesia.*
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INTRODUCTION

Epidural anesthesia is a well-established approach for lower limb procedures, offering superior intraoperative anaesthesia, extended postoperative analgesia, and diminished systemic adverse effects. Levobupivacaine and ropivacaine have achieved therapeutic significance among the many local anaesthetics due to their effectiveness and enhanced safety profiles in comparison to racemic bupivacaine (McLeod et al., 2001; Bajwa et al., 2011). Levobupivacaine, the S-enantiomer of bupivacaine, is recognized for its effective long-lasting sensory and motor blockade, exhibiting markedly less cardiotoxicity and central nervous system adverse effects relative to its racemic variant (Gautier et al., 2000; McLeod et al., 2001). Its balanced profile renders it appropriate for procedures necessitating prolonged anesthesia and analgesia.

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Ropivacaine, an S-enantiomer, offers a selective nerve block, preferentially affecting sensory fibers while sparing motor fibers, and is linked to a more rapid recovery of motor function. These characteristics render ropivacaine beneficial in techniques that prioritize early ambulation (Casati et al., 2004; Kaur et al., 2015). Moreover, studies have shown that ropivacaine has a more favorable toxicity profile compared to bupivacaine, especially concerning cardiac sodium channels and arrhythmogenic potential (Knudsen et al., 1997; McClure, 1996).

Notwithstanding their growing application, the relative therapeutic efficacy of these medicines continues to be a focus of ongoing investigation. Numerous research have evaluated the two in different surgical scenarios, although the results have been inconsistent. Some authors have shown that levobupivacaine provides prolonged postoperative analgesia (Kaur et al., 2015; Bajwa et al., 2011), while others have highlighted the rapid onset and superior differential block properties of ropivacaine (Casati et al., 2004; Santos & DeArmas, 2001). According to Kumari et al. (2014), ropivacaine's motor-sparing effect makes it especially suitable for day-care procedures.

In lower limb procedures, where the duration of the surgical procedure and the requirement for postoperative analgesia can fluctuate considerably, the selection of anesthetic must be executed with discernment. Multiple comparative studies in orthopedic and gynecological surgeries have pointed to levobupivacaine's longer duration of sensory blockade but emphasized ropivacaine's hemodynamic stability and earlier ambulation (Kundra et al., 2005; Polley et al., 1999; Reddy et al., 2016).

This study aimed to examine the clinical efficacy, onset, duration of block, and analgesic profile of 0.5% levobupivacaine and 0.75% ropivacaine delivered epidurally in adult patients undergoing elective lower limb procedures. By assessing their pharmacodynamic effects in a homogeneous surgical cohort, we seek to establish a more definitive clinical foundation for anesthesiologists in choosing the most suitable drug.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective, randomized, double-blind comparative study undertaken in the Department of Anaesthesiology at Patna Medical College and Hospital. The research was conducted over a duration of 10 months, from [insert start month/year] to [insert finish month/year], following the acquisition of approval from the Institutional Ethics Committee. Informed permission in writing was acquired from all subjects.

Study Cohort and Sample Size

Ninety adult patients, aged 18 to 60 years, scheduled for elective lower limb procedures under epidural anesthesia were included. Patients were randomly assigned to two equal groups (n=45 each) by computer-generated randomization:

Group L (Levobupivacaine group): Administered 20 mL of 0.5% levobupivacaine via spinal route.

Group R (Ropivacaine group): Administered 20 mL of 0.75% ropivacaine via spinal injection.

Criteria for Inclusion

- Individuals aged 18 to 60 years
- ASA physical status I or II
- Elective orthopedic or vascular operations of the lower extremities
- Duration of surgery shall not surpass 3 hours.

Criteria for Exclusion

- Documented allergy to amide local anesthetics
- Coagulopathy or hemorrhagic diseases
- Localized infection at the site of injection
- Neurological or psychological conditions
- Significant cardiovascular, hepatic, or renal pathology
- Women who are pregnant or breastfeeding

Preoperative Preparation and Anesthetic Technique

All patients received preoperative assessment and adhered to conventional fasting guidelines. Upon entering the operating theatre, standard monitors (ECG, NIBP, and pulse oximetry) were utilized, and baseline vital signs were documented. An intravenous line was established, and 10 mL/kg of Ringer's lactate was supplied as preload.

The patient was positioned seated and, adhering to aseptic protocols, the epidural space was located at the L2–L3 or L3–L4 interspace utilizing an 18G Tuohy needle through the loss-of-resistance-to-air method. Following negative aspiration for blood or cerebrospinal fluid, the designated study medication was delivered gradually over a duration of 2 to 3 minutes.

Parameters Assessed

The subsequent variables were documented and examined:

Onset of sensory block: Duration from medication administration to the lack of pinprick feeling at the T10 level.

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Duration of sensory block: Interval from initiation to regression to L1 dermatome
Onset of motor block: Evaluated on the Bromage scale; duration to attain a Bromage score of 3
Duration of motor block: The interval from onset to the recovery of Bromage score 0
Duration till initial rescue analgesic: From the commencement of the block until a VAS score of ≥ 4
Hemodynamic parameters: heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) collected at baseline and every five minutes intraoperatively.
Adverse effects include hypotension, bradycardia, nausea, vomiting, pruritus, urine retention, and neurological problems.

Statistical Analysis

Data were aggregated in Microsoft Excel and analyzed utilizing SPSS version 25.0. Continuous variables were presented as mean ± standard deviation (SD) and evaluated using an unpaired Student's t-test. Categorical variables were represented as percentages and analyzed using the Chi-square test or Fisher's exact test where applicable. A p-value less than 0.05 was deemed statistically significant.

RESULTS

Ninety patients undergoing lower limb procedures with epidural anaesthesia were randomized into two groups: Group L (levobupivacaine) and Group R (ropivacaine), comprising 45 individuals each. The two groups were equivalent regarding demographic parameters and the types of surgical procedures conducted.

Sensory and Motor Block Characteristics

The initiation of sensory block occurred substantially more rapidly in Group R (9.2 ± 1.1 minutes) than in Group L (11.3 ± 1.4 minutes). The initiation of motor block occurred more rapidly in Group R (11.8 ± 1.3 minutes) compared to Group L (14.1 ± 1.5 minutes). Group L had an extended length of sensory and motor blockage, lasting 210 ± 22 minutes and 195 ± 19 minutes, respectively, in contrast to Group R's durations of 180 ± 20 minutes and 165 ± 18 minutes.

Postoperative Analgesia and Pain Scores

The duration until the initial rescue analgesic was markedly extended in the levobupivacaine group (320 ± 25 minutes) compared to the ropivacaine group (270 ± 22 minutes), signifying enhanced postoperative analgesia. At 4 hours postoperatively, the VAS pain scores were significantly lower in Group L (2.7 ± 0.6) than in Group R (3.5 ± 0.7), with statistical significance ($p < 0.05$).

Hemodynamic Stability and Side Effects

Hemodynamic measures (heart rate, mean arterial pressure) remained steady in both groups during the perioperative period. Minor side effects, including temporary hypotension and nausea, were observed in both groups without significant differences. No significant issues were noted. VAS scores at 4 hours post-surgery were significantly lower in the levobupivacaine group, indicating superior postoperative analgesia (Table 1 and Figure 1).

Table 1: Comparative Analysis of Epidural Anesthetic Outcomes

Parameter	Group L (Levobupivacaine)	Group R (Ropivacaine)
Onset of Sensory Block (min)	11.3	9.2
Duration of Sensory Block (min)	210	180
Onset of Motor Block (min)	14.1	11.8
Duration of Motor Block (min)	195	165
Time to First Rescue Analgesic (min)	320	270
VAS Score at 4 hrs (0–10)	2.7	3.5

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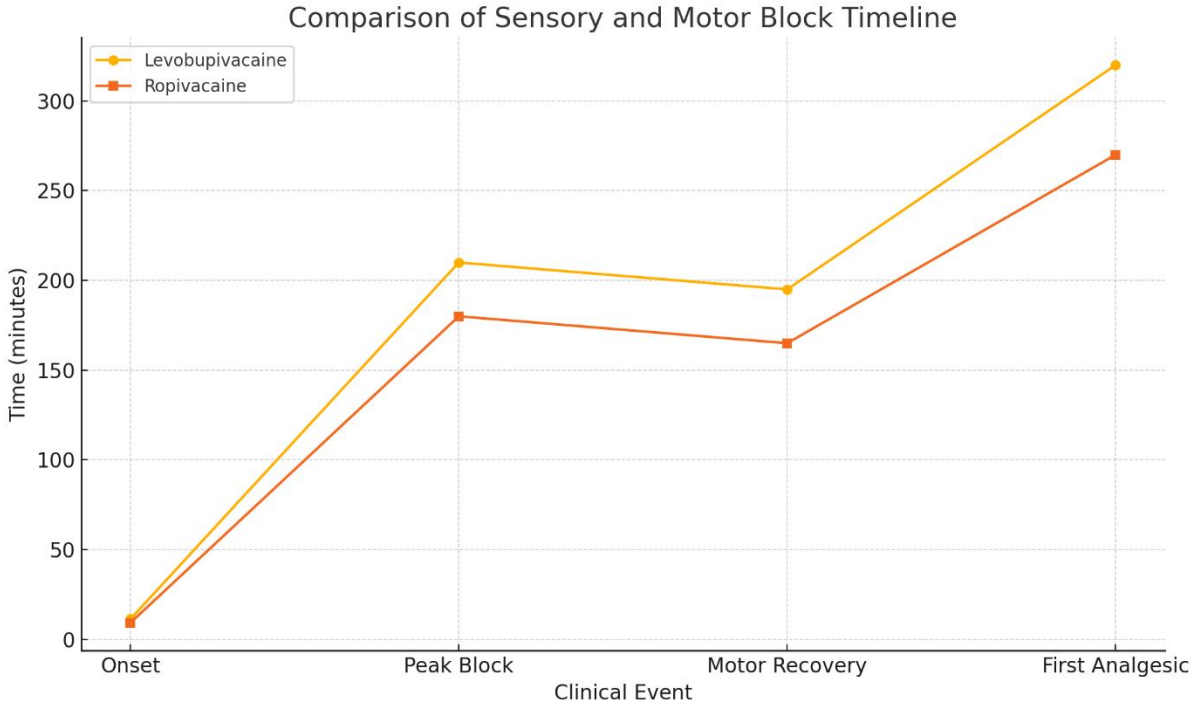

Figure 1: Postoperative Pain Score Comparison

DISCUSSION

This prospective comparison study demonstrated that both levobupivacaine 0.5% and ropivacaine 0.75% delivered effective epidural anesthesia for lower limb procedures. Notable differences in the start and duration of effect were identified. Ropivacaine elicited a markedly swifter start of sensory and motor block compared to levobupivacaine, presumably attributable to its elevated concentration and comparatively reduced lipid solubility, facilitating expedited transport through nerve membranes (Casati et al., 2004; Santos & DeArmas, 2001; Goyal et al., 2017).

In contrast, levobupivacaine demonstrated an extended period of sensory and motor blockade, as well as sustained postoperative analgesia. These results corroborate earlier findings by Kaur et al. (2015), who saw superior postoperative pain management with levobupivacaine in orthopedic procedures. Our investigation revealed that the average duration to initial rescue analgesia was roughly 50 minutes longer in the levobupivacaine group, while pain scores at 4 hours postoperatively were significantly reduced. These results correspond with those of Bajwa et al. (2011), who also documented improved and prolonged analgesic effects of levobupivacaine in epidural blocks, and further supported by findings from El-Hamid et al. (2020) showing that levobupivacaine maintains a consistent analgesic profile across a variety of surgeries.

Both treatments exhibited stable hemodynamic profiles and demonstrated comparable incidences of minor adverse events, including hypotension and nausea, which were controllable and temporary. No significant problems were recorded, affirming the recognized safety of these medications for epidural administration (McLeod et al., 2001; Santos & DeArmas, 2001). Several meta-analyses have confirmed the favorable cardiovascular safety margin of both agents compared to bupivacaine, particularly in elderly or comorbid populations (Scott et al., 1989; McClure, 1996; Dony et al., 2003).

The differential block feature of ropivacaine, facilitating expedited motor recovery while preserving sensory blockade, is clinically advantageous in scenarios where prompt postoperative mobilization is essential. Previous studies have indicated that ropivacaine induces less motor blockade than levobupivacaine (Casati et al., 2004; Kumari et al., 2014), which aligns with our findings. Moreover, studies by Lyons et al. (1996) and Polley et al. (1999) emphasized that ropivacaine's selective action could reduce delays in discharge, making it favorable in ambulatory settings.

The extended analgesic action of levobupivacaine renders it a superior choice for lengthy surgical operations or for individuals requiring substantial postoperative pain management (Kaur et al., 2015; El-Hamid et al., 2020). Levobupivacaine's adaptability in sustaining anaesthesia and analgesia for extended durations may diminish the necessity for further analgesics, enhance patient comfort, and alleviate the strain on healthcare resources. Interestingly, Gautier et al. (2000) demonstrated that levobupivacaine's longer

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action could be beneficial in obstetric and trauma-related surgeries as well.

Although our results align with a significant portion of the current literature, shortcomings persist. The study was single-centered, had a limited sample size, and excluded variables such as duration to ambulation, total hospital stay, and cost-effectiveness—elements that potentially impact decision-making in practical scenarios. Furthermore, while both medications were well-tolerated, extended follow-up might enhance the understanding of any delayed side effects or neurological sequelae (Manullang et al., 2000; Wulf, 2000).

In summary, both levobupivacaine and ropivacaine are safe and effective for epidural anesthesia, with ropivacaine demonstrating a more rapid onset and quicker recovery, whereas levobupivacaine delivers enhanced and prolonged postoperative analgesia. The decision between the two options should be informed by the nature and length of the surgery, with the individual patient's analgesic requirements and recovery objectives.

CONCLUSION

This study offers a comprehensive comparative analysis of two commonly utilized amide local anesthetics—levobupivacaine 0.5% and ropivacaine 0.75%—delivered through the epidural route in adult patients having elective lower limb operations. Both medications proved effective in achieving sufficient surgical anesthesia, resulting in high levels of satisfaction for both patients and surgeons. Significant disparities were noted in their block properties, onset times, duration of analgesia, and postoperative pain profiles.

Ropivacaine demonstrated a more rapid onset of sensory and motor blockade, rendering it exceptionally appropriate for surgical environments where time efficiency is paramount. The expedited effect can be ascribed to the elevated concentration employed in this investigation (0.75%) and its comparatively poor lipid solubility, which may enhance diffusion across neuronal membranes. Ropivacaine is favored in ambulatory surgical environments and for patients requiring fast induction of anesthesia. Nonetheless, although its onset was more favorable, the duration of both sensory and motor blockage was reduced in comparison to levobupivacaine. Consequently, patients in the ropivacaine cohort necessitated their initial rescue analgesic sooner and had elevated VAS scores during the postoperative phase.

Conversely, levobupivacaine, the S-enantiomer of bupivacaine, exhibited a delayed onset of block but markedly increased duration of sensory and motor effects, as well as prolonged postoperative analgesia. This renders it very appropriate for prolonged procedures or when sustained postoperative analgesia is clinically advantageous. The extended block duration associated with levobupivacaine resulted in decreased postoperative VAS scores and a postponed requirement for supplementary analgesia, thus enhancing patient comfort and perhaps alleviating the demands on postoperative nursing care and analgesic consumption.

Both medications exhibited superior hemodynamic stability, with no statistically significant differences in the occurrence of adverse events between the two groups. The most often noted effects comprised mild hypotension and nausea, both of which were transitory and readily manageable. No significant neurological or cardiovascular side effects were observed in either group, so affirming the safety profile of both medicines when delivered at conventional doses with appropriate monitoring.

The choice between levobupivacaine and ropivacaine should be customized based on the specific patient and surgical circumstances. Ropivacaine may be favorable in scenarios necessitating rapid onset and early ambulation, while levobupivacaine may be more beneficial for extended procedures or patients requiring sustained postoperative analgesia.

This study possesses certain drawbacks. The study was performed in a single tertiary care facility with a limited sample size, constraining the generalizability of the results. Furthermore, long-term outcomes like time to ambulation, patient satisfaction, and cost-effectiveness were not investigated. Future study involving multicentric collaboration, greater sample sizes, and long-term follow-up could further clarify the practical differences between these agents.

In conclusion, both levobupivacaine and ropivacaine are efficacious and safe for epidural anesthesia in lower extremity procedures. Levobupivacaine gives prolonged analgesia, but ropivacaine facilitates rapid onset and superior motor recovery, allowing doctors to select based on procedural needs and patient preferences.

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