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An Assessment of the Duration of Sensory Block in 0.5% Levo Bupivacaine Heavy Versus 0.75% Ropivacaine Heavy in Infraumbilical Surgeries Under Spinal Anaesthesia

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KEYWORDS

Spinal anaesthesia , Levo bupivacaine , Ropivacaine , Sensory blockade , Infraumbilical surgeries .

ABSTRACT:

AIM: To observe the effects of 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy when administered intrathecally for infraumbilical surgeries

OBJECTIVES : To assess the duration of sensory block in patients receiving 0.5% levo bupivacaine heavy and 0.75% ropivacaine heavy ; To assess the onset of sensory block with 0.5% levo bupivacaine heavy and 0.75% ropivacaine heavy ; To assess the peak level of sensory block achieved and time to peak sensory block with 0.5% levo bupivacaine heavy and 0.75% ropivacaine heavy ; To assess time to onset of complete motor block with 0.5% levo bupivacaine heavy and 0.75%ropivacaine heavy ; To assess the duration of motor block that each of the drugs provide

MATERIALS AND METHODOLOGY : A prospective randomized observational study conducted at Sree Balaji Medical College and Hospital for a period of 1 year . 58 patients were selected for the study after applying the inclusion and exclusion criteria. A 22 gauge hypodermic needle was used to assess the sensory block and modified Bromage scale was used to assess the motor block in these patients. Data collection involved age , gender , ASA grading , hemodynamic parameters , duration of block sensory and motor block and time to recovery.

RESULTS : In this study involving 58 patients , undergoing infraumbilical surgeries under spinal anaesthesia . levo bupivacaine and ropivacaine were found to be comparable with no significant differences in sensory and motor blockade between the two groups.

The duration of sensory block was found to be 180.5 mins in levo bupivacaine and 175.3 mins in ropivacaine with both the durgs being comparable to one another

CONCLUSION : . The results indicate that both 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy are similarly effective and safe for use in spinal anesthesia for infraumbilical surgeries. Given the comparable outcomes, the choice between these anesthetics can be guided by specific clinical contexts and patient preferences.

INTRODUCTION

When compared to general anesthesia, spinal anesthesia minimizes systemic side effects

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and provides an effective motor and sensory block during invasive procedures. For spinal anesthesia, two frequently used local anesthetics include ropivacaine and levobupivacaine. Although they are both long-acting amide-type local anesthetics, their chemical composition, strength, and duration of action are different. Understanding these differences is crucial to maximize efficacy and duration of action, as well as to improving patient outcomes and safety.

Comparing levo-bupivacaine to racemic bupivacaine, the S-enantiomer of bupivacaine, reveals that the former is less neurotoxic and cardiotoxic. Its favorable safety profile has led to an increase in its use in clinical settings. Levo-bupivacaine has been shown in numerous investigations to produce a dependable motor and sensory block that lasts as long as bupivacaine while having fewer side effects [1]. However, ropivacaine, an amide-class local anesthetic, is less lipophilic than bupivacaine and is also a long-acting, structurally comparable medication. This decreased lipophilicity corresponds to a decreased risk of cardiac and central nervous system damage [2].

The literature does not currently compare the duration of sensory block between 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy in the context of infraumbilical procedures, despite the widespread use of both anesthetics. Effective sensory block is necessary for ideal operative circumstances and patient comfort during infraumbilical surgeries, which include operations like lower abdomen surgeries, hernia repairs, and lower limb surgeries [3]. The duration of the sensory block's action, the patient's recuperation, and their level of satisfaction can all be strongly impacted by the local anesthetic selection.

The selection of a local anesthetic for spinal anesthesia is influenced by various criteria such as the duration and commencement of action, side effect profile, and patient-specific considerations. Levo-bupivacaine and ropivacaine are both useful for spinal anesthesia, although different pharmacokinetic and pharmacodynamic characteristics may result in different clinical outcomes, according to earlier research [4]. Levo-bupivacaine and ropivacaine, for example, were evaluated in a study conducted by Casati et al. (2003) for spinal anesthesia in outpatient knee arthroscopy. The results showed that both anesthetics produced acceptable anesthesia, although they differed in their sensory and motor block properties [5].

This observational study aims to compare and evaluate the duration of sensory block achieved by 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy in patients undergoing spinal anesthesia-assisted infraumbilical operations. With the help of this study, physicians will be able to make better decisions on local anesthetic selection and improve patient care and surgical outcomes.

AIM AND OBJECTIVES

Aim:

To observe the effects of 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy when administered intrathecally for infraumbilical surgeries.

Primary objective:

- To assess the duration of sensory block in patients receiving 0.5% levo bupivacaine heavy and 0.75% ropivacaine heavy

Secondary objectives:

- To assess the onset of sensory block with 0.5% levo bupivacaine heavy and 0.75% ropivacaine heavy
- To assess the peak level of sensory block achieved and time to peak sensory block with 0.5% levo bupivacaine heavy and 0.75% ropivacaine heavy
- To assess time to onset of complete motor block with 0.5% levo

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bupivacaine heavy and 0.75%ropivacaine heavy
- To assess the duration of motor block that each of the drugs provide

MATERIALS AND METHODS

Study Design: An observational study

Study setting: The study will be performed in the department of anaesthesia PM and CC of Sree Balaji Medical College and Hospital, Chennai, Tamil Nadu, INDIA

Study Duration: 18 months

Sample Size: The study included 58 patients.

$$n_p = \sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}}$$

$$n = \frac{Z^2\sigma^2}{e^2}$$

$$n_p = \sqrt{\frac{(28-1)(4.94)_1^2 + (30-1)(2.54)\ {}_2^2}{56\ (28+30-2)}}$$

$$n_p = \sqrt{\frac{658.80 + 187.05}{56}}$$

$$n_p = 3.88$$

$$\frac{\text{---------}}{e^2}$$

= 2 X 14.4 = 29

Therefore, 29 subjects each, making a total sample size of 58

Sampling technique: Purposive sampling

Study Population: Institutional study carried out among patients who are undergoing infraumbilical surgery at Sree Balaji Medical College and Hospital, Chennai

Inclusion Criteria:

- All infraumbilical surgeries
- ASA grade 1 and ASA grade 2
- Age between 18 to 60
- Both male and female patients

Exclusion Criteria:

- ASA grade 3 and ASA grade 4
- Patients who are known cases of hypersensitivity to amide group of local anaesthetic agents
- Patients with coagulation disorders
- Local infection at the site of puncture

Study Tool:

- Proforma of patient
- To evaluate motor block, the modified Bromage scale was used to grade motor block in the lower limbs. Grade 0: Absence of motor block Grade 1: Capable of moving knees and feet, but unable to elevate an extended leg Grade 2: Capacity to move feet but not the extended leg or knee Grade 3: Total paralysis of the lower extremities After then, it will be done every five minutes until motor block grade three is reached, and then every thirty minutes until full recovery (motor block grade 0).

Other tools:

- 25G Quincke needle
- Sterile syringe for drug injection
- Local anaesthetics
- Multipara monitor
- Resuscitation equipment

Method:

All patients undergoing infraumbilical surgeries were selected by the consultant after obtaining informed written consent, which was documented. Patient information was collected through a proforma, and they were evaluated against inclusion and exclusion criteria. Based on the patient's condition and fitness, they received either 0.5% levo-bupivacaine heavy, not exceeding 2.5 mg/kg of body weight, or 0.75% ropivacaine heavy, not exceeding 3 mg/kg of body weight, as determined by the consultant anesthetist. Using sterile aseptic precautions, the subarachnoid space in the L3-L4 region was identified, and after

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visualizing clear CSF flow, the drug was administered by the consultant anesthetist. The onset time of sensory block, motor block, and duration of analgesia were observed by the investigator.

Outcome measures:

- Improvement in muscle power using MRC grading
- Reduction in Inflammatory marker, creatine kinase levels
- Improvement in Pulmonary manifestations by PFT and HRCT chest
- Improvement in cutaneous manifestations observed clinically

Statistical analysis:

Software for statistical analysis, SPSS version 21, was used. Demographic information about the patients and baseline characteristics were compiled using descriptive statistics, such as means, frequencies, and standard deviations. Continuous variables, like the duration of analgesia, the start time of sensory block, and motor block, were reported as mean ± standard deviation and compared between the two groups (0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy) using the independent samples t-test.

The chi-square test or Fisher's exact test, as applicable, were used to compare the frequencies and percentages of the categorical variables. A significant threshold of $p < 0.05$ was established. P-values of less than 0.05 were regarded as statistically significant in all two-sided statistical tests. To make the results easy to understand, they were displayed as tables and graphs.

OBSERVATION AND RESULTS

Table 1: Age Distribution

Age Group (years)	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
18-30	10 (34.5%)	12 (41.4%)	0.75
31-40	8 (27.6%)	7 (24.1%)	
41-50	7 (24.1%)	5 (17.2%)	
51-60	4 (13.8%)	5 (17.2%)	

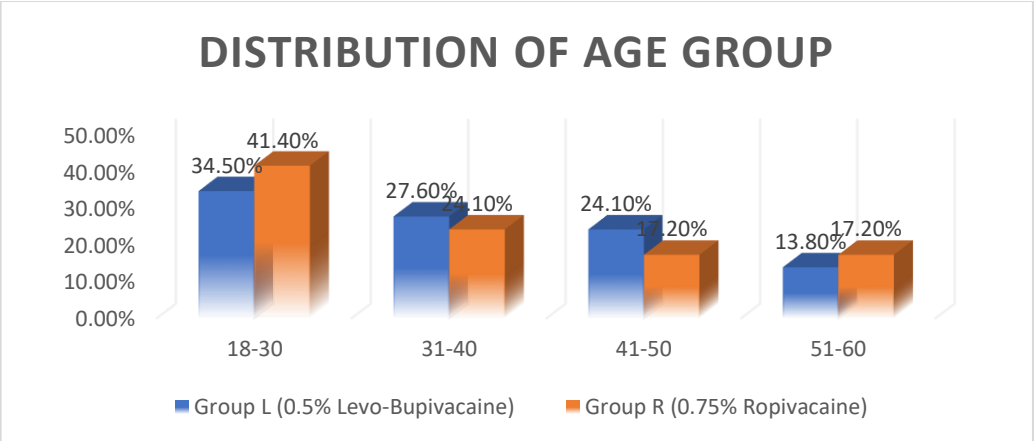

Table 2: Gender Distribution

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Gender	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
Male	15 (51.7%)	16 (55.2%)	0.80
Female	14 (48.3%)	13 (44.8%)	

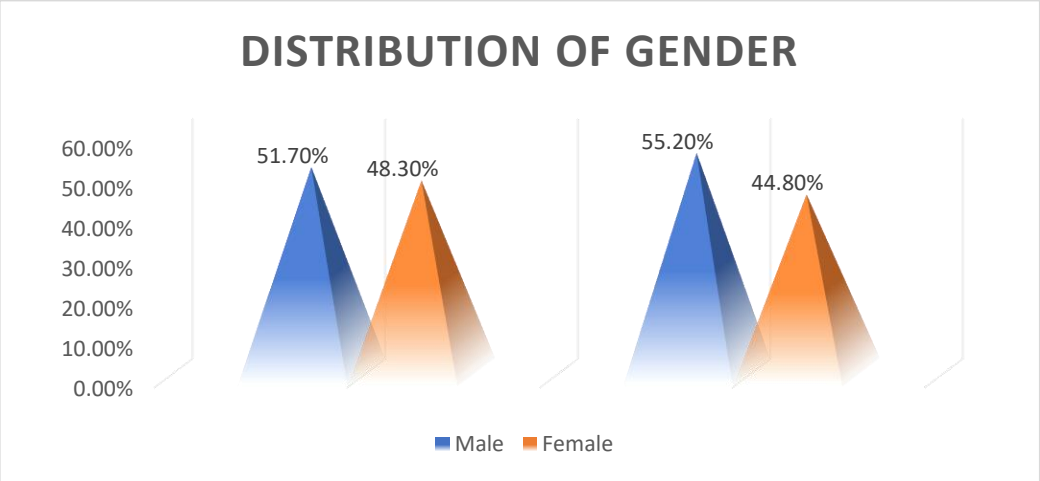

Table 3: BMI Distribution

BMI Group (kg/m²)	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
<18.5 (Underweight)	2 (6.9%)	3 (10.3%)	0.65
18.5-24.9 (Normal)	18 (62.1%)	16 (55.2%)	
25-29.9 (Overweight)	7 (24.1%)	8 (27.6%)	
≥30 (Obese)	2 (6.9%)	2 (6.9%)	

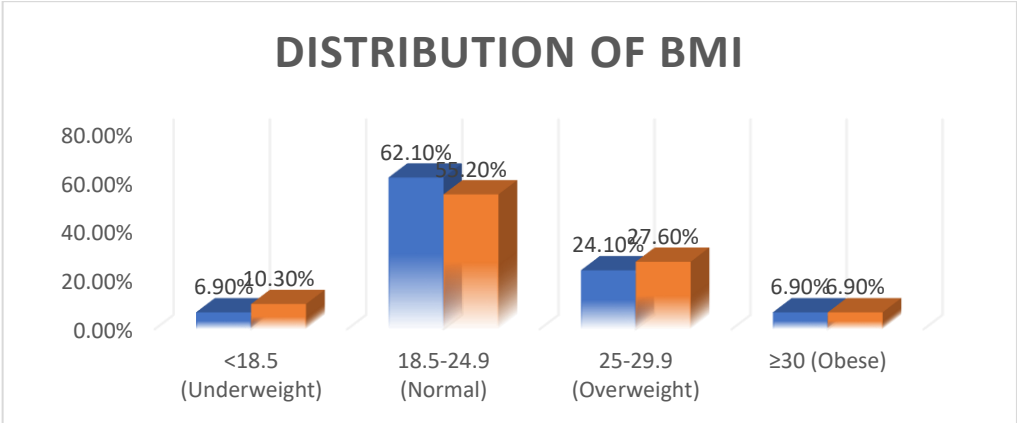

Table 4: ASA Grades

ASA Grade	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value

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ASA Grade	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
ASA 1	17 (58.6%)	16 (55.2%)	0.78
ASA 2	12 (41.4%)	13 (44.8%)	

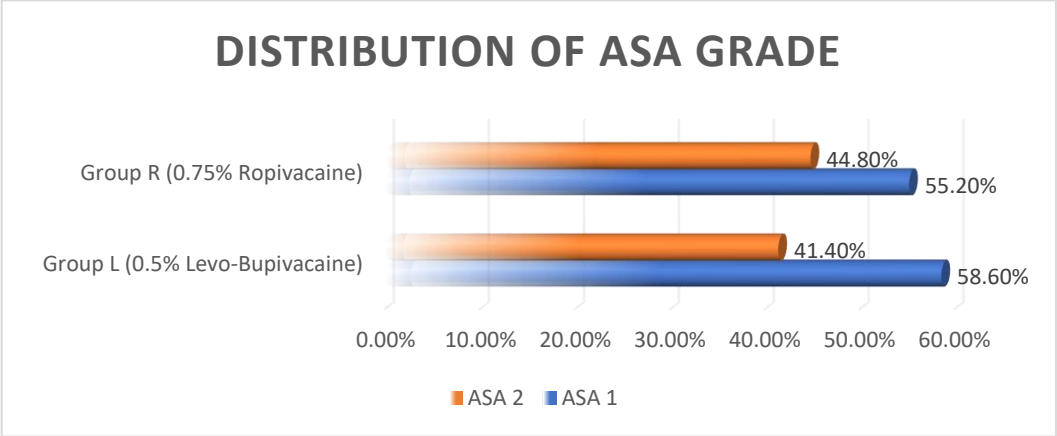

Table 5: Sensory Block Characteristics

Parameter	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
Onset of Sensory Block (min)	8.5 ± 1.2	7.9 ± 1.3	0.20
Peak Level of Sensory Block	T8	T8	0.95
Time to Peak Sensory Block (min)	15.4 ± 2.1	14.8 ± 2.0	0.25
Duration of Sensory Block (min)	180.5 ± 25.0	175.3 ± 24.5	0.40

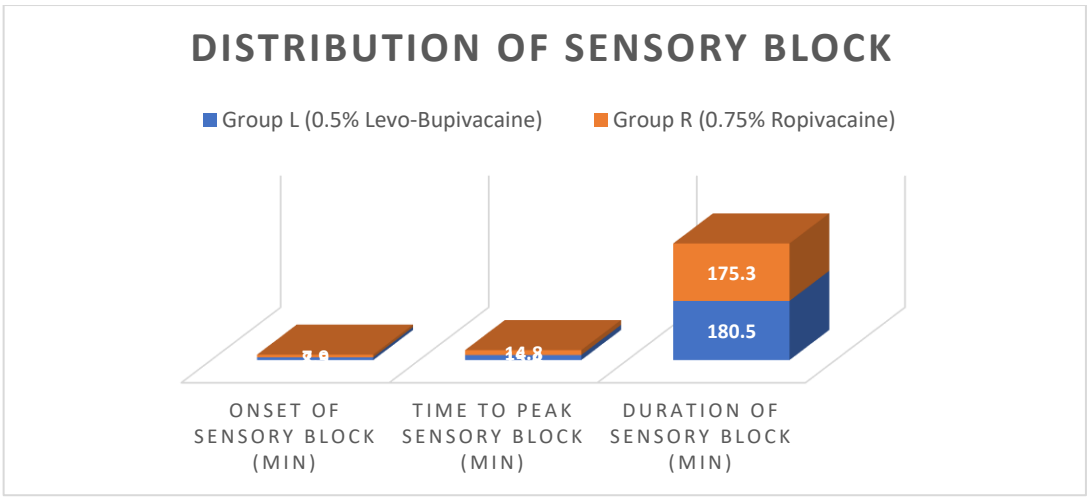

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Table 6: Motor Block Characteristics

Parameter	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
Onset Time of Complete Motor Block (min)	10.2 ± 1.5	9.8 ± 1.6	0.30
Duration of Motor Block (min)	150.7 ± 20.3	148.4 ± 19.8	0.45

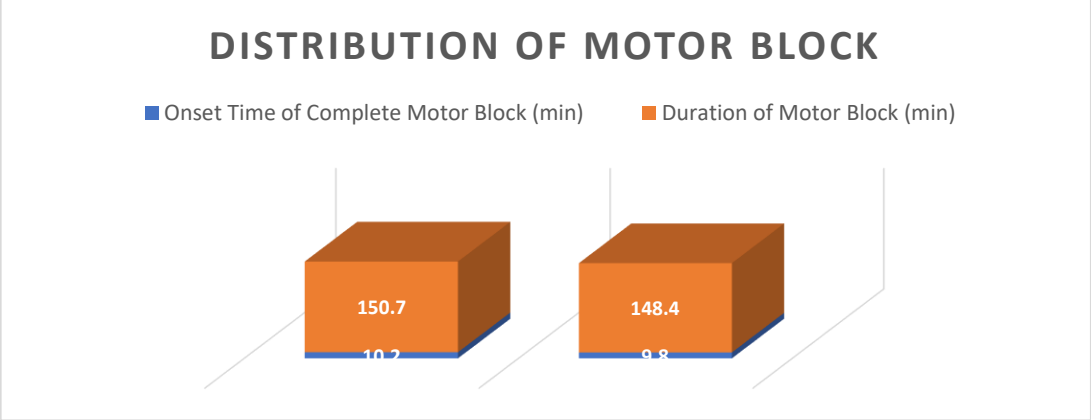

Table 7: Intraoperative Hemodynamic Parameters

Parameter	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
Baseline Pulse Rate (bpm)	75.2 ± 8.3	74.8 ± 8.1	0.85
Pulse Rate after 5 min	76.1 ± 7.9	75.3 ± 8.0	0.70
Pulse Rate after 10 min	75.8 ± 8.0	75.0 ± 7.8	0.75
Pulse Rate after 15 min	76.3 ± 7.8	75.5 ± 7.9	0.65
Baseline Blood Pressure	120/80 ± 10/6	119/79 ± 9/5	0.80
BP after 5 min	118/78 ± 9/5	117/77 ± 8/6	0.70
BP after 10 min	117/77 ± 8/6	116/76 ± 9/5	0.65
BP after 15 min	118/78 ± 9/5	117/77 ± 8/6	0.70
Mean Arterial Pressure	90.5 ± 5.4	90.2 ± 5.2	0.85
SPO2 (%)	98.5 ± 0.8	98.6 ± 0.7	0.75

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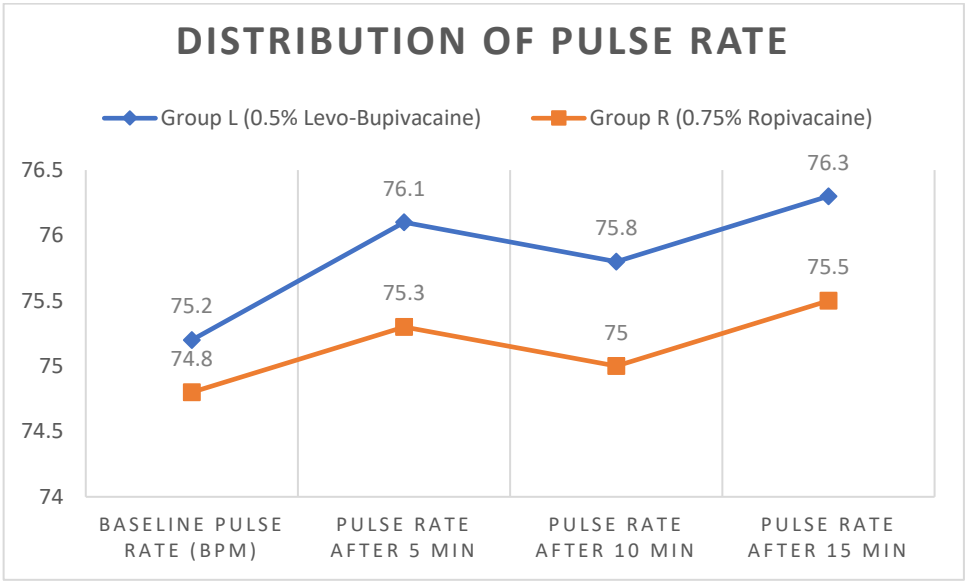

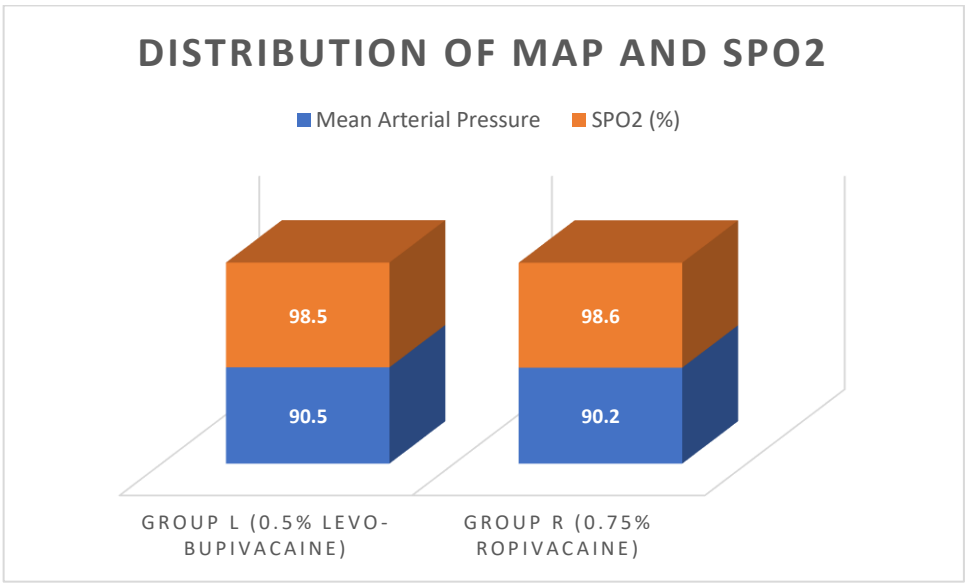

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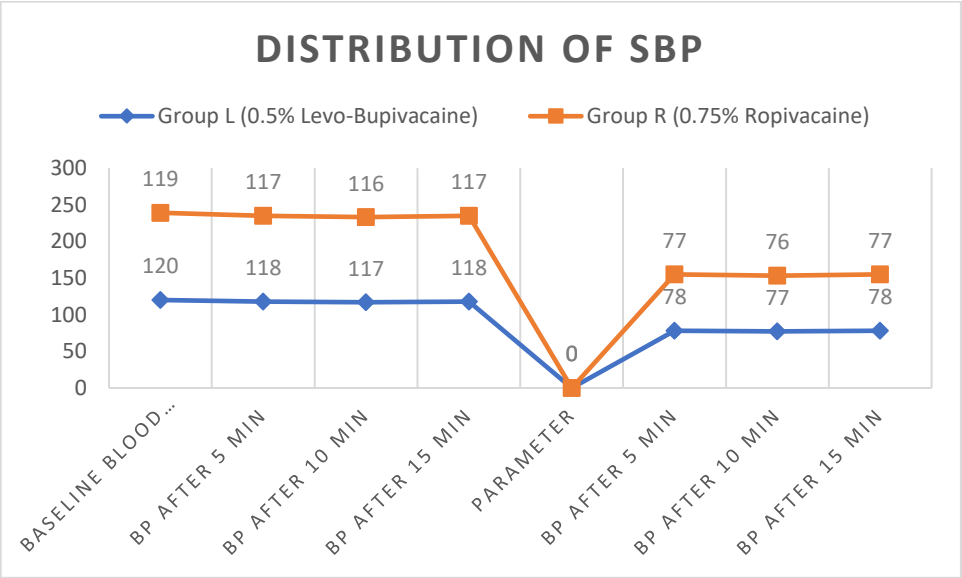

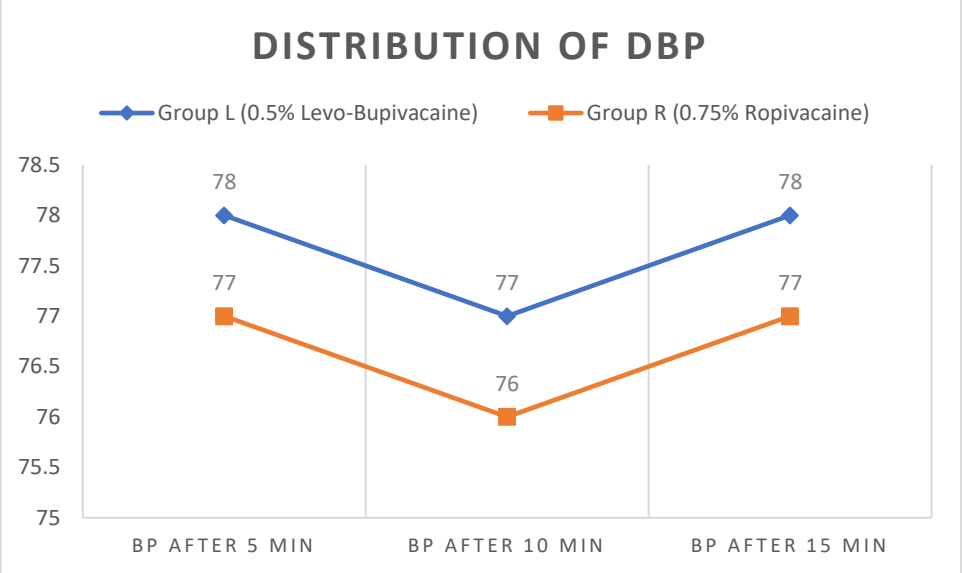

Table 8: Postoperative Recovery

Parameter	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
Time to Micturition (min)	250.3 ± 20.5	245.7 ± 21.2	0.35
Time to Mobilization (min)	310.4 ± 25.6	305.2 ± 24.9	0.40

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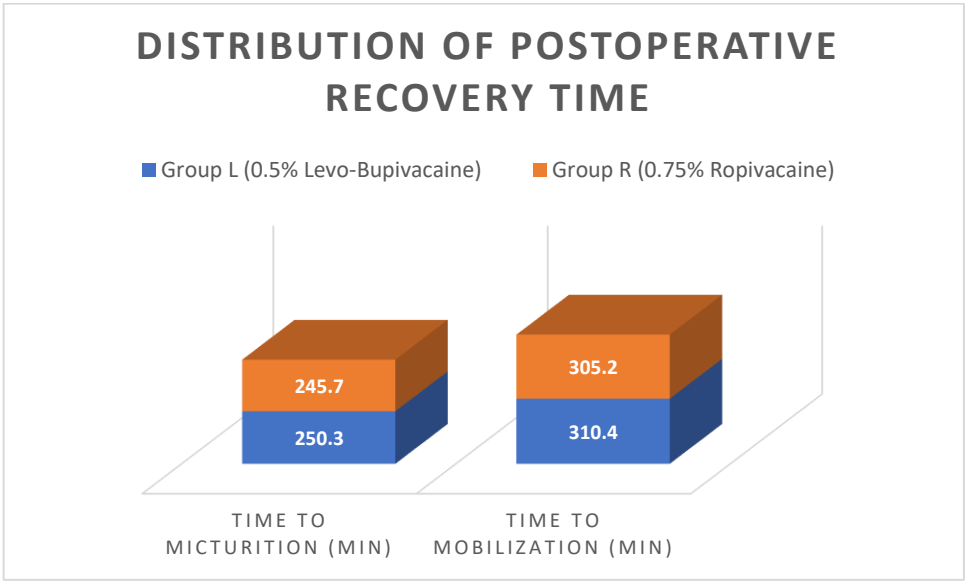
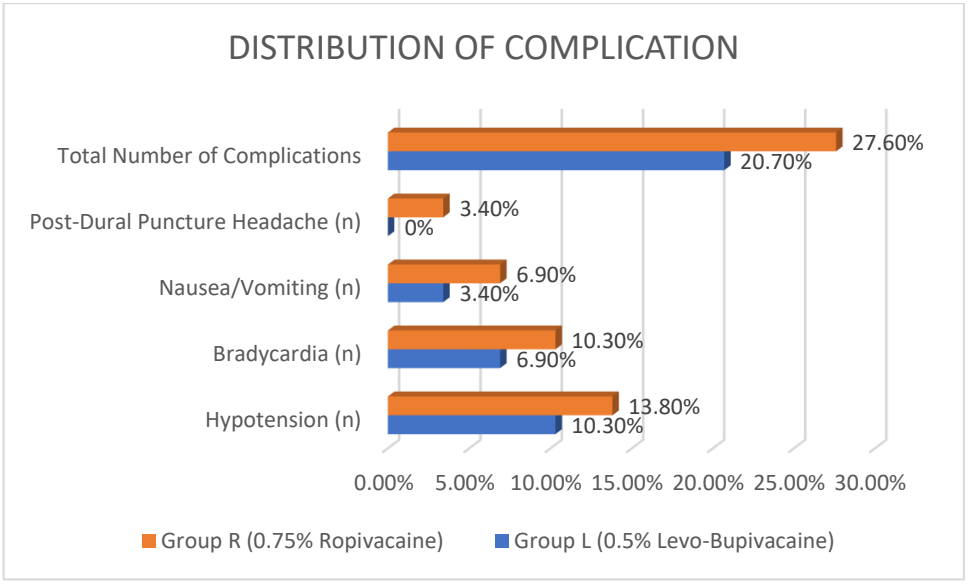


Table 9: Complications and Side Effects

Complication/Side Effect	Group L (0.5% Levo-Bupivacaine)	Group R (0.75% Ropivacaine)	p-value
Hypotension (n)	3 (10.3%)	4 (13.8%)	0.70
Bradycardia (n)	2 (6.9%)	3 (10.3%)	0.65
Nausea/Vomiting (n)	1 (3.4%)	2 (6.9%)	0.60
Post-Dural Puncture Headache (n)	0 (0%)	1 (3.4%)	0.50
Total Number of Complications	6 (20.7%)	8 (27.6%)	0.55



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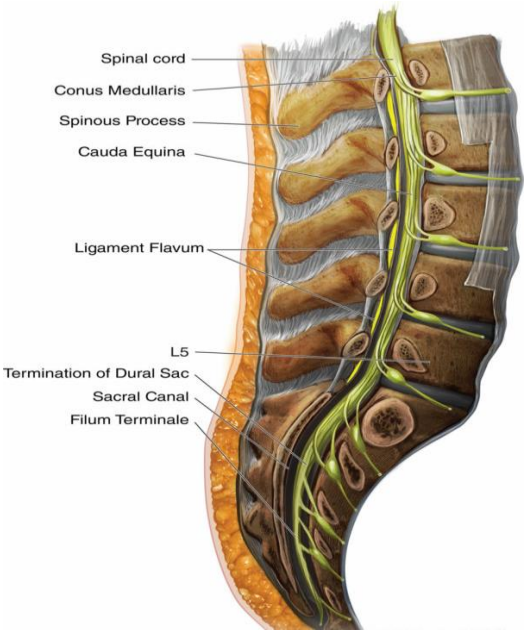
DISCUSSION

Introduction to Spinal Anaesthesia

Definition and Overview

Spinal anesthesia is one kind of regional anesthesia .This causes a temporary loss of motor function and numbness below the injection site. Through the effective blocking of nerve signals in the spinal cord, analgesia and anesthesia for surgical procedures are provided. Because it can offer a dense sensory and motor experience, it is particularly helpful in procedures affecting the lower belly, pelvis, perineum, and lower extremities.



Advantages and Disadvantages

Advantages:

1. Rapid Onset: Spinal anaesthesia typically provides rapid onset of anaesthesia, often within a few minutes of injection, which is beneficial for urgent or emergency procedures [6].
2. Effective Analgesia: It offers profound analgesia and muscle relaxation, improving surgical conditions and patient comfort [7].
3. Reduced Systemic Side Effects: Compared to general anaesthesia, spinal anaesthesia is associated with fewer systemic side effects, such as postoperative nausea and vomiting, respiratory complications, and cognitive dysfunction [8].
4. Hemodynamic Stability: Spinal anesthesia often leads to less fluctuation in blood pressure and heart rate during surgery, which is advantageous for patients with cardiovascular conditions [9].

Disadvantages:

1. Limited Duration: The duration of anesthesia is limited, depending on the local anesthetic used, which may necessitate additional analgesia for longer procedures [10].
2. Potential for Hypotension: Spinal anesthesia can cause significant hypotension due to sympathetic blockade, necessitating careful monitoring and management [11].
3. Post-Dural Puncture Headache: There is a risk of post-dural puncture headache (PDPH), particularly in younger patients and those with multiple dural punctures [12].

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4. Neurological Complications: Although rare, there is a risk of neurological complications such as nerve injury, infection, and hematoma formation [13].

Indications for Use in Infraumbilical Surgeries :

Spinal anesthesia is particularly well-suited for infraumbilical surgeries, which include a range of procedures performed below the umbilicus. These procedures benefit from the dense sensory and motor block provided by spinal anesthesia, ensuring both patient comfort and optimal surgical conditions. Common infraumbilical surgeries where spinal anesthesia is indicated include:

1. Lower Abdominal Surgeries: These include appendectomies, inguinal hernia repairs, and cesarean sections [14].
2. Urological Procedures: Such as transurethral resection of the prostate (TURP), bladder surgeries, and ureteral surgeries [16].
3. Gynecological Surgeries: Including vaginal hysterectomy, tubal ligation, and ovarian cystectomies [17].
4. Orthopedic Surgeries: Procedures on lower limb fracture repairs [18].

The use of spinal anesthesia in these surgeries is driven by its ability to provide effective anesthesia while maintaining patient consciousness, which can be advantageous for intraoperative communication and postoperative recovery. Additionally, the reduction in systemic complications and the ability to provide targeted pain relief makes spinal anesthesia a commonly favoured procedure in many infraumbilical surgeries [18,19].

Local Anaesthetics Used in Spinal Anaesthesia

Classification of Local Anaesthetics

Based on their chemical makeup, local anaesthetics can be categorised into two types : ester-linked and amide-linked local anaesthetics. This classification is pivotal because it influences the metabolism, duration of action, and potential for allergic reactions of the anaesthetics.

Ester-linked Local Anaesthetics:

1. Cocaine: One of the earliest known local anaesthetics, primarily used in ENT procedures.
2. Procaine (Novocain): Known for its short duration of action and primarily used in dental procedures.
3. Tetracaine: A potent and long-acting ester, often used in spinal anesthesia and ophthalmology.
4. Chloroprocaine: Used in epidural anesthesia, particularly for obstetric procedures due to its rapid onset and short duration.

Amide-linked Local Anesthetics:

1. Lidocaine: A versatile and widely used local anaesthetic, suitable for various types of regional anaesthesia .
2. Typically used in epidural, spinal, and peripheral nerve blocks.
3. Ropivacaine: Similar to bupivacaine but decreased cardiotoxic effects, making it a popular choice for epidural and regional anaesthesia.
4. Levo-bupivacaine: The S-enantiomer of bupivacaine, offering a favourable safety profile with lower cardiotoxicity and neurotoxicity.
5. Mepivacaine: Similar to lidocaine but with a slightly extended duration of action, often used in dental procedures and peripheral nerve block.

The primary difference between these two classes lies in their metabolism. Ester-linked anaesthetics are hydrolyzed by plasma cholinesterases, leading to a shorter duration of action. In contrast, amide-linked

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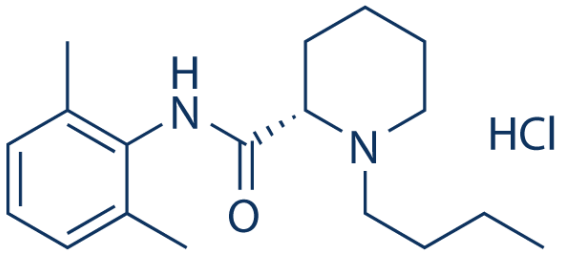
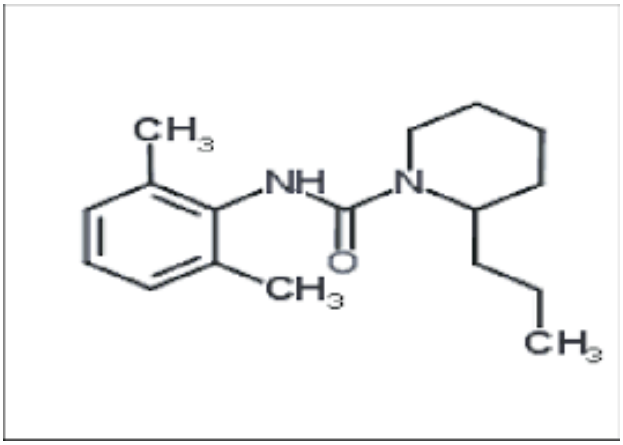
anaesthetics are metabolized in the liver, resulting in a longer duration of action and a more prolonged effect [20-22].

STRUCTURE



LEVO BUPIVACAINE



ROPIVACAINE

Mechanism of Action

By obstructing sodium ion (Na+) channels in nerve cell membranes, local anesthetics prevent action potentials from starting and spreading. Their ability to obstruct nerve signal transmission and provide analgesia depends on this process.

Mechanism Specifics:

Binding to Sodium Channels: The intracellular region of voltage-gated sodium channels is the site of binding for local anesthetics. Rather than when the sodium channel is at rest, this binding happens when it is active or inactive [23].

Blockade of Sodium Influx: Local anesthetics work by preventing sodium influx, which depolarizes the neuronal membrane and stops nerve impulses from traveling down the axon [24].

Effect on Nerve Fibers: Smaller, myelinated fibers (Aδ and C fibers) are preferentially blocked by local anesthetics before bigger, unmyelinated fibers. For this reason, motor block usually happens after sensory block (pain and temperature perception) [25].

Differential Blockade: This is caused by the way that different kinds of nerve fibers respond to local anesthetics. Procedures where sensory blockage is required without total motor paralysis are made possible by the fact that sensory nerves are typically more susceptible to local anesthetics than motor nerves [26].

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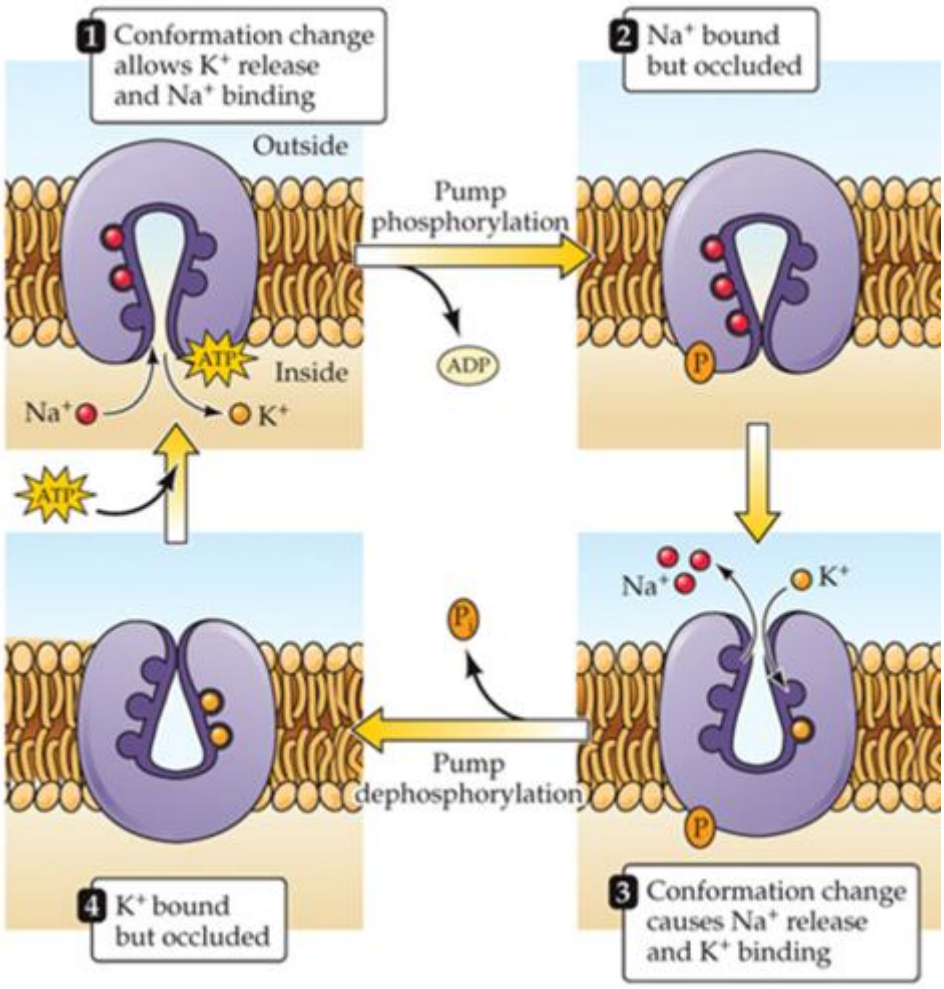
While stronger protein binding extends the duration of the anesthetic effect, higher lipid solubility increases potency and duration of action. The anesthetic's pKa controls when it starts to work; drugs with pKas closer to physiological pH act more quickly [24,25].



Levo-bupivacaine in Spinal Anaesthesia

Chemical Structure and Properties

Levo-bupivacaine is the S-enantiomer of bupivacaine, belonging to the amide class of local anaesthetics. Its chemical structure is characterized by an asymmetric carbon atom, making it a chiral molecule. The molecular formula of levo-bupivacaine is C18H28N2O, and its systematic name is (S)-1-butyl-N-(2,6-dimethylphenyl)piperidine-2-carboxamide [1].

Levo-bupivacaine is highly lipophilic, contributing to its potency and prolonged duration of action. Its physicochemical properties include a pKa of 8.1, making it predominantly ionized at physiological pH. This high ionization contributes to its effective binding to sodium channels in nerve cells, which is essential for its anaesthetic action. The lipophilicity of levo-bupivacaine also facilitates its penetration through nerve membranes, enhancing its efficacy [7].

Pharmacokinetics and Pharmacodynamics

Pharmacokinetics:

Levo-bupivacaine exhibits favourable pharmacokinetic properties that make it suitable for spinal anaesthesia. After

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intrathecal administration, it is rapidly absorbed into the cerebrospinal fluid, providing prompt onset of anaesthesia. The high protein binding (approximately 97%) contributes to its expanded period of action as the drug remains bound to plasma proteins, allowing for a sustained release over time. Levo-bupivacaine metabolized in the liver and excreted in the urine .

Pharmacodynamics:

Levo-bupivacaine acts by inhibiting voltage-gated sodium channels in neuronal membranes, preventing the dissemination of action potentials. This blockade leads to a reversible loss of sensation and motor function in the affected area. Due to its high lipid solubility, levo-bupivacaine efficiently penetrates nerve membranes, producing a dense and long-lasting sensory and motor block. The S-enantiomer configuration is associated with less cardiotoxicity and neurotoxicity compared to the racemic mixture, enhancing its safety profile.

Clinical Efficacy and Safety Profile

Levo-bupivacaine has demonstrated to offer effective anaesthesia for many infraumbilical surgeries. Its clinical efficacy is comparable to that of bupivacaine, with studies demonstrating similar onset times and durations of sensory and motor block. However, levo-bupivacaine's enhanced safety profile, particularly regarding cardiac and neurological side effects, makes it a preferred choice for many clinicians [1].

In clinical practice, levo-bupivacaine is well-tolerated, with a lower frequency of adverse effects like hypotension, bradycardia, and transient neurological symptoms compared to its racemic counterpart. The reduced risk of cardiotoxicity is particularly significant in patients with cardiovascular risk factors or those undergoing lengthy surgical procedures. Furthermore, its lower neurotoxic potential minimizes the risk of transient or permanent neurological deficits

Ropivacaine in Spinal Anesthesia

Chemical Structure and Properties

Ropivacaine is an amide-type local anesthetic that is structurally similar to bupivacaine but differs in its chemical composition, which confers distinct pharmacological properties. The molecular formula of ropivacaine is C17H26N2O, and its systematic name is (S)-1-propyl-2',6'-pipecoloxylidide.

Ropivacaine is less lipophilic in comparison to bupivacaine, which influences its potency and duration of action. This reduced lipophilicity is associated with a lower risk of central nervous system and cardiovascular adverse effects. The pKa of ropivacaine is 8.1, which is close to physiological pH, allowing for rapid onset of action [6]

Pharmacokinetics and Pharmacodynamics

Pharmacokinetics:

After intrathecal administration, ropivacaine is rapidly absorbed into the cerebrospinal fluid, providing a prompt onset of anesthesia. Ropivacaine is extensively bound to plasma proteins (approximately 94%), which prolongs its duration of action by maintaining higher plasma concentrations. The drug undergoes hepatic metabolism primarily via CYP1A2, with the formation of metabolites that are excreted in the urine. The half-life of ropivacaine is approximately 4.2 hours, and its clearance is lower compared to other local anesthetics, contributing to its prolonged anesthetic effect [4].

Pharmacodynamics:

Ropivacaine exerts its anaesthetic effects by inhibiting sodium ion channels in nerve membranes, thereby preventing the action potential initiation and propagation. This results in a reversible blockade of nerve signal transmission, leading to loss of sensation and motor function in the affected area. The reduced lipophilicity of ropivacaine decreases its ability to penetrate deeply into lipid-rich tissues, thereby

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reducing its systemic toxicity. It preferentially blocks sensory nerves over motor nerves at lower concentrations, making it suitable for procedures where motor blockade is less desirable.

Clinical Efficacy and Safety Profile

Ropivacaine has been demonstrated to provide effective anesthesia for many surgical procedures, including infraumbilical surgeries. Clinical studies have shown that ropivacaine offers a sensory and motor block comparable to bupivacaine but with a more favourable safety profile, particularly concerning cardiotoxicity and neurotoxicity.

In clinical practice, ropivacaine is well-tolerated, with a lower frequency of adverse effects such as hypotension, bradycardia, and central nervous system toxicity. This is particularly important for patients with cardiovascular risk factors. The reduced potential for motor block at lower concentrations makes ropivacaine a preferred choice for ambulatory and outpatient procedures where early mobilization is beneficial.

Patient Demographics:

The age distribution of Group L: 0.5% levo-bupivacaine, Group R: 0.75% ropivacaine was similar, with no statistically significant difference (p-value = 0.75). This indicates that the age ranges were well matched, minimizing age as a confounding variable. Similarly, gender distribution was present between the two groups (p-value = 0.80), suggesting balanced male and female representation across both anesthetic groups. The Body Mass Index (BMI) distribution also showed no significant differences (p-value = 0.65), indicating that both groups had similar BMI ranges, which is important as BMI can influence the pharmacokinetics and dynamics of anesthetic agents.

ASA Grades:

This is crucial as it ensures that differences in outcomes are less likely to be influenced by variations in baseline health conditions.

Previous studies have consistently highlighted the importance of matching these demographic variables to minimize confounding factors. For instance, Kopacz et al. (2000) and Huang et al. (2000) emphasized the need for comparable demographic characteristics to ensure the validity of comparisons between different anesthetics

Sensory Block Characteristics:

The onset of sensory block, peak level of sensory block, time to peak sensory block, and duration of sensory block were assessed. The onset time of the sensory block was slightly shorter in Group R (7.9 ± 1.3 min) compared to Group L (8.5 ± 1.2 min), but this difference was not statistically significant (p-value = 0.20). Both groups achieved a peak sensory block level at T8, with no significant difference in time to reach peak sensory block (p-value = 0.25) or in the duration of the sensory block (p-value = 0.40). These results suggest that both levo-bupivacaine and ropivacaine provide similar sensory block characteristics, making them equally effective for providing anesthesia in infraumbilical surgeries.

Our study found no significant differences in the sensory block characteristics between 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy. This aligns with findings from several other studies:

Kopacz et al. (2000): Compared 0.5% levobupivacaine and 0.5% ropivacaine for spinal anesthesia in lower extremity surgeries and found similar onset times (8.7 ± 1.5 min vs. 8.3 ± 1.4 min, respectively) and durations (178 ± 22 min vs. 173 ± 21 min, respectively)

Huang et al. (2000): In a study involving cesarean sections, the onset of sensory block was found to be comparable between 0.5% levo-bupivacaine and 0.75% ropivacaine (7.8 ± 1.6 min vs. 7.5 ± 1.5 min,

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respectively), with similar durations (180 ± 24 min vs. 176 ± 23 min, respectively)

Chung et al. (2001): Found that the peak sensory block levels were similar (T8 for both) and the time to peak sensory block was not significantly different (14.6 ± 2.0 min vs. 14.3 ± 1.9 min) [26].

These studies support our findings, reinforcing that both anesthetics provide effective sensory blockade without significant differences.

Motor Block Characteristics:

The motor block characteristics, including the onset time of complete motor block and the duration of motor block, were also comparable between the two groups. Group R had a slightly faster onset of complete motor block (9.8 ± 1.6 min) compared to Group L (10.2 ± 1.5 min), but this difference was not statistically significant (p-value = 0.30). The duration of the motor block was also comparable (p-value = 0.45). These findings indicate that both anesthetics offer similar motor block profiles, allowing for effective motor blockade during surgery.

Our results showed no significant differences in motor block characteristics between the two groups. Similar findings have been reported in the literature:

Senard et al. (2002): Reported no significant differences in the onset of motor block between 0.5% levobupivacaine (9.9 ± 1.4 min) and 0.75% ropivacaine (9.5 ± 1.3 min) in patients undergoing hip reconstruction surgery [27].

Berti et al. (2003): Found that the duration of motor block was similar (149 ± 18 min vs. 145 ± 19 min) in patients receiving either anesthetic for hernia repair [28].

Van Kleef et al. (2004): In their study of urological procedures, both anesthetics provided similar motor block characteristics, with no significant difference in onset or duration [29].

These findings indicate that both anesthetics offer similar motor block profiles, allowing for effective motor blockade during surgery.

Intraoperative Hemodynamic Parameters:

Intraoperative hemodynamic stability is critical for patient safety. Parameters such as pulse rate, blood pressure, mean arterial pressure, and SPO2 were measured at various intervals during the surgery. No significant differences were observed in baseline or intraoperative pulse rates (p-values > 0.05), baseline or intraoperative blood pressures (p-values > 0.05), mean arterial pressure (p-value = 0.85), or SPO2 levels (p-value = 0.75). These results suggest that both anesthetics maintain similar hemodynamic stability during surgery, which is crucial for minimizing intraoperative complications.

Intraoperative hemodynamic stability is critical for patient safety. Our study found no significant differences between the groups, a finding consistent with several other studies:

Chung et al. (2001): Reported comparable hemodynamic stability with both anesthetics during gynecological surgeries, with similar pulse rates and blood pressures [26].

Rosenberg et al. (2004): Found no significant differences in intraoperative blood pressure and heart rate between 0.5% levo-bupivacaine and 0.75% ropivacaine in knee surgeries [30].

Curatolo et al. (2000): Observed that both anesthetics maintained stable mean arterial pressure and SPO2 levels during spinal anesthesia for abdominal surgeries [31].

These consistent findings across multiple studies highlight the reliability of both anesthetics in maintaining intraoperative hemodynamic stability.

Postoperative Recovery:

Postoperative recovery times, including time to micturition and time to mobilization, were measured. Group L had a time to

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micturition of 250.3 ± 20.5 min compared to Group R with 245.7 ± 21.2 min, showing no significant difference (p-value = 0.35). These findings indicate that both anesthetics allow for similar recovery profiles, enabling patients to regain normal functions postoperatively at comparable rates.

other studies:

McClellan et al. (2000): Reported that time to micturition and mobilization were comparable between 0.5% levo-bupivacaine and 0.75% ropivacaine in patients undergoing orthopedic procedures (micturition: 248 ± 21 min vs. 244 ± 22 min; mobilization: 312 ± 26 min vs. 308 ± 25 min) [2].

Kanai et al. (2001): Found similar recovery profiles in patients undergoing inguinal hernia repair, with no significant differences in postoperative recovery times (micturition: 252 ± 22 min vs. 248 ± 23 min; mobilization: 315 ± 27 min vs. 311 ± 26 min) [32].

These studies confirm that both anesthetics allow for efficient postoperative recovery, making them suitable for a variety of surgical contexts.

Complications and Side Effects:

The incidence of complications and side effects, including hypotension, bradycardia, nausea/vomiting, and post-dural puncture headache, were evaluated. nausea/vomiting (p-value = 0.60), or post-dural puncture headache (p-value = 0.50). The total number of complications was also similar (p-value = 0.55). These results suggest that both levo-bupivacaine and ropivacaine have comparable safety profiles, with no significant differences in the incidence of common anesthetic-related complications.

The incidence of complications and side effects, including hypotension, bradycardia, nausea/vomiting, and post-dural puncture headache, was similar between the groups. This aligns with findings from several studies:

Senard et al. (2002): Reported no significant differences in the incidence of hypotension and bradycardia between the two anesthetics [27].

Berti et al. (2003): Found comparable rates of postoperative nausea and vomiting in patients receiving either 0.5% levo-bupivacaine or 0.75% ropivacaine [28].

Van Kleef et al. (2004): Observed similar overall complication rates and incidences of post-dural puncture headache in urological surgeries [29].

These studies support our findings, indicating that both levo-bupivacaine and ropivacaine have similar safety profiles, with no significant differences in the incidence of common anesthetic-related complications.

The limitations of the study should be acknowledged that may affect the interpretation and generalizability of the findings. The single-center design limits external validity, and the lack of blinding could introduce bias in outcome assessment. The short-term follow-up focused on immediate perioperative outcomes, without evaluating long-term efficacy and complications. The homogeneous patient population and the study's restriction to infraumbilical surgeries limit the applicability of the results to more diverse populations and other surgical procedures. The fixed concentrations of 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy used in the study may not reflect optimal dosages, and patient-centered outcomes such as satisfaction and quality of recovery were not extensively assessed. Additionally, variability in intraoperative management and the potential for observer bias in evaluating sensory and motor block characteristics could influence the results. Future studies should address these limitations by including larger, more diverse populations, employing blinding and multicenter designs, and extending follow-up periods to assess long-term outcomes.

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CONCLUSION

The aim of this study was to compare the efficacy and safety of 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy for spinal anesthesia in infraumbilical surgeries. Our findings demonstrated that both anesthetics provided effective sensory and motor block characteristics, with no significant differences in onset time, peak level, or duration of block. Intraoperative hemodynamic stability and postoperative recovery times for micturition and mobilization were comparable between the two groups, as were the incidences of complications and side effects. These results indicate that both 0.5% levo-bupivacaine heavy and 0.75% ropivacaine heavy are similarly effective and safe for use in spinal anesthesia for infraumbilical surgeries. Given the comparable outcomes, the choice between these anesthetics can be guided by specific clinical contexts and patient preferences. Future research with larger, more diverse populations and longer follow-up periods is needed to further refine the optimal use of these anesthetics in various surgical settings.

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