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Original Research Article

Comparative Study of the Effect of Intrathecal 0.5% Hyperbaric Levobupivacaine Versus 0.75% Hyperbaric Ropivacaine for Lower Limb Orthopedic Surgeries

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Abstract

Background and Aim: Spinal anaesthesia is widely used for lower limb orthopaedic surgeries due to its effectiveness, safety, and ability to provide excellent intraoperative and postoperative analgesia. Levobupivacaine and ropivacaine are newer long-acting local anaesthetics with reduced cardiotoxicity compared to bupivacaine. This study compared the anaesthetic and analgesic efficacy of intrathecal 0.5% hyperbaric levobupivacaine and 0.75% hyperbaric ropivacaine.

Methods: A randomized double-blind controlled study was conducted on 100 patients (ASA I–II, aged 18–75 years) undergoing elective lower limb orthopaedic surgeries under spinal anaesthesia. Patients were randomly allocated into two groups: Group L received 3 mL of 0.5% hyperbaric levobupivacaine and Group R received 3 mL of 0.75% hyperbaric ropivacaine intrathecally. Sensory and motor block characteristics, haemodynamic parameters, postoperative pain scores, time to first rescue analgesia, analgesic consumption, and adverse effects were assessed.

Results: Group R demonstrated a significantly faster onset of sensory blockade (88.8±15.5 s vs. 142.4±16.1 s; $p<0.001$) and earlier attainment of peak sensory level. However, Group L showed significantly longer sensory regression time (125.2±11.7 min vs. 88.5±9.4 min; $p<0.001$), prolonged motor block duration (243.8±17.6 min vs. 184.1±12.8 min; $p<0.001$), and longer duration of analgesia (245.2±11.3 min vs. 198.4±14.7 min; $p<0.001$). Rescue analgesic requirements were lower in Group L. Haemodynamic parameters remained comparable between groups, and adverse effects were minimal.

Conclusion: Both agents provided effective spinal anaesthesia. Hyperbaric ropivacaine offered faster onset and earlier recovery, whereas hyperbaric levobupivacaine provided prolonged sensory and motor blockade with superior postoperative analgesia.

Keywords: Duration of Analgesia, Hyperbaric Levobupivacaine, Hyperbaric Ropivacaine, Spinal Anaesthesia.

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Introduction

Effective intraoperative and postoperative pain management is a fundamental component of modern anaesthesia practice. In surgical procedures, particularly lower limb surgeries, regional anaesthesia improves patient outcomes by providing targeted analgesia while minimizing systemic adverse effects [1]. Inadequately managed pain may lead to prolonged hospital stay, delayed wound healing, increased complication rates, psychological and physiological distress, financial burden, and reduced patient satisfaction [1]. Spinal anaesthesia is widely used as it suppresses the neuroendocrine stress response, avoids airway manipulation, reduces the risk of aspiration, and provides effective intraoperative and postoperative analgesia, making it preferable to general anaesthesia in many lower limb and infraumbilical surgeries [2,3].

Several local anaesthetics have been used for intrathecal blockade, including lidocaine, prilocaine, procaine, chloroprocaine, mepivacaine, and bupivacaine. Although bupivacaine has been the traditional agent of choice, its prolonged motor blockade delays recovery and PACU discharge, and it is associated with greater cardiac and neurological toxicity. These limitations led to the development of single-enantiomer local anaesthetics such as levobupivacaine and ropivacaine, which exhibit reduced cardiotoxicity and CNS toxicity.

Levobupivacaine, the S-enantiomer of bupivacaine, produces effective sensory and motor blockade with a safer cardiovascular profile. Ropivacaine, also a pure S-enantiomer, provides reliable sensory blockade with relatively less intense motor block. The clinical characteristics of both agents—including onset, duration, and quality of block—depend on concentration and baricity [23].

Levobupivacaine and ropivacaine are available in concentrations ranging from 0.25% to 0.75%. Evidence suggests that 0.5% levobupivacaine offers an optimal balance between efficacy and safety, whereas higher concentrations (0.75%) are associated with increased hypotension, nausea, vomiting, and delayed block regression [4,5]. Studies on ropivacaine indicate that 0.75% concentration provides a faster onset of sensory and motor blockade, reduced intraoperative analgesic requirements, and higher patient satisfaction compared to 0.5% solutions [6,7].

Both drugs are available in isobaric and hyperbaric formulations. Hyperbaric solutions provide a more predictable and consistent block with fewer adverse effects compared to isobaric preparations [8]. Hyperbaric levobupivacaine demonstrates a faster onset of sensory and motor blockade with a comparable duration of action [22]. Similarly, hyperbaric ropivacaine offers reliable blockade, faster onset, and earlier mobilization, making it suitable for day-care surgeries, whereas isobaric ropivacaine may produce inadequate motor block [9].

Limited studies have directly compared 0.5% hyperbaric levobupivacaine with 0.75% hyperbaric ropivacaine. This study therefore aims to compare their efficacy in spinal anaesthesia for lower limb orthopaedic surgeries.

Aims and Objectives

Aim: To evaluate anaesthetic and analgesic efficacy of 0.5% hyperbaric Levobupivacaine versus 0.75% hyperbaric Ropivacaine for Lower limb Orthopaedic surgeries.

Primary Objectives: comparison between two groups for

- The characteristics of sensory and motor block.
- VAS (Visual analogue scale) for post-operative pain.

Secondary Objectives: comparison between two groups for

- Time of first rescue analgesia.
- Hemodynamic parameters (HR, SBP, DBP, MAP, SPO2).
- Adverse effect if any.

Material and Methods

After receiving approval from the ethical committee, 100 patients posted for elective Lower limb orthopaedic surgeries under spinal anaesthesia were enrolled in the study. Patients were explained about the procedure in detail and informed written consent was obtained. This study was conducted at Tertiary Care Hospital, Ahmedabad, Gujarat, from January 2023 to January 2025.

Study Design: This was a randomized controlled, double blind study. Randomization was carried out using random numbers generated by a computer. And allocating the patients to either group.

Inclusion Criteria

- Patients who are willing to give written and informed consent
- Patients who are understand & rate their pain on VAS score.
- Elective Orthopaedic lower limb surgeries under spinal anaesthesia.
- ASA physical status I and II.
- Age of 18–75 years.
- BMI<35 Kg/m2.

Exclusion Criteria

- Refusing to give consent.
- ASA grade III, IV, V.
- Coagulopathies, valvular heart disease, any major systemic illness.
- Allergy to study drug.
- History of gross congenital anomaly.
- Infection to local site injection at lumbar region.
- Spine deformities.
- Patients with history of psychiatric disorders.
- Patients on any ongoing drugs that modify pain receptors.
- Patients having neurological deficits.
- Patients having raised ICP.

Pre-Anaesthetic Evaluation: All patients underwent a comprehensive pre-anaesthetic assessment, including detailed medical history and thorough general and systemic examination. Routine laboratory investigations were performed for all patients, with additional investigations conducted as clinically indicated.

Pre-anaesthetic Preparation: Written informed consent was obtained from patients and/or their relatives, and all patients were kept nil per os (NPO) prior to surgery. Standard anaesthesia equipment, including the anaesthesia workstation, airway equipment, and resuscitation drugs, was checked and kept ready. A wide-bore intravenous cannula was secured, and patients were preloaded with crystalloid solution at 10 mL/kg. Standard multiparameter monitoring (electrocardiography, non-invasive blood pressure, pulse oximetry, respiratory rate, and temperature) was instituted, and baseline vital parameters were recorded. Premedication with intravenous ondansetron (0.1 mg/kg), ranitidine (1 mg/kg), and prophylactic antibiotics was administered prior to the procedure.

Randomization was carried out using random numbers generated by acomputer and the patients were allocated to either group

Group L: 3ml of 0.5% hyperbaric Levobupivacaine.

Group R: 3ml of 0.75% hyperbaric Ropivacaine.

All patients received a total drug volume of 3ml Intrathecally.

Material: The equipment's required for giving spinal anesthesia are kept ready.

Blinding: It was ensured that the patients participating in the study were unaware of the drug given and the doctor who administered the spinal anesthesia and observes the results is also blinded. The study drug mixture was prepared by the doctor who was not participating in the study. Hence, it was a double-blind study.

Technique: Under all strict aseptic and antiseptic precautions, in a sitting position, spinal anesthesia with the selected drug was given at L3-L4 intervertebral space using midline approach and 25 G Quincke's needle is after aspiration of free flow of clear CSF.

Observation

Sensory Block

- Sensory blockade was checked by using the pin-prick method.
- Time of onset (time from injection of drug to loss of pinprick sensation at L1dermatome level).
- Time to peak sensory block (time taken to attain T8 dermatome level).
- Maximum level of sensory achieved.
- Duration of block (time of regression upto 2 dermatomal levels)

Motor Block

Motor block was assessed by the Modified Bromage Scale

- Time of onset of Motor Block
- Time taken to Modified Bromage Scale 3
- Duration of motor block. (Time of regression to modified Bromage score 0)
- Duration of surgery (Time from incision to surgery is completed)

Vital signs like the patient's heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were observed immediately(0min) after giving spinal anaesthesia, then at 5, 10, 15, 20, 25, 30, 60, 90, 120, 150min intraoperatively and then at 1hr,2hr,4hr,6hr and 12hr,24hr postoperatively. No sedative or analgesic medication was used during the intraoperative period. Any patient with failed spinal anaesthesia or a patient requiring general anaesthesia due to unavoidable circumstances was excluded from the study. The Visual Analogue Scale (VAS) (0-10) was used to assess the pain postoperatively. Patients assess their pain intensity by placing a mark on a line that reflects their level of pain, with the score determined by measuring the distance from the "no pain" to the end of the line (0-10).

Duration of Analgesia

- Time to first rescue analgesic was considered as the interval from time of intrathecal injection to the time of 1st analgesic demand postoperatively VAS score ≥ 4.
- Total number of analgesics required.
- Injection Inj. Tramadol 100mg IV was given (after giving inj. Ondansetron4mg IV) as a rescue analgesic.
- Patients were observed for any complications/adverse effects such as bradycardia, hypotension, respiratory depression, shivering, nausea, vomiting and PDPH postoperatively period for 24 hrs.

Statistical Analysis:

- All the data was filled in proforma and was statistically analysed by using "UNPAIRED STUDENT t- TEST".
- Statistical analysis was prepared using MSEXCEL and mean value was calculated for each parameter.

P Value was applied as follows:

If P value > 0.05, it means that there is no significant difference between the concerned variable of the two groups. If P value <= 0.05, it indicates that there is significant difference between the two groups.

If P value <0.001was considered as highly significant.

Observation and Results

Table 1: Characteristics of Sensory Blockade

Time	Group L	Group R	P Value	Inference
Onset Of Sensory Blockade(Sec) (Mean± Sd)	142.40±16.10	88.80± 15.50	< 0.001	Hs
Time to achieve Highest Sensory Block Level (T8)(Min) (Mean± Sd)	8.66±1.21	6.79±0.87	< 0.001	Hs
Two Segment Regression time (Min) (Mean± Sd)	125.24±11.71	88.48±9.41	< 0.001	Hs

Table 2: Characteristics of Motor Blockade

Time	Group L	Group R	P Value	Inference
Onset Of Motor Blockade (Min) (Mean±Sd)	5.32±0.75	6.69±1.078	< 0.001	Hs
The Time To Achieve Maximum motor Block (Modified Bromage Grade3) (Min) (Mean± Sd)	7.67±0.70	11.05±1.38	< 0.001	Hs
Time To Regression of Motor Block From Score 3 To Score 0(Min) (Mean± Sd)	243.8±17.57	184.1±12.75	< 0.001	Hs

Table 3: Comparison of Perioperative Heart Rate (In Per Minute) Between Two Groups.

Time	Group L (Mean±Sd)	Group R (Mean±Sd)	P Value	Inference
Pre-Procedure	86.90± 8.89	85.10± 9.44	0.33	Ns
Immediate (0min) After Sa	85.00± 9.41	86.98± 8.79	0.28	Ns
5 Min After Sa	81.20± 9.58	81.32± 7.99	0.95	Ns
10 Min After Sa	76.82± 8.13	77.62± 7.83	0.62	Ns
15 Min After Sa	75.66± 8.59	77.88± 5.07	0.12	Ns
20 Min After Sa	74.36± 6.85	74.96± 7.38	0.68	Ns
25 Min After Sa	73.22± 6.66	73.82± 6.19	0.64	Ns
30 Min After Sa	72.28± 5.47	72.88± 5.47	0.58	Ns
60 Min After Sa	73.88± 6.16	74.48± 6.10	0.63	Ns
90 Min After Sa	75.56± 6.63	76.16± 6.52	0.65	Ns
120 Min After Sa	76.81± 6.43	77.45± 6.47	0.62	Ns
150 Min After Sa	81.52± 5.03	81.57± 4.95	0.96	Ns
1 Hr Post-Operative	78.68± 7.18	79.28± 7.26	0.67	Ns
2 Hr Post-Operative	80.28± 6.20	80.88± 6.50	0.63	Ns
3 Hr Post-Operative	82.96± 5.29	83.56± 5.64	0.58	Ns
4 Hr Post-Operative	85.12± 4.36	85.66± 9.98	0.72	Ns
6 Hr Post-Operative	86.10± 12.13	87.14± 11.53	0.66	Ns
12 Hr Post-Operative	87.62± 9.04	85.40± 9.63	0.23	Ns
24 Hr Post-Operative	77.06± 7.75	75.52± 8.05	0.332	Ns

Table 4: Comparison of Peri-Operative Systolic Blood Pressure (In Mmhg) Between Two Groups.

Time	Group L (Mean±Sd)	Group R (Mean±Sd)	P Value	Inference
Pre-Procedure	133.36±8.79	134.68±5.74	0.376	Ns
Immediate (0min) After Sa	134.32±9.89	133.66±9.79	0.738	Ns
5 Min After Sa	124.06±13.52	120.52±8.63	0.122	Ns
10 Min After Sa	121.04±11.62	118.84±5.77	0.233	Ns
15 Min After Sa	119.08±11.82	117.48±2.28	0.35	Ns
20 Min After Sa	118.86±10.83	119.66±11.01	0.715	Ns
25 Min After Sa	119.36±9.88	120.20±9.87	0.671	Ns
30 Min After Sa	118.44±8.03	119.24±7.63	0.611	Ns
60 Min After Sa	119.88±10.53	120.88±10.12	0.629	Ns
90 Min After Sa	121.96±9.84	123.12±9.21	0.544	Ns
120 Min After Sa	122.38±10.36	123.02±10.06	0.763	Ns
150 Min After Sa	127.63±8.88	127.48±2.52	0.934	Ns
1hr Post-Operative	124.12±11.08	125.04±10.65	0.673	Ns

2hr Post-Operative	125.72±9.23	126.64±8.91	0.613	Ns
3hr Post-Operative	128.16±8.16	129.28±2.79	0.361	Ns
4hr Post-Operative	128.92±5.83	129.00±10.34	0.962	Ns
6hr Post-Operative	129.72±9.69	131.52±10.64	0.379	Ns
12hr Post-Operative	131.88±9.51	129.44±10.39	0.224	Ns
24hr Post-Operative	124±9.13	122.66±9.53	0.475	Ns

Table 5: Comparison of Peri-Operative Diastolic Blood Pressure (In Mmhg) Between Two Groups

Time	Group L (Mean±Sd)	Group R (Mean±Sd)	P Value	Inference
Pre-Procedure	85.08± 6.08	85.36± 4.75	0.798	Ns
Immediate (0min) After Sa	82.84± 7.02	80.92± 6.90	0.171	Ns
5 Min After Sa	75.76± 9.10	75.32± 5.96	0.776	Ns
10 Min After Sa	72.92± 8.08	74.64± 3.65	0.173	Ns
15 Min After Sa	70.80± 6.65	71.04± 3.24	0.819	Ns
20 Min After Sa	71.60± 7.03	72.48± 6.95	0.531	Ns
25 Min After Sa	73.18± 6.49	73.98± 6.21	0.53	Ns
30 Min After Sa	71.40± 6.06	72.28± 6.38	0.481	Ns
60 Min After Sa	74.24± 6.62	75.08± 6.22	0.515	Ns
90 Min After Sa	74.84± 6.06	75.32± 5.79	0.687	Ns
120 Min After Sa	75.19± 5.91	75.66± 5.65	0.695	Ns
150 Min After Sa	80.96± 3.94	80.74± 2.23	0.8	Ns
1hr Post-Operative	77.08± 6.13	77.96± 5.93	0.467	Ns
2hr Post-Operative	78.04± 5.28	78.88± 5.02	0.417	Ns
3hr Post-Operative	80.96± 3.69	81.76± 4.29	0.32	Ns
4hr Post-Operative	80.92± 3.48	80.72± 7.12	0.85	Ns
6hr Post-Operative	84.68± 7.09	85.30± 4.40	0.6	Ns
12hr Post-Operative	83.00± 6.97	80.92± 6.90	0.137	Ns
24hr Post-Operative	75.28± 7.67	74.5±7.91	0.618	Ns

Table 6: Time to First Rescue Analgesia and Number of Rescue Analgesia Required In 24 Hours

Time	Group L	Group R	P Value	Inference
Time To First Rescue Analgesia (Min) (Mean±Sd)	245.2±11.25	198.4±14.65	<0.001	Hs
Number Of Rescue Analgesia Required in 24 Hours	1.8±0.57	2.62±0.53	<0.001	Hs

Table 7: Perioperative Side Effects

Adverse Effect	Group L	Group R
Hypotension	4	2
Bradycardia	3	2
Nausea	2	2
Shivering	1	1

Discussion

Drugs and their Concentration: In our study, there were 100 patients posted for elective lower limb orthopaedic surgery under Spinal anaesthesia.

F. Fattorini et al [14] in their results confirmed that levobupivacaine and racemic bupivacaine show no clinical differences when administered intrathecally and hence, Levobupivacaine can be used as a valid alternative to racemic bupivacaine for spinal anaesthesia with minimal side effects.

Gohil et al[11] in their study concluded that hyperbaric Ropivacaine solution (0.75%) can provide effective spinal anaesthesia that matches the block quality of hyperbaric Bupivacaine (0.5%), while offering shorter sensory and motor block duration, similar anaesthetic quality and comparable hemodynamic effects. Dikkala and Guntreddy[20] concluded that ropivacaine and levobupivacaine are newer drugs with better pharmacological safety profile when compared to racemic bupivacaine.

Amruth Murali, et al [22] in their research concluded that hyperbaric 0.5% Levobupivacaine is a preferable alternative over its isobaric counterpart for intrathecal block due to its faster onset of action.

Gupta et al [9] concluded that hyperbaric ropivacaine is preferred over isobaric ropivacaine because it produces more consistent and reliable blocks due to the addition of glucose, which increases the density of the solution, allowing for equal distribution of the drug and increased block height.

Demographic Characters: Both the groups in our study were comparable (p>0.05) with respect to demographic factors like age, body weight, gender, height, and ASA physical status.

Gangopadhyay et al[26] observed that demographic profiles of patients were comparable between the two groups with no significant differences in age, sex distribution, ASA grade distribution, height, and weight (p>0.05), similar to our study.

Characteristics of Sensory and Motor Blockade: (Table 1 &2)

Onset of Sensory block: In the present study, the time to onset of sensory block at L1 level was 142.4±16.11 seconds in group-L and 88.8±15.5 seconds in group-R. P value was <0.001, which was statistically highly significant. The onset of sensory blockade was delayed in the levobupivacaine group as compared to the Ropivacaine group.

Dikkala and Guntreddy [20] showed that the onset of sensory blockade was slower in the levobupivacaine group (188.28±12.46 seconds) compared to the ropivacaine group (163.64±16.13 seconds) (p<0.001) which is similar to our study.

Gohil, et al [11] in their study concluded that the mean onset of sensory block at T10 level was (3±0.56 min) in the Bupivacaine group and (2.6±0.53 min) in the Ropivacaine group (P=0.006). Similarly, Hazarika R et al [13]: concluded that the onset of sensory block (T10) was slower in levobupivacaine group (7.028± 1.61 min) compared to ropivacaine group (5.71 ±1.75 min) (p<0.001). These findings were similar to the findings of our study.

Time to achieve highest sensory level (T8): The mean time to reach maximum T8 level of sensory block in our study was longer in group-L (8.66±1.21 min) than in group-R (6.79±0.87min). P value was <0.001, which was statistically highly significant.

Shukla, U, et al 2024[23] in their study found that the mean time from intrathecal injection to highest sensory level blockade was significantly longer in the levobupivacaine group (19.2±1.4 min) than the ropivacaine group (17.9±1.2 min) (p<0.001).

Similarly, Manazirathar et al. 2015[21] also observed that shorter time was taken to reach maximum height (T4/T5) in the Ropivacaine group (13.17 ± 3.02 minutes) compared to the Levobupivacaine group (20.33 ± 5.31 minutes) (p < 0.0001). These findings were similar to the findings of our study.

Two segment sensory block regression: In our study, the mean time of two segment sensory block regression was 125.24 ± 11.71 min in group-L and 88.48 ± 9.41 min in group-R. P value was <0.001, which was statistically highly significant. The time of two segment sensory blockade regression was longer in the Levobupivacaine group as compared to the ropivacaine group.

Shukla, U, et al 2024[23] concluded that the mean time of two segment regression from the highest sensory level blockade (min) was significantly longer in the levobupivacaine group (72.4±5.1 min) than the ropivacaine group (65.7±3 min) (p<0.001). Hazarika R et al[13] also concluded their study with similar findings. This finding can be attributed to ropivacaine's better sensory motor dissociation feature.[35]

Yadav et al [25] found that the time to achieve maximum sensory level was longer in the ropivacaine group (10.35± 3.48 min) compared to the levobupivacaine group (7.5± 1.46 min) and bupivacaine group (9.4± 4.4 min) (p<0.05). The time to two-segment regression was comparable in the ropivacaine group (97.25± 19.01 min), the levobupivacaine group (104.75± 22.73min) and the bupivacaine group (107.45± 20.35 min) (p=0.282). This result was in contrast to our study, which may be due to the use of 0.5% isobaric ropivacaine with fentanyl adjuvant. In our study, we used 0.75% hyperbaric ropivacaine without adjuvant.

Lipid solubility plays a crucial role in determining the effectiveness of local anaesthetics. Generally higher the lipid solubility, higher is the penetration of large myelinated fibers, as ropivacaine is less lipophilic so, it has lesser penetration in the myelinated fibers and greater effect on no myelinated pain fibers. Therefore sensory block onset is seen faster in ropivacaine compared to levobupivacaine [16].

Onset of Motor block: In the present study, the mean time to onset of motor blockade was 5.32±0.75 mins in group-L and 6.69±1.08 mins in group-R. The p-value was <0.001, which was statistically highly significant. The onset of motor blockade was delayed in the ropivacaine group as compared to the levobupivacaine group.

Gangopadhyay et al [26] found that the onset of motor blockade was significantly slower in the hyperbaric ropivacaine group (14.9±1.6 min) as compared to the hyperbaric levobupivacaine group (10.1±1.3 min) (p<0.05). Sule PM et al [18] finalized that the mean value of onset of motor blockade in the Ropivacaine group was (6.47±3.04 mins), while in the Bupivacaine group it was (3.57±1.45 mins) (p=0.001), which is similar to our study. A similar study was also conducted by Daret al[16] wherein they found that the mean onset of motor blockade was significantly slower in the ropivacaine group (13±1.6min) as compared to the bupivacaine group (9±1.3min)(p < 0.001).

Time to Achieve Maximum Motor block: The mean time to achieve maximum modified Bromage level 3 motor blockade in this study was 7.67±0.70 mins in group-L and 11.05±1.38 mins in group-R. The p value was <0.001 which was statistically highly significant. The time to achieve maximum modified Bromage level 3 motor blockade was delayed in ropivacaine group as compared to levobupivacaine group.

Luck et al [15] established that the mean time to achieve maximum motor blockade was longer in Ropivacaine (10min) as compared to Levobupivacaine (5min) and Bupivacaine (5min) (p=0.002). Similarly, Gautieretal[12] concluded that the mean time to achieve maximum motor blockade was longer in Ropivacaine(14min) as compared to Levobupivacaine (10min) and Bupivacaine (9min) (p<0.05). These findings correlate with the findings of our study.

Yadav et al [25] found that the mean time of onset of motor blockade was significantly delayed (p=0.007) in the Ropivacaine group (10.35± 3.48 min) as compared to the Levobupivacaine (7.5± 1.46 min) and Bupivacaine group (9.4± 4.4), similar to the findings of our study.

Manazirathar et al [17] established that the time taken for complete motor blockade was significantly longer in the levobupivacaine group (12.17 ± 4.09 min) as compared to theropivacaine group (7.83±2.84 min)(p< 0.0001).These findings are incontrasttoour study, which may be due to the use of isobaric drugs. In our study, we have used a hyperbaric drugs.

Time to complete Regression of Motor Blockade (duration of motor blockade): The mean time of duration of motor blockade was 243.8±17.57 mins in group- L and 184.1±12.73 mins in group-R. This difference was statistically highly significant (p <0.0001). Motor blockade lasted longer in the levobupivacaine group as compared to the ropivacaine group.

Shukla, U, et al [23] found a similar finding, that the time of regression of motor blockade (Bromage scale 0) was significantly less in the ropivacaine group (119.5±6 min) than the levobupivacaine group (128.8±7 min) (p= 0.0001). Manazirathar et al [17] showed that Levobupivacaine produced significantly longer duration of motor blockade (290.50 ± 34.67 min) as compared to ropivacaine (222.50 ± 23.00 min) (p < 0.0001), which is similar to our study. Yadav et al [25] concluded that the mean time to complete recovery from motor blockade was significantly shorter in the Ropivacaine group (204.75±34.39 min) than the Bupivacaine group (260±40.78 min) and the Levobupivacaine group (280.25±28.72 min) (p<0.001).

The probable explanation is that ropivacaine has lower penetration into myelinated motor fibres and lower lipid solubility, thus lesser duration of motor blockade. [35] Ropivacaine has lower lipid solubility. It blocks Adeltaand C fibers (which are responsible for pain transmission), faster than the AALPHA and Abeta fibers (which are controlling for proprioception and motor function). Therefore, ropivacaine provides faster analgesia with less motor blockage compared to Levobupivacaine [24].

Hemodynamic Parameters: We studied and observed hemodynamic parameters like Heart rate, Systolic blood pressure, Diastolic blood pressure, Mean arterial blood pressure, Spo2 throughout the procedure at various time intervals like pre procedure, immediately after Spinal anaesthesia (0 min), and at 5min, 10 min, 15 min, 20min, 25min, 30min, 60min, 120min,150min intraoperatively and 1hr,2hr,4hr,6hr,12hr and 24hr postoperatively. In our study, it was observed that there was no significant intergroup variation (P>0.05) as shown in Tables 3, 4 and 5. Thereafter, until the end of surgery, patients in both groups remained hemodynamically stable with no major fluctuations.

Shukla, U, et al[23] and Manazirathar et al[17] in their respective studies observed that haemodynamic parameters were comparable between both the groups (p>0.05). Levobupivacaine demonstrates a lower affinity for cardiac sodium channelsand a higher plasma protein binding capacity compared to its dextro isomer, thereby decreasing the risk of cardiotoxicity. These benefits make levobupivacaine a preferable option for spinal anaesthesia over the racemic form[27]. Ropivacaine also has a lower affinity for sodium channels compared to bupivacaine. So, it is less likely to interfere with the electrical conduction in the heart, producing a risk of arrhythmias and other cardiovascular issues.

Time to First Rescue Analgesia: Mean time to first rescue analgesia is defined as the time from intrathecal injection to the first request for rescue analgesics. The rescue analgesic in this study was given based on pain scores (VAS score) in the postoperative period. The patients of either group were administered IV Tramadol as rescue analgesia when VAS ≥4. Time of duration of analgesia was 198.40±14.65 min in GroupR and it was 245.20 ± 11.25 min in Group L. This difference was statistically highly significant (P<0.001). The duration of analgesia was prolonged in the Levobupivacaine group as compared to Ropivacaine, as shown in Table 6.

Manazirathar et al[17] concluded that the mean duration of analgesia was also significantly longer in the levobupivacaine group (309.83 ± 36.45 min) than in the ropivacaine group (249.50 ± 22.83 min) ($p < 0.0001$).

McNamee et al [10] found that the median time to first analgesic request was significantly shorter in the Ropivacaine group than in the Bupivacaine group (3.4 vs 4.9h, $p<0.001$).

Number of Rescue Analgesia Required In 24 Hours: The mean number of rescue analgesics (IV Tramadol) required in the first 24 hrs was 2.62±0.530 in the Ropivacaine group and it was 1.8±0.571 in the Levobupivacaine group. This difference was statistically highly significant ($P<0.0001$). Therefore, patients from the Levobupivacaine group required less in number of rescue analgesics in the first 24 hrs of surgery as compared to the Ropivacaine group in our study.

Kumar, et al [19] found that greater number of analgesic doses were required in the ropivacaine group on the first day of surgery as compared to the bupivacaine group (33.33% vs.11.11%; $P = 0.011$).

Perioperative Side Effects (Table 7): Hypotension: In this study, hypotension was observed in 4 out of 50 patients in the levobupivacaine group and while 2 out of 50 had in the ropivacaine group and were managed by IV fluid bolus or 6mg IV bolus of mephentermine. These episodes were of short duration and promptly treated without any serious consequences.

Bradycardia: In our study, 3 patients had bradycardia in the levobupivacaine group and 2 patients in the ropivacaine group and were managed with 0.6 mgof IV atropine bolus.

The incidences of other side effects, like nausea and shivering, were comparable in both groups.

Manazirathar et al[17] showed that hypotension was slightly more in the levobupivacaine group (10 patients) compared to the ropivacaine group (7 patients). A similar incidence of bradycardia was observed in both groups. Meanwhile, nausea/vomiting was comparable in the levobupivacaine group (4 patients) and in the ropivacaine group (2 patients), while shivering occurred in near similar in the levobupivacaine group (3 patients) and in the ropivacaine group (5 patients). Sagar and Byndoor [27] showed that nausea was comparable in the levobupivacaine group (3 patients) and in the ropivacaine group (2 patients). Hypotension was similar in the levobupivacaine group (7 patients) and in the ropivacaine group (8 patients). Bradycardia was reported slightly higher in levobupivacaine (4 patients) compared to ropivacaine (2 patients). Shivering was comparable in the levobupivacaine group and in the ropivacaine group.

Conclusion

In conclusion, the study effectively demonstrated that both hyperbaric 0.5% Levobupivacaine and hyperbaric 0.75% Ropivacaine are suitable for spinal anaesthesia in patients undergoing lower limb orthopaedic surgeries. Levobupivacaine is advantageous for its prolonged motor blockade, thereby providing with prolonged postoperative analgesia, whereas Ropivacaine stands out for its quicker onset and faster motor recovery, making it suitable for use in surface surgeries where muscle relaxation is not required. Ropivacaine also allows early mobilization and is therefore useful in daycare surgeries. Both the agents were well tolerated with minimal adverse effects observed. Further studies are recommended to explore long term safety profiles and outcomes in larger, more diverse populations.

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