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Original Research Article

# Comparison of Isobaric Levobupivacaine and Isobaric Ropivacaine for Spinal Anaesthesia in Patients Undergoing Elective Lower Abdominal and Lower Limb Orthopedic Surgeries: A Randomized Study

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**Conflict of interest: Nil**

**Abstract:**

**Introduction**: Levobupivacaine and Ropivacaine are two relatively new amide local anesthetic agents that have been produced in order to address the issues of bupivacaine toxicity.

**Aim and objectives:** To compare block characteristics of levobupivacaine with ropivacaine in providing anaesthesia for lower abdominal and lower limb procedures

**Methodology:** The study was conducted involving 200 patients belonging to ASA grade I and II coming for lower abdominal and lower limb surgeries. They were divided into 2 groups of 100 each. Group L received 0.5 % isobaric levobupivacaine 15 mg and R group received 0.75% isobaric ropivacaine 22.5 mg. Following administration of spinal anesthesia, block characteristics such as onset and duration of sensory blockade, maximum sensory level achieved, time needed for 2-segment sensory regression, onset and duration of motor blockade and time for rescue analgesia, hemodynamic parameters were compared. Adverse effects such as hypotension, shivering, nausea, and vomiting were noted.

**Results:** The onset of sensory block was similar with both groups. The duration of sensory and motor blockade was longer in group L. Time needed for 2-segment sensory regression and time for rescue analgesia were shorter in group R. Shorter duration of motor block and rescue analgesia was noted with ropivacaine as compared to levobupivacaine. Hemodynamic parameters and the incidence of shivering and nausea vomiting were comparable in both the groups; there was no incidence of hypotension and bradycardia noted in either group.

**Conclusion:** The pharmacokinetic profile of ropivacaine makes it an ideal drug for day-care procedures, whereas kinetics of levobupivacaine favours it for prolonged surgical procedures.

**Keywords:** Ropivacaine, Levobupivacaine, Isobaric, Subarachnoid Block, Motor Block.



## Introduction

Spinal anaesthesia is a safe, reliable, and inexpensive technique with the advantage of providing surgical anaesthesia with prolonged post-operative pain relief. It is also an effective treatment for operative pain. It blunts autonomic, somatic and endocrine responses [1].

Traditionally, bupivacaine has been the drug of choice for subarachnoid block. However, the use of hyperbaric racemic bupivacaine in spinal anaesthesia has some drawbacks. It has a high propensity to cause hypotension and bradycardia following intrathecal injection, and there is potential for catastrophic cardiac toxicity due to the high affinity of bupivacaine to cardiac myocyte, also long duration of action delays recovery of motor function and prolongs post anaesthesia care unit stay [2]. Bupivacaine is available as a racemic mixture of its enantiomers, dextrobupivacaine and levobupivacaine. The last few years, it's pure S(-) enantiomers, ropivacaine and levobupivacaine, have been introduced into clinical practice because of their lower cardiac and central nervous system toxicity [3].

Levobupivacaine the pure S (-) enantiomer is a high potency, long-acting local anesthetic with a relatively slow onset of action. It has a lower propensity to block inactivated sodium and potassium channels along with faster rate of dissociation compared to its racemic form. The pharmacodynamic studies of nerve block indicate

that levobupivacaine has similar potency, yet lower risk of cardiovascular toxicity than bupivacaine [4]. Ropivacaine is the 'S' isomer of the propyl analogue of bupivacaine with longer duration of action, low lipid solubility, low potency and low cardiovascular and CNS toxicity. It blocks nerve fibers involved in pain transmission (A and C fibers) to a greater degree than those controlling motor function (A fibers) [5]. It has lower lipid solubility and is less likely than bupivacaine to penetrate large, myelinated motor fiber. [6]

The concept of a single shot with bupivacaine can do all is now questioned and necessitates the judicious use of safer substitutes. Therefore, this study was conducted to compare the efficacy and characteristics of isobaric forms of intrathecal levobupivacaine 0.5% with ropivacaine 0.75% in equipotent doses for lower abdominal and lower limb orthopaedic surgery.

**Materials and Method**

After obtaining institute ethical committee approval, written informed consent was taken from the patients and the procedure was thoroughly explained before the study. Two hundred eligible patients fulfilling the inclusion criteria with ASA I/II, age between 18 to 60 years age group undergoing elective lower abdominal and lower limb orthopaedic procedures were included in the study.

The exclusion criteria were patients of ASA grade III and above, emergency surgeries, patients having any absolute contraindications for spinal anaesthesia like raised intracranial pressure, severe hypovolemia, bleeding diathesis, local infection. Randomization was done using sealed envelope method into two groups, group L and group R of 100 patients each. Group-L received 3 ml isobaric 0.5% levobupivacaine. Group- R received 3 ml isobaric 0.75% Ropivacaine.

**Sample size calculation**

Sample size is calculated using Open Epi, Version 3* and considering 9% as test group exposure as per the study conducted by Soanl Two-sided significance level(1-alpha) as 95% and power as 80. Sample size: Based on the previous similar study done by Sonal [7] we presumed the occurrence of the difference in VAS 2 hours after surgery, among groups to be (2.44±0.82) (mean ± SD). It was found that total of 55 patients in each group would have been needed to achieve a power of 90% and type 1 error 0.05.

Patients were connected to minimum mandatory monitors and started on 18G venflon in non-dominant hand and coloaded with 15ml/kg of ringer lactate solution. and non-invasive blood pressure monitoring was done every 5 minutes interval. Under strict aseptic precaution, lumbar puncture was performed with patient in sitting position at L3-L4 inter space using 25G Quincke needle was inserted into the L3-L4 subarachnoid space and the drug isobaric ropivacaine or levobupivacaine according to the group the patient was allocated. Anesthetist who was not a part of the study performed the procedure. While another anesthetist recorded the findings. Both patient and the observer anesthetist were blinded to the study drugs used making the study double blind.

The primary objective was to find the onset of sensory blockade. Secondary objectives were total duration of sensory blockade, maximum level of sensory blockade attained, time for two segments sensory regression time, onset of motor blockade and total duration of motor blockade. Hemodynamic parameters like heart rate, systolic blood pressure (SBP) diastolic blood pressure (DBP), were recorded. Time for rescue analgesia and side effects shivering, bradycardia hypotension, nausea vomiting was noted

Onset of sensory blockade is the time taken from the completion of the injection of the study drug till the subject does not feel the pin prick at T10 level. Time taken for maximum sensory blockade is defined as the time from the completion of the injection of the study drug to the maximum sensory blockade attained. Onset of motor blockade is defined as the time taken from the completion of injection of the study drug till patient develops Bromage zero. Quality of motor blockade is assessed according to modified Bromage scale. Time taken for maximum motor blockade is defined as the time from the completion of the injection of the study drug to the maximum motor blockade attained.

Duration of motor blockade is the time taken from the time of injection till the subject attains complete motor recovery, Bromage-0. [8] Hypotension is reduction of systolic blood pressure (SBP) more than 30% below baseline or fall in SBP less than 90 mm of Hg, and it will be treated with increased rate of intravenous (IV) fluids and if needed injection Mephenteramine 3mg IV increments. Bradycardia is defined as heart rate less than 60 beats/minute, treated with injection Atropine 0.6mg IV.

**Statistical analysis methods:**

Data was entered in MS EXCEL and analyzed using SPSS version 20. Descriptive statistics such as mean and standard deviation for continuous variables, frequency and percentage for categorical variables were calculated. All data were analysed for normal distribution using the Shapiro-Wilk test. The Chi square test was done to find the association between categorical values and Student's paired't' test was used for continuous variables. Line diagram and bar chart were used to

represent the data. P value <0.05 was considered as significant.

**Results**

There was no statistically significant difference between the two groups with respect to age, ASA status and type of surgery and surgical duration (Table 1).

**Table 1: Anaesthetic and surgical characteristics between the groups**

| Variable | Group L (Mean ± SD) | Group R (Mean ± SD) | P value |
|---|---|---|---|
| Age(in years) | 41.93 ± 11.86 | 42.50±12.009 | >0.05 |
| ASA status 1 (n=200) | 67 | 61 | >0.05 |
| ASA status 2 | 33 | 39 | >0.05 |
| Type of surgery | | | |
| Orthopedics | 58 | 49 | >0.05 |
| Lower abdominal surgeries | 42 | 51 | >0.05 |
| Total duration of surgery | 72±28.55 | 75±32.31 | >0.05 |

The mean onset of sensory time was 5.980 ± 1.2059 in group L and mean in group R was 6.250 +/- 0. 9003.

There was no statistically significant difference between the two groups with respect to onset sensory block (p value=0.074). (Table 2) There was a statistically significant difference between the two groups with respect to time for two segment regression. The mean (SD) in group L was 113.58 ±13.367 whereas the mean in group R was 105.00 ±8.954/ Min (p value<0.001) Duration of sensory block, mean time until recovery to Bromage scale 0, the mean time for rescue analgesia was prolonged in group L.

There was no statistically significant difference between the two groups with respect to heart rate, systolic and diastolic blood pressure during the perioperative period.(Figure 1 and 2)

**Table 2: Block characteristics between two groups**

| S. No | Variable | Group L (Mean ± SD) | Group R (Mean ± SD) | p value |
|---|---|---|---|---|
| 1. | The mean onset of sensory time | 5.980 ± 1.2059 | 6.250 +/- 0.9003 | >0.076 |
| 2. | Two Segment regression time | 113.58 ±13.367 | 105.00 ±8.954/ | <0.001 |
| 3. | Duration of Sensory Block | 213.55+/-12.935 | 145.63+/-15.169 | <0.001 |
| 4. | The mean onset of motor block | 10.36±1.404 | 16.33±1.400 | <0.001 |
| 5. | Motor block recovery time | 182.96±13.082 | 110.00±8.505 | <0.001 |
| 6. | The mean time for rescue analgesia | 229.98±13.467 | 156.97±15.780 | <0.001 |

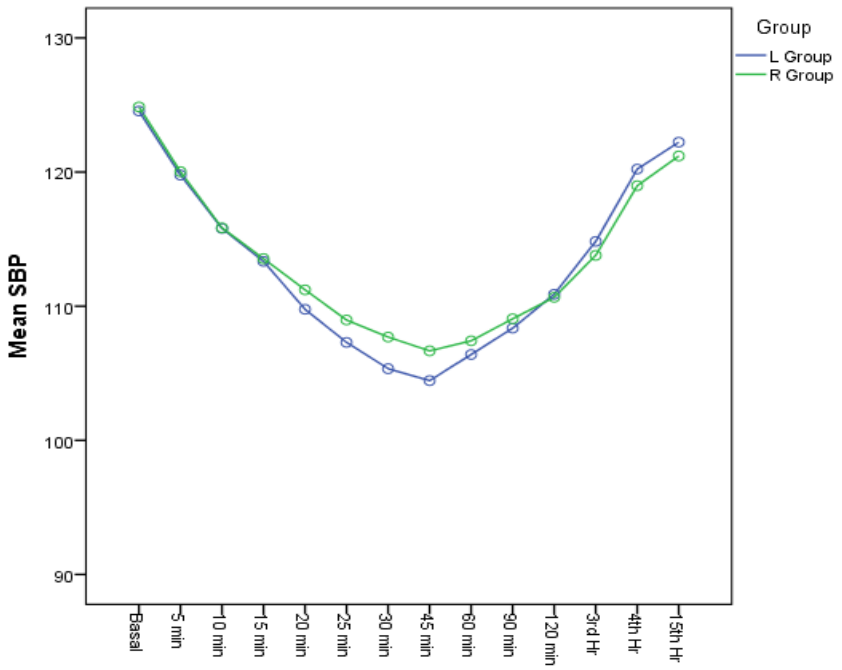


**Figure 1: Mean systolic blood pressure between groups**

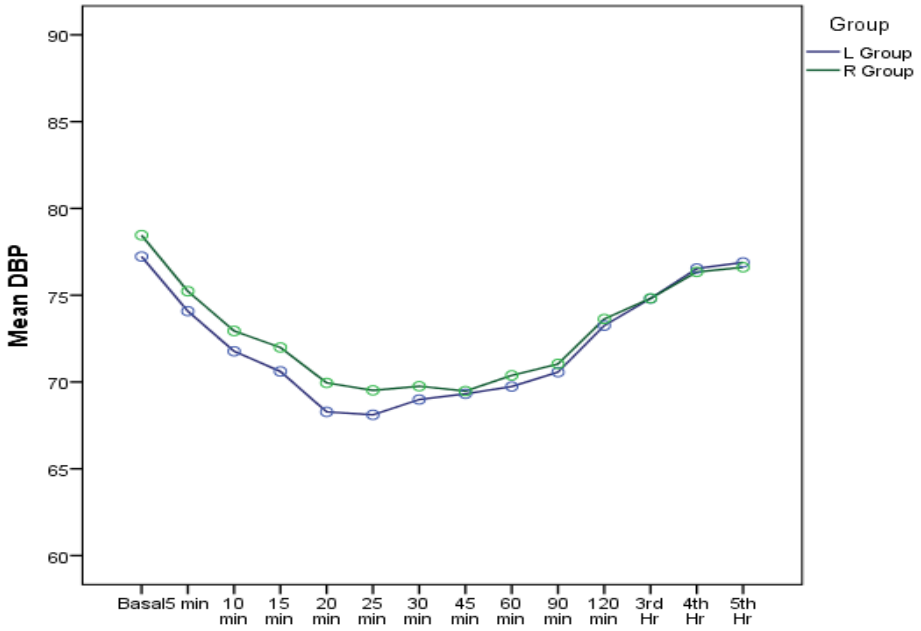


**Figure 2: Mean diastolic blood pressure between groups**

## Discussion

Bupivacaine has been the drug of choice for subarachnoid block. However, it causes long duration of action, delays recovery of motor function and causes higher neurological and cardio toxicity compared to other local anesthetics.

Levobupivacaine and ropivacaine are two new amide local anesthetic agents that have been produced to address the issue of bupivacaine toxicity.

From the results of our study, the mean onset of sensory time was 5.980 ±1.2059 minutes in group L and mean in group R was 6.250 +/- 0.900 (p value=0.074 ). There was no statistically significant difference between the two groups with respect to onset sensory time. Tungria et al evaluated of equipotent doses of isobaric Levobupivacaine and Ropivacaine with neuraxial adjuvant Fentanyl for lower abdominal and lower extremity surgery and proved that sensory onset time was quicker in levobupivacaine group.

In other previous study which compared onset of sensory block between levobupivacaine and ropivacaine the results were varying. In the study by Athar et al [9] isobaric levobupivacaine showed significantly slower onset of sensory and motor block but with prolonged duration of analgesia compared to ropivacaine. Similarly study by Vildan Taspinar et al, [10] S. Vani et al [11], Gautham singh[12] et al found sensory block onset time and time to reach the T6 dermatome were significantly faster in group L. There was a statistically significant difference between the two groups with respect to time for two segment regression in minutes. The mean (SD) in group L was 113.58 ±13.367 whereas the mean in group R was 105.00 ±8.954. (-<0.001). Similarly in study by Athar et al [9] found that time for regression of sensory block to L1 was longer in the group L than group R (251.50 ± 33.12 min versus 191.50 ± 22.86 min; p< 0.0001) . They concluded that time for sensory (L1) and motor regression of ropivacaine was comparatively faster than levobupivacaine.

Similarly study by Kalaria et al [13],the time to two segment regression of sensory block (60 ± 7.15 min) was longer in Group L statistically highly significant (p < 0.001).

Our study also supports the study done by Ritika Jindal et al [14] that levobupivacaine had longer duration of sensory block and time to 2-segment regression (T8- T10) when compared with ropivacaine group.

In the study by J. F. Luck et al [15] compared the block characteristic between bupivacaine, levobupivacaine and ropivacaine. The times of sensory block regression, to T10 [bupivacaine 129 (58–178), levobupivacaine 131 (50–205), and ropivacaine 84 (45–145)] and complete regression, were shorter in the ropivacaine group than the other two. There was no significant difference in the pattern of sensory regression between the bupivacaine and the levobupivacaine groups.

Duration of sensory block was 213.55+/-12.935 in group L and in group R 145.63+/-15.169.(p value<0.001).There was a statistically significant difference between the two groups with respect to

duration of sensory block. This is also in concurrence with the study by Athar et al, Kajal et al [4,9]that duration of sensory block was longer in all the studies ,which was in accordance with our study. This is in concurrence with study Jain et al [16] found the mean duration of sensory block in levobupivacaine group was 287.23±84.45 min, while it was 245.50±66.22 min in ropivacaine group.

The mean onset time of motor block in minutes min is 10.36±1.404 in group L and mean (SD) 16.33±1.400 in group R. (p value<0.001).

In concordance to our study Govindarao Dinesh et al [17] found that Onset of motor block were significantly faster in Group L (1.87 min) compared to Group R (3.10 min).

In the study by Athar et al [9] ropivacaine showed faster onset of motor blockade compared to levobupivacaine. However, the study did not measure the specific gravity of the drug, taking into consideration the fact that bupivacaine and ropivacaine are hypobaric at 37◦C, it can be assumed that the hypobaric nature of our drug, sitting position and comparatively faster rate of injection has resulted in quicker onset of motor blockade.

Mantouvalou M et al[18] compared the anesthetic efficacy and safety of three local anesthetic agents: racemic bupivacaine and its two isomers: ropivacaine and levobupivacaine, in patients undergoing lower abdominal surgery. They found that the onset of motor block was significantly faster in the bupivacaine group compared with that in the ropivacaine group and almost the same of that in the levobupivacaine group ($P < 0.05$).

In the present study the mean time until recovery according to bromage scale was found to be 182.96±13.082 in group L whereas the mean (SD) in group R was 110.00±8.505.( p value<0.001).There was a statistically significant difference between the two groups with respect to Time until recovery according to Bromage Scale.

Our study was in concurrence with study done by Vildan Taspinar et al [10] time to first analgesic requirement was significantly shorter in group R compared to group.

In the study by kajal et al The duration of motor block in Group L (170 ± 16.4 min) was longer than in Group R (140 ± 10.1 min).

Gautier et al [19] Compared of the effects of intrathecal ropivacaine, levobupivacaine, and bupivacaine for Caesarean section and concluded that bupivacaine provided a longer duration of analgesia and motor block ($P<0.05$) than levobupivacaine and ropivacaine.

In the study by J.F. luck [20]et al to compare the block characteristics bupivacaine, levobupivacaine and ropivacaine. The degree and duration of motor block were significantly less in the ropivacaine group compared with the other two groups. Thus, patients in the ropivacaine group mobilized significantly sooner than patients in the other two groups. There was no statistically significant difference between the bupivacaine and the levobupivacaine groups with respect to motor block characteristics or time to independent mobilization.

Various studies have confirmed that equal volumes and concentrations of bupivacaine and ropivacaine produce similar degree of sensory block, but the motor block produced by ropivacaine is slower in onset, less in intensity and short in duration than bupivacaine. As ropivacaine is less lipid soluble when compared to bupivacaine, the blockade of Aα and Aβ is slow and hence produce less motor blockade than bupivacaine.

In our present study the mean time for rescue analgesia (SD) was 229.98±13.467 in group L and the mean time for rescue analgesia (SD) was 156.97±15.780 in group R. Monica del-Rio-Vellosillo et al [21]did a study was to compare the sensory, motor, and neuro ophthalmological effects of isobaric levobupivacaine and bupivacaine when intrathecally administered. They concluded that the levobupivacaine group required use of analgesia earlier ($P = 0.025$). However Fattorini F et al [22] compared the clinical and anesthetic features of levobupivacaine and racemic Bupivacaine when intrathecally administered in 60 patients undergoing major orthopaedic procedures. There were no significant differences between the groups regarding request for rescue analgesic.

There was no statistically significant difference between the two groups with respect to Heart rate, systolic and diastolic blood pressures during the perioperative period.at any time points. (Figure 1 and 2)

Our study was in concurrence with study by Govindarao Dinesh et al [17] that both the groups had stable hemodynamics. Similarly in the study by Vildan Taspinar et al there were no significant differences in arterial blood pressure and heart rate between the 2 trials throughout the time course. Also study J.F Luck et al [15]found Cardiovascular changes were unremarkable, with no statistically significant differences between the groups in heart rate, systolic arterial pressure .

**Adverse effects**

Nine patients (0.09%) developed shivering in group L and 10 patients (0.1%) in group R developed shivering. Two patients in group L (0.02%) developed nausea and three patients (0.03%) in

group R had nausea. No incidence of hypotension or bradycardia was found in our study.

## Conclusion

The study highlights that levobupivacaine produces significantly longer duration of analgesia than ropivacaine. Hence, levobupivacaine should be suitable for prolonged surgeries.

Delay in onset of motor block, shorter duration of sensory and motor block was noted with ropivacaine leads to early patient mobilization making it ideal drug for day care surgeries.

Considering the sensory and motor characteristic of both the drugs we conclude that levobupivacaine having longer duration of action is ideal drug for longer duration surgeries whereas ropivacaine is a suitable drug for day care and ambulatory surgery where early mobilization of patient is possible.

### References


1. Bhavani V, Raajesh IJ. Comparison of intrathecal isobaric levobupivacaine, levobupivacaine-clonidine, with hyperbaric bupivacaine as a control for quality of anaesthesia intraoperative hemodynamics and duration of post-operative pain relief in patients undergoing vaginal hyster. Indian J Clin Anaesth. 2016;3(2):148.
2. Milligan KR. Recent advances in local anaesthetics for spinal anaesthesia. Eur J Anaesthesiol. 2004 Nov;21(11):837–47.
3. After L, Repair H. Pain Medicine. 2012; 1(3): 174–7.
4. Bajwa SJS, Kaur J. Clinical profile of levobupivacaine in regional anesthesia: A systematic review. J Anaesthesiol Clin Pharmacol [Internet]. 2013 Oct ;29(4):530–9.
5. Sanford M, Keating GM. Levobupivacaine: a review of its use in regional anaesthesia and pain management. Drugs . 2010;70(6):761–91.
6. Apfelbaum JL, Hawkins JL, Agarkar M, Bucklin BA, Connis RT, Gambling DR, et al. Practice Guidelines for Obstetric AnesthesiaAn Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. Anesthesiology . 2016 Feb 1;124(2):270–300.
7. SN B, None H, M U. Comparison of efficacy and safety of ropivacaine with bupivacaine for intrathecal anesthesia for lower abdominal and lower limb surgeries. Anesth essays Res 2013];7(3):381.
8. Soni P, Sharma L M, Tungria H , Singh Y, A comparative evaluation of equipotent doses of isobaric Levobupivacaine and Ropivacaine with neuraxial adjuvant Fentanyl for lower abdominal and lower extremity surgery. Indian J Clin Anaesth 2019;6(1):59-65
9. Athar M, Ahmed SM, Ali S, Doley K, Varshney A, Siddiqi MMH. Levobupivacaine or ropivacaine: A randomised double blind controlled trial using equipotent doses in spinal anaesthesia. Colomb J Anesthesiol. 2016 Apr 1;44(2):97–104.
10. Taspinar V, Sahin A, Donmez NF, Pala Y, Selcuk A, Ozcan M, et al. Low-dose ropivacaine or levobupivacaine walking spinal anesthesia in ambulatory inguinal herniorrhaphy. J Anesth . 2011 20];25(2):219–24.
11. Modn IJ, Revs R, Vani S, Dhakshanamoorthy M, Srinivasan SK. International journal of modern research and reviews original article comparative study of intrathecal isobaric levobupivacaine 0 . 5 % with isobaric ropivacaine 0. 5 % for infra umbilical surgeries Post Graduate , Department of Anaesthesia , Rajah Muthi. 2015;834–6.
12. Singh DG kumar, Kelkar DV, Kulkarni DSJ, Nayak DP, Udiavar DA, Warkari DT. Comparison of Isobaric Levobupivacaine 0.5% and Isobaric Ropivacaine 0.5% for Spinal Anaesthesia in Lower Limb Surgeries. 2017;
13. Kalaria RT, Upadhyay MR. Spinal anaesthesia for lower abdominal surgery: Levobupivacaine versus racemic bupivacaine. J Clin Diagnostic Res. 2018 Mar 1;12(3):UC09-UC13.
14. Jit S, Bajwa S, Kulshrestha A, Jindal R. Co-loading or pre-loading for prevention of hypotension after spinal anaesthesia ! 2018;6–11.
15. Luck JF, Fettes PDW, Wildsmith J a W. Spinal anaesthesia for elective surgery: A comparison of hyperbaric solutions of racemic bupivacaine, levobupivacaine, and ropivacaine. Br J Anaesth. 2008;101(5):705–10.
16. Jain S, Bendwal HP, Deodhar P, Bhambani P, Romday R, Jain P. Comparative study of ropivacaine (0.5%) plain versus levobupivacaine (0.5%) plain in gynecological surgeries. Int J Reprod Contraception, Obstet Gynecol. 2017;6(4):1573.
17. Dinesh G, Lakshmi P, Sunitha G. E. Study of spinal anaesthesia with isobaric levobupivacaine and ropivacaine in elective lower limb orthopaedic surgeries. Indian Journal of Clinical Anaesthesia. 2018;5(1).
18. Mantouvalou M, Ralli S, Arnaoutoglou H, Tziris G, Papadopoulos G. Spinal anesthesia : Comparison of plain ropivacaine, bupivacaine and levobupivacaine for lower abdominal surgery. Acta Anaesthesiol Belg. 2008;
19. Gautier PE. Intrathecal ropivacaine. Acta Anaesthesiol Belg. 2000 Jun;51(2):127–9.
20. Luck JF, Fettes PDW, Wildsmith JAW. Spinal anaesthesia for elective surgery: A comparison of hyperbaric solutions of racemic bupivacaine, levobupivacaine, and ropivacaine.

Br J Anaesth. 2008;101(5):705–10.
21. Del-Rio-Vellosillo M, Garcia-Medina JJ, Abengochea-Cotaina A, Pinazo-Duran MD, Barbera-Alacreu M. Spinal anesthesia for knee arthroscopy using isobaric bupivacaine and levobupivacaine: Anesthetic and neuro ophthalmological assessment. Biomed Res Int. 2014;2014.
22. Fattorini F, Ricci Z, Rocco A, Romano R, Pascarella MA, Pinto G. Levobupivacaine versus racemic bupivacaine for spinal anaesthesia in orthopaedic major surgery. Minerva Anestesiol . 2006;72(7–8):637–44.