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Comparison of Equipotent Doses of Hyperbaric Ropivacaine and Hyperbaric Levobupivacaine in Spinal Anaesthesia for Patients Undergoing Lower Abdominal and Lower Limb Surgeries

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Abstract

Background: Spinal anaesthesia provides sensory as well as motor blockade. Levobupivacaine is less cardio toxic than bupivacaine, as it has decreased potency at the sodium channel. Ropivacaine is similar in chemical structure to bupivacaine, but it is less potent than bupivacaine. Intrathecal Ropivacaine is safe, has shorter duration of action than bupivacaine and lesser incidence of neurological symptoms as compared with intrathecal lignocaine. Literature suggest that potency of Ropivacaine is less when compared with levobupivacaine since it has lower lipid solubility, and thereby using an equipotency ratio of 1.5:1 between Ropivacaine and Levobupivacaine provides nearly similar efficacy outcome. *Method*: The study was carried out as prospective, interventional, double blind in 60 patients divided in two equal groups using equipotent doses of intrathecal hyperbaric Ropivacaine and hyperbaric Levobupivacaine (with ASA grading I and II). *Results:* The distribution of patients with respect to age, height, weight was statistically not significant in both the groups. (p value > 0.05). Mean time to onset of motor block was 25.07±1.97 minutes in group-L and 24.37±1.70 minutes in group-R. Average duration of motor block was 116.73±29.95 minutes in group-L and 112.93±15.40 minutes in group-R. Mean time to onset of sensory block was 17.07±1.93 minutes in group-L and 15.5 ± 1.81 minutes in group-R. Mean time to attain highest level of sensory block was 22.07±1.93 minutes in group-L and 20.5±1.81 minutes in group-R. Mean time to two segment regression of sensory block was 69±8.5 minutes in group-L and 61.83±6.31 minutes in group-R. Average duration of sensory block was 188.73±29.94 minutes in group-L and 192.2±36.01 minutes in group-R. There were no changes in vital parameters and oxygen saturation in the intra-operative and post-operative period. Mean duration of post-operative analgesia was 137.70±28.01 minutes in Group L and 131.2±38.97 minutes in Group R. Analgesic consumption for 24 hours postoperatively was similar in both the groups. It was observed that both the molecules showed similar time of onset of motor and sensory block and also nearly similar duration of motor and sensory blocks. Both the drugs were also found to be safe in terms of impact on hemodynamic parameters and no complications observed. *Conclusion:* Both drugs are reliable in terms of efficacy and safety and can be used interchangeably. Ropivacaine can be specifically used for population that is at higher risk of cardiac toxicity, without compromising on time of onset or duration of motor and sensory blocks.

Keywords: Spinal Anesthesia; pain; Ropivacaine; Levobupivacaine; bupivacaine.

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Introduction

Spinal anaesthesia was introduced in clinical practice by Karl August Bier, in 1898 [1]. it is obtained by administering local anaesthetic agents in the subarachnoid space and thereby blocking nerves. Subarachnoid block is usually performed for lower abdominal and lower limb surgeries.

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It provides sensory as well as motor blockade. Levobupivacaine, an amide local anesthetic, is an S-enantiomers of racemic bupivacaine. On a per-milligram basis, it is less cardio toxic than bupivacaine, as it has decreased potency at the sodium channel. Studies have suggested that it has equivalent clinical efficacy to bupivacaine [6]. Ropivacaine is another amino-amide local anesthetic (LA) agent that is similar in chemical structure to bupivacaine, but it is 30-40% less potent than bupivacaine. Intrathecal Ropivacaine is safe, has shorter duration of action than bupivacaine and lesser incidence of transient neurological symptoms (TNS) as compared with intrathecal lignocaine.

In this study, we evaluated and compared the influence of hyperbaric Levobupivacaine and hyperbaric Ropivacaine on onset, duration of motor and sensory blockade, the incidence of side effects and complications particularly bradycardia, hypotension, fall of mean arterial pressure etc for spinal anaesthesia in patients undergoing lower abdominal and lower limb Surgeries.

Materials and Methods

This prospective, interventional, double blind study included sixty patients who were scheduled for lower abdomen and lower limb surgery under spinal anesthesia whose consents were taken. A detailed pre-anaesthetic check-up was done a day prior to surgery. In pre-induction phase details like temperature, pulse, blood pressure, respiratory rate, oxygen saturation (SpO_2), intravenous line, details of pre medication and pre-loading were captured.

Inclusion criteria: Patients of either gender aged between 20-60 years, Scheduled for surgery to be performed under spinal anaesthesia, Patient with American Society of anaesthesiologists grade-I and II (ASA I & II), Weight: 40-80 kg, No known history of drug allergy, sensitivity or history of other form of reaction.

Exclusion criteria: Patient with ASA III or IV, Patients with history of coagulopathy. Patients with spine deformity. Patients with local skin infections at the site of injection. Patient having fever, history of drug allergy. Patients who had shivering even before administering spinal anaesthesia Patients requiring supplementation with general anaesthesia Patients who were not willing to participate in the study.

Investigational medicinal product details

Study drug 1: Hyperbaric Ropivacaine

Study drug 2: Hyperbaric Levobupivacaine

Preparation of equipotent doses of hyperbaric Levobupivacaine and Ropivacaine: Various studies suggest that Ropivacaine is less potent than Levobupivacaine because of its lower lipid solubility, however using an equipotency ratio 1.5:1 between Ropivacaine and Levobupivacaine results in substantially similar in clinical profile. On the day of the surgery, patients were randomly assigned by computer generated randomisation table to either of the two arms mentioned below:

Group – R–Hyperbaric Ropivacaine [0.75% Ropivacaine (3 ml) + 25% dextrose(1 ml) (Total 4 ml)]

Group–L –Hyperbaric Levobupivacaine [0.5% Levobupivacaine (3 ml) + 25% dextrose (1 ml) (Total 4 ml)]

Dosage: 3.5 ml of the prepared solution was injected in each of the groups.

Procedure for study drug administration

All the patients were kept nil by mouth for more than 6 hours, i.e. were fasted preoperatively since 10 pm, night before surgery. All the patients were pre medicated with Inj. Ondansetron 4 mg and Inj. Ranitidine 50 mg and inj. Glycopyrrolate 0.2 mg intravenously. On the day of surgery the patients were brought to the operation theatre (OT), standard monitors (that measure pulse, blood pressure, Respiratory rate, Oxygen saturation) were attached and baseline parameters recorded. Patients were pre-loaded with ringer lactate 10 ml/kg and spinal anaesthesia performed. Efficacy / safety assessment was performed by investigator, who was blinded to study treatment allocation.

Efficacy (Onset of the Sensory and Motor Block) / Safety Assessment

Sensory block assessment - It was tested by pin prick using hypodermic needle.

Following parameters were recorded: Time of onset (time of intrathecal injection of drug to achieve T10 segment level block) Highest level of sensory blockade, Time for two segment regression of sensory level, Duration of sensory block (time period from onset of block to the time of two segment regression from T10).

Motor block assessment- It was tested using Bromage scale.

Following parameters were recorded: Time of onset (when Bromage scale 3 ie. patient is unable to move the hip, knee and ankle joint is achieved), Degree of motor blockade

Duration of motor blockade were recorded (time

period from onset to Bromage scale 0 ie. patient is able to move the hip, knee and ankle joint).

Intra-Operative Patient Monitoring: All patients of both groups were monitored for: Systolic and Diastolic blood pressure & Pulse rate (Haemodynamic parameters) Arterial oxygen saturation (SpO2) and Respiratory rate Side effects and complications (if any). Decrease in systolic arterial pressure (SAP) by more than 20% from the pre-anaesthetic value or decrease of patients' mean arterial pressure (MAP)to below 60 mmHg were considered to be suggestive of significant hypotension and were managed using injection Mephentermine 6 mg in increments intravenously along intravenous fluid replacement. Significant bradycardia (HR <60 beats/min) was treated with inj. atropine sulphate 0.6 mg intravenously.

Results

The data were analyzed using SPSS software version 18.0. Statistical analysis of data among groups was done, performed by

- Nominal data (such as Age groups) were presented as number and Percents.
- Continuous data (such as age, lab values) were expressed as mean, standard deviation and range.
- *'f' test and 't' test* was applied as appropriate for comparison of continuous data.
- *'Chi' test* was applied as appropriate for comparison of nominal data.
- '*p*' value of 0.05 was considered as statistically significant. (Confidence interval of 95% was taken into account).

In the present study, a total of 60 patients with ASA grading II and III undergoing lower abdominal surgery were enrolled. Equal number of patients were randomized in group- L (those who received levobupivacaine as spinal anesthesia) (n=30) and group – R(those who received ropivacaine as spinal anesthesia) (n=30).

Table 1: Comparison of time of onset of motor block in both the groups

Study groups		Time of onset of motor block (minutes)	P-value	Remarks
Group-L	Mean	25.07	>0.05	NS
	SD	1.97		
Group-R	Mean	24.37		
	SD	1.70		

Time of onset of motor block was compared in both the groups. It was seen that mean time to onset of motor block was 25.07±1.97minutes in group-L and 24.37±1.70 minutes in group-R. The difference was not clinically significant (Table 1).

Table 2: Comparison of average duration of motor blockade in both the groups

Study groups		Duration of motor blockade (Minutes)	P-value	Remarks
Group-L	Mean	116.73	>0.05	NS
	SD	29.95		
Group-R	Mean	112.93		
	SD	15.40		

Average duration of motor block was compared in both the groups. It was seen that average duration of motor block was 116.73±29.95 minutes in group-L and 112.93±15.40 minutes in group-R. The difference was not clinically significant (Table 2).

Table 3: Time of onset of Sensory block (Minutes)

Study Groups		Time of onset of Sensory block (Minutes)		
Group-L	Mean	17.07	>0.05	NS
	SD	1.93		
Group-R	Mean	15.5		
	SD	1.81		

Time of onset of sensory block was compared in both the groups. It was seen that mean time to onset of sensory block was 17.07±1.93 minutes in group-L and 15.5±1.81 minutes in group-R. The difference was not clinically significant (Table 3).

Table 4: Time to highest level of Sensory block (Minutes) in both the groups

Study Group		Time to highest level of sensory blockade minutes	P value	Remarks
Group-L	Mean	22.07	<0.05	S
	SD	1.93		
Group-R	Mean	20.5		
	SD	1.81		

Time to highest level of sensory block was compared in both the groups. It was seen that mean time to attain highest level of sensory block was 22.07±1.93 minutes in group-L and 20.5±1.81 minutes in group-R. The difference was clinically significant (Table 4).

Table 5: Time to two segment regression of sensory level (Minutes) in both the groups

Study group		Time to two segment regression of sensory level (minutes)	P-value	Remarks
Group-L	Mean	69	<0.05	S
	SD	8.5		
Group-R	Mean	61.83		
	SD	6.31		

Time to two segment regression of sensory block was compared in both the groups. It was seen that mean time to two segment regression of sensory block was 69±8.5 minutes in group-L and 61.83±6.31 minutes in group-R. The difference was clinically significant (Table 5).

Table 6: Duration of sensory block (Minutes) in both the groups

Study group		Duration of sensory block (minutes)	P-value	Remarks
Group-L	Mean	188.73	>0.05	NS
	SD	29.94		
Group-R	Mean	192.2		
	SD	36.01		

Average duration of sensory block was compared in both the groups. It was seen that average duration of sensory block was 188.73±29.94 minutes in group-L and 192.2± 36.01 minutes in group-R. The difference was not clinically significant (Table 6).

Discussion

Literature, suggest that ropivacaine on a molar to molar basis is considered to be less potent than levobupivacaine due to lower lipid solubility, and thereby using an equipotency ratio of 1.5:1 between ropivacaine and levobupivacaine provides nearly similar efficacy outcome [9]. etron. This study was conducted to compare the efficacy and safety profile of equipotent doses of levobupicaine and ropivacaine in patients undergoing lower limb and lower abdominal surgeries. Current study was conducted in 60 patients aged between 20 and 60 years having ASA grade I or II and scheduled for elective lower abdominal surgeries under spinal anaesthesia. Group L (Levobupivacaine group) – received hyperbaric levobupivacaine [0.5% Levobupivacaine (3 ml) + 25% dextrose (1ml) (Total 4 ml)].

Group R (Ropivacaine group) – received hyperbaric ropivacaine [0.75% Ropivacaine (3 ml) + 25% dextrose (1 ml) (Total 4 ml)] the following parameters were observed:

1. Time of onset (time of intrathecal injection of drug to achieve T10 segment level block)
2. Time to highest level of sensory blockade,
3. Time for two segment regression of sensory level
4. Duration of sensory block (time period from onset of block to the time of two segment regression from T10)
5. Time of onset (when Bromage scale 3 ie. patient is unable to move the hip, knee and ankle joint is achieved)
6. Duration of motor blockade were recorded (time period from onset to Bromage scale 0 ie. patient is able to move the hip, knee and ankle joint)

In our study the mean time of onset of motor block was 25.07±1.97 minutes in group-L and 24.37 ±1.70 minutes in group-R and the difference was not clinically significant. This was similar to the findings by Suri A et al., where in the mean onset of time of motor block was 24.09±3.07 vs 25.47±4.13 minutes in group L and group R and the difference was not clinically significant (p = 0.076) [26]. However, the mean time of onset of motor block in study by Mantouvalou M et al. was 12±5 min in the ropivacaine group (group B) and 11±7 min in the levobupivacaine group, the early onset in this study as compared to our study may be due to the fact that, Mantouvalou M et al. used isobaric preparation in their study which may have resulted in rapid intrathecal spread [24]. Additionally, the mean age of the patients in the study by Mantouvalou M et al. was higher compared to our study and as per literature at the extremes of age there are small but significant increases in maximum spread, rate of onset of motor block and cardiovascular instability, regardless of the solution used [3]. Luck JF in their study observed that mean time to maximum motor block was 5 (2–20) and 10 (5–20) (min) in levobupivacaine and ropivacaine group respectively [22]. The early onset seen in Luck JF study may have been due to the fact that the mean age of the patients enrolled in the study was 57 (26–73) and 59 (37–75) in group L and R respectively which was higher compared to our study.

The average duration of motor block in the current study was 116.73±29.95 minutes in group-L and 112.93±15.40 minutes in group-R. Similar findings were seen in the published literature, although Mantoualou M et al. have observed significantly higher duration of motor block, authors have offered no explanation for the same (Table 7).

In the current study time of onset of sensory block was 17.07±1.93 minutes in group-L and 15.5

±1.81 minutes in group-R. The results were similar to published literature (Table 8).

Time to highest level of sensory block was 22.07 ±1.93 minutes in group-L and 20.5±1.81 minutes in group-R. The results were similar to published literature (Table 9).

Time to two segment regression of sensory block was 69±8.5 minutes in group-L and 61.83±6.31 minutes in group-R. The results were similar to published literature (Table 10).

Average duration of sensory block was 188.73 ± 29.94 minutes in group-L and 192.2±36.01 minutes in group-R. The results were similar to published literature (Table 11).

In the current study he mean duration of post-operative analgesia was 137.70±28.01 minutes in Group L and 131.2±38.97 minutes in Group R. The results were similar to published literature (Table 12).

Conclusion

From the present prospective, interventional, double blind study of intrathecal equipotent doses of Ropivacaine and Levobupivacaine, it can be concluded that Ropivacaine is reliable and safe alternative to Levobupivacaine and can be used interchangeably. Hyperbaric Ropivacaine can be specifically used for population that is at higher risk

Table 7: Comparison of average duration of motor block of current study with literature

	Average duration of motor block (Minutes)				
Literature	**Current study**	**Suri A et al. [26]**	**Gautier P et al. [17]**	**Luck JF et al. [22]**	**Mantouvalou M et al. [24]**
Group-L	116.73±29.95	118.53±18.14	121±25	180 (90–210)	273±80
Group-R	112.93±15.40	111.42±16.70	116±19	90 (60–120)	269±20

Table 8: Comparison of time of onset of sensory block of current study with literature

	Mean time of onset of sensory block (Minutes)			
Literature	**Current study**	**Suri A et al. [26]**	**Luck JF et al. [22]**	**Khan A et al. [19]**
Group-L	17.07±1.93	18.62±3.09	5 (2–15)	9.66±1.99
Group-R	15.5±1.81	17.93±2.98	5 (2–15)	9.48±1.92

Table 9: Comparison of time to highest level of sensory block of current study with literature

	Mean time to highest level of sensory block (Minutes)			
Literature	**Current study**	**Gautier P et al. [17]**	**Luck JF et al. [22]**	**Mantouvalou M et al. [24]**
Group-L	22.07±1.93	17±9	25 (10–30)	11±6
Group-R	20.5±1.81	15±9	20 (2–30)	12±7

Table 10: Comparison to two segment regression of sensory block of current study with literature

	Time to two segment regression of sensory block (Minutes)			
Literature	**Current study**	**Mantouvalou M et al. [24]**	**Gautier P et al. [17]**	**Luck JF et al. [22]**
Group-L	69±8.5	65±11	69±14	131 (50–205)
Group-R	61.83±6.31	60±9	60±21	84 (45–145)

Table 11: Comparison average duration of sensory block of current study with literature

	Average duration of sensory block (Minutes)				
Literature	**Current study**	**Suri A et al. [26]**	**Gautier P et al. [17]**	**Khan A et al. [19]**	**Luck JF et al. [22]**
Group-L	188.73±29.94	189.0±19.53	124±24	175.38±13.60	255 (180–360)
Group-R	192.2±36.01	196.78±20.31	120±27	170.80±19.81	210 (180–330)

Table 12: Comparison mean duration of post-operative analgesia of current study with literature

	Mean duration of post-operative analgesia (Minutes)			
Literature	**Current study**	**Suri A et al. [26]**	**Gautier P et al. [17]**	**Khan A et al. [19]**
Group-L	188.73±29.94	253.78±24.43	140 (110-270)	190.27±18.61
Group-R	192.2 ± 36.01	263.0 ± 22.77	135 (95-175)	187.67±23.92

of cardiac toxicity, without compromising on time of onset or duration of motor and sensory blocks

References

1. Bier A. Versucheuber Kokainiserung des Ruchenmarkes (Experiments on cocaine rash). Dtsche Z Chir. 1899;51:361–9.
2. Bier A. On the current state of spinal anesthesia, its legitimacy, its advantages and disadvantages compared to other methods of anesthesia. Langenbeck's Archiv fur Klinische Chirurgie. 1905; 77:198-208.
3. G. Hocking, J.A.W. Wildsmith. Intrathecal drug spread. British Journal of Anaesthesia. 2004;93(4):568–78.
4. Barker AE. Clinical experiences with spinal analgesia in 100 cases. Br Med J 1907;1:665.
5. Pitkin GP. Spinocain: the controllable spinal anaesthetic. Br Med J. 1929;2:189.
6. McLeod GA, Burke D. Levobupivacaine. Anaesthesia. 2001 Apr;56(4):331-41
7. Kulkarni KR et al. A comparative evaluation of hyperbaric ropivacaine versus hyperbaric bupivacaine for elective surgery under spinal anesthesia. Journal of Anaesthesiology Clinical Pharmacology. 2014 April-June:30(2);238-42.
8. Clinical trial NCT03142880. Spinal Marginally Hyperbaric Ropivacaine for Cesarean Delivery. https://clinicaltrials.gov/ct2/show/NCT03142880
9. Stefania Leone, Stefania Leone, Simone Di Cianni, Andrea Casati, Guido Fanelli Pharmacology, toxicology and clinical use of new long acting local anesthetics, ropivacaine and levobupivacaine. Acta Biomed 2008;79:92-105.
10. Looseley A. Corning and cocaine: the advent of spinal anaesthesia. Grand Rounds. 9;L1–L4.
11. Calatayud J, González Á. History of the Development and Evolution of Local Anesthesia Since the Coca Leaf. Anesthesiology. 2003;98:1503–8.
12. Ruetsch YA, Böni T, Borgeat A. From cocaine to ropivacaine: the history of local anesthetic drugs. Curr Top Med Chem. 2001 Aug;1(3):175-82.
13. Casati A, Putzu M. Bupivacaine, levobupivacaine and ropivacaine: are they clinically different? Best Pract Res Clin Anaesthesiol. 2005 Jun;19(2):247-68.
14. Ang Li et al. Ropivacaine versus levobupivacaine in peripheral nerve block. Medicine. 2017;96:14.
15. Khairnar P et al. Comparative efficacy of ropivacaine and levobupivacaine in combined femoral and lateral femoral cutaneous nerve block with adjuvant magnesium for post-operative analgesia. Indian Journal of Anaesthesia. 2016 Aug;60(8):64-9.
16. Charles PD et al. 0.5% levobupivacaine versus 0.5% ropivacaine: Are they different in ultrasound-guided sciatic block?. Saudi Journal of Anesthesia. 2015 January-March;9(1):3-8.
17. P. Gautier, M. De Kock, L. Huberty, T. Demir, M. Izydorczic, B. Vanderick. Comparison of the effects of intrathecal ropivacaine, levobupivacaine, and bupivacaine for Caesarean section. British Journal of Anaesthesia. 2003;91(5):684-9.
18. Hanna M, Sloan P. A Comparison of Levobupivacaine and Ropivacaine for Interscalene and Femoral Nerve Blocks: A Randomized, Double-Blind, Prospective Clinical Trial. J Anesthe Clinic Res. 2011;2:135.
19. Khan A, Nanda H S, Chandra R. Levobupivacaine versus Ropivacaine: A Comparative Study of the Analgesic and Hemodynamic Spectrum. Int J Sci Stud. 2016;4(1):190-195.
20. Khaw KS, NganKee WD, Wong M, Ng F, Lee A. Spinal ropivacaine for cesarean delivery: a comparison of hyperbaric and plain solutions. AnesthAnalg. 2002 Mar;94(3):680-5.
21. P. Gautier, M. De Kock, L. Huberty et al. Comparison of the effects of intrathecal ropivacaine, levobupivacaine, and bupivacaine for Caesarean section. British Journal of Anaesthesia. 2003;91(5):684-9.
22. Luck JF, Fettes PDW, Wildsmith JAW. Spinal anaesthesia for elective surgery: a comparison of hyperbaric solutions of racemic bupivacaine, levobupivacaine, and ropivacaine. British journal of Anaesthesia. 2008;101(5):705-10.
23. Gupta R et al. Comparative study of intrathecal hyperbaric versus isobaric ropivacaine: A randomized control trial. Saudi J Anaesth. 2013 Jul-Sep;7(3):249–53.
24. Mantouvalou M, Ralli S, Arnaoutoglou H, Tziris G, Papadopoulos G. Spinal anesthesia: Comparison of plain ropivacaine, bupivacaine and levobupivacaine for lower abdominal surgery. ActaAnaesth. Belg. 2008;59:65-71.
25. Bigat Z, Boztug N, Karsli B, Cete N, Ertok E. Comparison of hyperbaric ropivacaine and hyperbaric bupivacaine in unilateral spinal anaesthesia. Clin Drug Investig. 2006;26(1):35-41.
26. A Suri, G Sindwani, R Mane. Comparison of onset and duration of sensory and motor blockade between equipotent doses of 0.75% plain ropivacaine and 0.5% plain levobupivacaine in lower abdominal surgeries under epidural anaesthesia - A one year hospital based randomized clinical study.
27. Greene NM. Distribution of local anesthetic solutions within the subarachnoid space. AnesthAnalg. 1985; 64:715–30.