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A Comparative Study of Hyperbaric Ropivacaine (0.5% in Glucose 5%) with Hyperbaric Bupivacaine (0.5% in Glucose 8%) for Spinal Anaesthesia for Lower Abdominal Surgery

Atul Kumar[1], Ashutosh Singh[2]

[1]Associate Consultant, Max Super Speciality Hospital Dehradun, Uttarakhand 248001, India. [2]Assistant Professor, Department of Anaesthesiology, Shri Guru Ram Rai Institute of Medical & Health Sciences, Dehradun, Uttarakhand 248001, India.

Abstract

Background: Spinal anaesthesia is well established technique in which several local anaesthetic drugs are used. These drugs have their own advantages and disadvantages regarding safety profile, onset and duration of action. The continuous search is going on to find safer drugs with having lesser side effects. *Material and Method:* This study was planned with an aim to compare Ropivacaine 0.5% in 5% glucose solution with the commercially available Bupivacaine 0.5% in glucose 8% (heavy) given in spinal anaesthesia regarding stability; onset and duration of sensory block; onset and duration of motor block and associated side effects like nausea/vomiting and pruritus. This was a prospective randomized double blind clinical control trial in which total 80 patients of either sex were enrolled and divided into two groups (Group A-Ropivacaine and Group B- Bupivacaine) using envelope method. *Data Analysis:* Data of both the groups were recorded and compared statistically. To compare the means, independent t-test was applied and to compare categorical data chi-square test was used. *Result:* As a result of the study it was found that hemodynamic parameters were comparable in both the groups; Onset of sensory as well as motor block were faster in the Bupivacaine group; total duration of motor block and sensory block was shorter in Ropivacaine group; time taken for mobilization was significantly lesser in Ropivacaine group; side effects like nausea/vomiting were also less in Ropivacaine group. *Conclusion:* It can be concluded that Ropivacaine 0.5% in 5% glucose is a good alternate to Bupivacaine heavy in short duration lower abdominal surgeries with shorter sensory and motor block duration and lesser incidence of adverse effects.

Keyword: Hyperbaric Ropivacaine; Spinal Anesthesia; Bupivacaine; Lower abdominal surgery.

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Introduction

Spinal Anaesthesia/Subarachnoid block is a commonly used technique in various types of surgeries. This technique was first performed by August Von Bier in 1898 [1]. Gradually ithas become one amongst the commonest procedures performed in the field of anesthesiology. It has successfully been used in lower abdominal and lower limb surgeries. Various aspects of Sub arachnoid block

Corresponding Author: Ashutosh Singh, Assistant Professor, Department of Anaesthesiology, Shri Guru Ram Rai Institute of Medical & Health Sciences, Dehradun, Uttarakhand 248001, India.

E-mail: drashutoshsingh17@gmail.com

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have been studied and experimented, especially in the aspect of basic physiology, clinical application and drug pharmacology. Spinal anesthesia causes profound nerve block in the lower part of body unless the drug blocks the cephalad segments by spreading through cerebrospinal fluid (CSF). This is associated with exaggerated fall in blood pressure and prolonged effect of spinal anaesthesia.

Since more than thirty years the most commonly used drug for spinal anesthesia in clinical practice is Bupivacaine but it is has many systemic adverse effects like- cardiovascular toxicity, central nervous system toxicity and muscular weakness. So there was a large scope and need ofcontinuous search for newer and safer local anesthetic agents in recent years [2]. That search has led to the introduction of newer drugs like levobupivacaine (s enantiomer of Bupivacaine) and Ropivacaine. Both of them have lower systemic toxicity.

Ropivacaine, s-enantiomer of a newer amidehas been evaluated in adults and older children in many studies [3]. In previous studies it has been found that Ropivacaine causes reduced cardiovascular and neurological toxicity [4,5]. Ropivacaine is less lipophilic and that's why unable to penetrate thick myelinated neurons, which supply muscles. This is the reason that it has differential effect on motor neurons. It selectively inhibits Aδ and C fibers (which transmit pain) than motor Aβ fibers [6]. It is extensively metabolized in liver by cytochrome P450 and very less amount of it getsexcreted out unchanged [7]. Recently, it has been used in adults for spinal anesthesiaand various studies have been reported regarding its clinical efficacy and safety. Ropivacaine has now been established in clinical use as sensory block for many purposes like-local infiltration, peripheral nerve block, and lumber epidural block and is a long acting local anesthetic which gives surgical anesthesia of good quality [8]. Ropivacaine is well known local anaesthetic drug which is tolerated very well regardless of the route through which it is administered. In previous studies Ropivacaineand Bupivacaine both were used by intrathecal route. It was found that duration of action of Ropivacainewas found to be short and thus making it a possible alternative for short day care surgeries. It has shown to be little less potent than Bupivacaine [9].

Europian union in February 2004 approved Ropivacaine for its use in spinal anesthesia. The issue regarding baricity of drug remained less addressed. Some studies have shown that adding glucose into the drug make it hyperbaric and a more predictable spread helps to decrease the side effects like episodes of hypertension, bradycardia and respiratory difficulties [10]. In the current study hyperbaric solution of Ropivacaine was compared with hyperbaric Bupivacaine for its clinical efficacy and side effects while giving subarachnoid block in lower abdominal surgeries.

Materials and Methods

After institutional ethical committee clearance, 80 patients posted for lower abdominal surgeries were registered in the study. All the registered patients were between age group of 20 to 60 years, belonging to ASA grade I, II and either sex. Patients of ASA grade III and above, having coagulopathy, shock, sepsis, anatomic deformities of spine, local skin infections on site of injection, with increased intra cranial pressure, patients on potent antiplatelet drugs and known allergy to the drugs used in the study; were excluded.

All the enrolled patients undergone thorough pre anesthetic checkup. All the routine investigations were done as per need and informed written consent was taken.

The patients were randomly distributed into two groups of 40 patients each with the help of envelope method. The spinal anaesthesia during the surgery was given by one anesthetist and data was recorded by another anesthetist (blind to the grouping and treatment of patients).

Group 1 (Ropivacaine group): Received 3 ml of 0.5% hyperbaric Ropivacaine in glucose 5% intrathecally.

Here 0.5% Ropivacaine in 5% glucose was prepared by mixing 2 ml 0.75% Ropivacaine in 1 ml of 15% glucose solution.

Group 2 (Bupivacaine group): Received 3 ml of 0.5% hyperbaric Bupivacaine (available commercially) Intrathecally.

Procedure- After taking into operation theatre, all the patients were given spinal anesthesia with 25 G needle after attaching monitors. Every patient was given 10 ml/kg ringer lactate for fluid preloading. Recording of vitals such as Systolic Blood Pressure (SBP), Diastolic blood pressure (DBP), Pulse Rate (PR), Respiratory Rate (RR) and SPO_2 was done at 3 minutes interval in the initial 15 minutes followed by 5 minutes interval upto next 15 minutes and thereafter at 10 minutes interval till end of surgical procedure. Time 0 was considered when intratheal drug was injected.

Sensory block characteristics werecompared for time of onset of sensory effect at T10 level (when

pin prick sensation was lost), time required to attain maximum cephalad spread and time required for sensory regression to L1.

Motor block characteristics were compared using modified Bromage scale regarding time taken to attain grade 3 motor block and total duration of grade 1 motor block.

As per Bromage scale grade 0 was given for no paralysis, grade 1 for Inability to lift outstretched leg, grade 2 for Inability to flex the knees and grade 3 for complete paralysis of lower limbs. If any incidence of hypotension (fall in BP > 20%) noted, Ephedrine 6 mg intravenous was given. Atropine 0.3 mg intravenous was given when heart rate decreased upto less than 50 per minute.

In the postoperative period, time of patient's mobilization and micturition were recorded. The time for analgesia and first requirement of analgesic drug was also noted. 50 mg tramadol was given when visual analogue scale was found > 3. The incidence of following adverse effects- Nausea/ vomiting and pruritus was noted upto 24 hours in this study.

Statistical Analysis- The data collected was entered in Microsoft excel version 2016 after examining the errors and codes. Statistical parameters like mean and standard deviation were used to express quantitative data whereas qualitative data was shown in terms of percentages and proportions. To compare the means, independent t-test was applied and to compare categorical data chi-square test was used. The p-value < 0.05 was considered as significant statistically. Graphs were formed using Excel software while Kaplan-Meier survival analysis curve was drawn using SPSS software version 23. Survival curve was drawn using Log rank test to compare two groups.

Observation and results

No significant difference was found regarding demographic profile and duration of surgery in between the groups (Table 1).

While observing the sensory block characteristics, mean sensory onset time at T 10 and time taken for achieving highest sensory level both were lesser in group 2 than in group 1 (p value=0.00). Regression time of sensory block at the level of L1 was found longer in group 2 in comparison to group 1 and difference was found significant (p value=0.00).

On comparing motor block characteristics, the onset of motor block (Bromage grade 3) was earlier in group 2 than that in group 1 (p value=0.00). The total motor block duration (Bromage grade 1) was found longer in group 2 than in group 1 (p value =0.00).

Mean time taken for mobilization as well as micturition of the patients were significantly lesser in group 1 than in group 2 (p value=0.00) (Table 1, Fig. 1).

Table 1: Comparison of demographic parameters in group 1 and group 2

Parameter	Mean (S.D.) of Group 1	Mean (S.D.) of Group 2	p-value
Age	38.43 (15.03)	36.80 (14.73)	0.63
Weight	62.42 (7.82)	62.23 (6.54)	0.90
Height	155.58 (6.00)	153.70 (5.63)	0.15
Duration of surgery	42.00 (13.21)	50.13 (14.43)	0.01

Table 2: Comparision of perioperative and post-operative measures in Group 1 and 2

Parameter Time (minutes)	Mean (S.D.) Group 1	Mean (S.D.) Group 2	p-value
Time to start of sensory block at T10	5.30	2.48	0.00
Time to highest sensory level	20.07 (1.84)	15.00 (1.19)	0.00
Regression to L1	67.87 (7.67)	110.37 (6.92)	0.00
Onset of motor block (Grade 3)	14.97 (1.54)	10.20 (1.24)	0.00
Duration of motor block (Grade 1)	92.75 (12.45)	230.00 (9.54)	0.00
Time to achieve complete analgesia	88.87 (6.84)	136.75 (11.79)	0.00
Time for rescue analgesia	108.12 (7.22)	155.00 (12.56)	0.00
Time taken to mobilize	231.37 (15.93)	327.87 (14.50)	0.00
Time taken for micturarition	250.12 (15.42)	341.50 (15.15)	0.00

A Kaplan Mierer plot was drawn to show the time of first rescue analgesia. It was 108.12 and 155.00 in group 1 and 2 respectively. The difference was statistically significant (p=0.00). (Figure 5).

The hemodynamic parameters (Pulse rate, Systolic Pressure, Diastolic Pressure) were comparable in both the study groups with p value >0.05. (Tables 3,4,5), (Figs. 2,3,4).

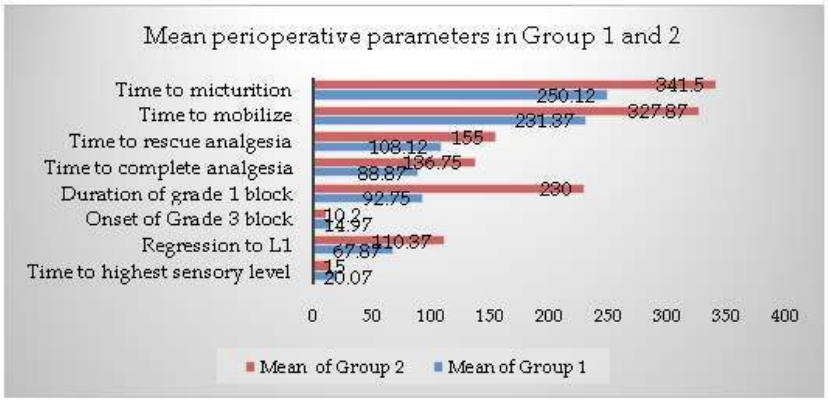

Fig. 1: Comparison of Perioperative measures in group 1 and 2

Table 3: Comparision of mean pulse rate at different time intervals during intraoperative period

Time (minutes)	Mean (S.D.) Pulse rate Group 1	Mean (S.D.) Pulse rate Group 2	p-value
0	85.70 (16.08)	85.95 (15.66)	0.94
3	83.70 (15.25)	81.90 (14.75)	0.59
6	80.30 (14.99)	78.25 (14.32)	0.53
9	79.00 (14.63)	77.80 (13.28)	0.70
12	78.67 (14.08)	77.40 (12.89)	0.67
15	77.90 (12.95)	77.30 (12.72)	0.83
20	77.25 (12.56)	77.05 (13.39)	0.94
25	77.10 (12.24)	77.15 (13.20)	0.98
30	77.13 (12.09)	76.70 (13.16)	0.88
40	77.20 (12.16)	76.25 (12.93)	0.73
50	76.90 (12.25)	75.75 (12.33)	0.67
60	76.85 (12.03)	75.65 (12.34)	0.66
70	77.15 (12.58)	76.10 (12.40)	0.70
80	77.00 (12.69)	76.15 (12.29)	0.76
90	76.68 (12.40)	75.80 (12.17)	0.75

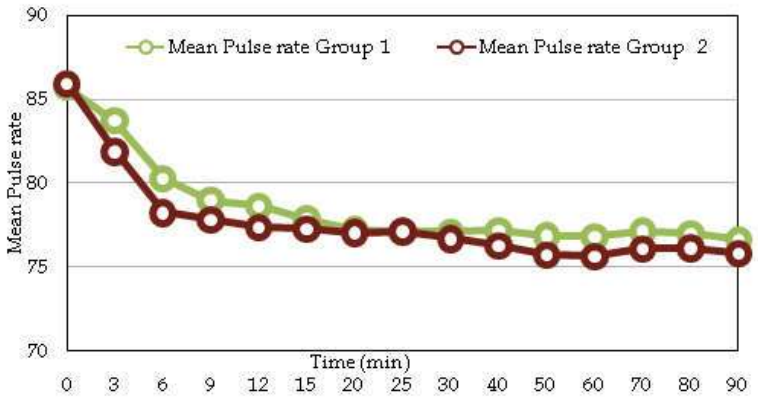

Fig. 2: Comparison of Mean pulse rate of two groups

Adverse effects- Two patients in group 1 experienced nausea/vomiting as compared to 13(32%) patients in group 2, which was statistically significant (p=0.00). No patient in group 1 and only one patient in group 2 showed incidence of pruritus, this difference was found statistically insignificant (p value= 0.50). (Table 6).

Table 4: Comparision of mean (S.D.) systolic blood pressure during intraoperative period

Time (minute)	Mean (S.D.) SBP Group 1	Mean (S.D.)SBP Group 2	p-value
0	122.75 (10.09)	119.45 (17.72)	0.30
3	118.40 (9.45)	117.20 (9.84)	0.58
6	114.45 (9.20)	110.60 (8.96)	0.06
9	112.10 (8.94)	109.80 (9.28)	0.26
12	111.55 (8.15)	110.10 (7.95)	0.42
15	111.15 (7.70)	110.05 (7.15)	0.51
20	111.85 (7.25)	110.05 (6.63)	0.25
25	111.80 (7.59)	110.58 (6.36)	0.43
30	111.10 (7.58)	110.88 (6.19)	0.88
40	111.25 (7.99)	110.80 (5.90)	0.77
50	111.20 (7.52)	110.50 (6.60)	0.66
60	110.83 (6.81)	110.45 (6.50)	0.80
70	111.00 (7.22)	110.98 (6.56)	0.98
80	110.85 (7.62)	111.45 (5.87)	0.74
90	110.68 (6.78)	110.60 (5.17)	0.95

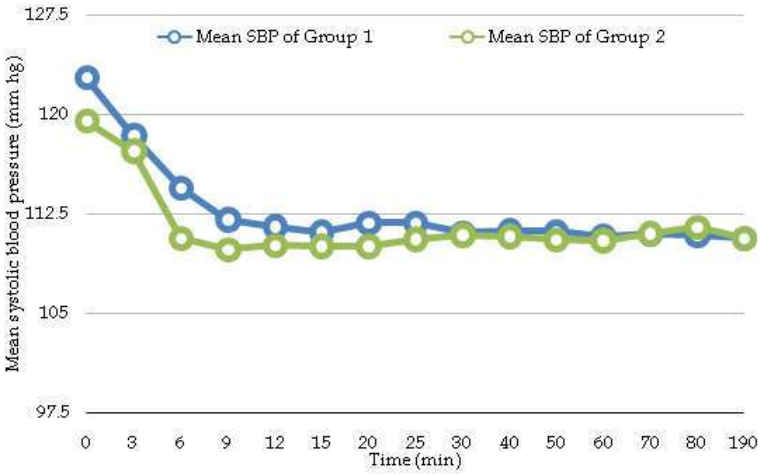

Fig. 3: Comparison of mean Systolic Blood Pressure (SBP) of two groups

Table 5: Comparision of mean (S.D.) diastolic blood pressure during intraoperative period

Time (minute)	Mean (S.D.) DBP of Group 1	Mean (S.D.) DBP of Group 2	p-value
0	76.75 (8.84)	78.70 (9.06)	0.33
3	73.75 (8.55)	72.95 (8.85)	0.68
6	70.45 (9.43)	69.35 (8.28)	0.58
9	68.90 (8.32)	69.50 (7.98)	0.74
12	69.25 (8.42)	69.15 (8.22)	0.96
15	69.48 (7.87)	69.20 (7.90)	0.88
20	69.35 (7.88)	69.40 (8.21)	0.98
30	69.15 (7.74)	69.50 (7.73)	0.84
40	69.30 (8.18)	69.15 (7.90)	0.93
50	69.10 (7.94)	69.10 (7.83)	1
60	69.28 (8.35)	69.00 (7.91)	0.88
70	69.40 (7.80)	69.45 (7.74)	0.97
80	68.75 (8.00)	69.95 (7.99)	0.50
90	68.95 (7.96)	70.00 (8.03)	0.56

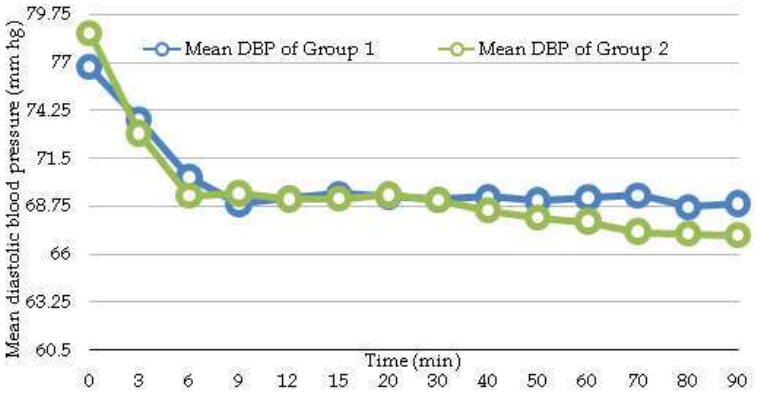

Fig. 4: Comparison of mean Diastolic Blood Pressure (DBP) of two groups

Table 6: Comparison of adverse effects of used drugs in group 1 and group 2

Adverse effect	Group 1 (no of patients)	Group 2 (no of patients)	p value
Nausea/Vomiting	02	13	0.00
Pruritus	00	01	0.50

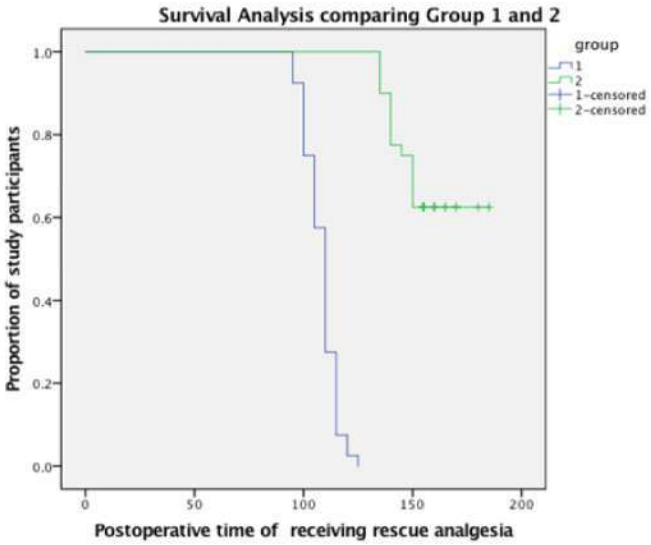

Fig. 5: Kaplin–meirer plot showing postoperative time of receiving rescue analgesia

Discussion

Role of Ropivacaine is well established when used in local infiltarion and epidural anesthesia, yet its role in spinal anaesthesia is continuously under scrutiny. In the present study hyperbaric solution was prepared by adding 5% glucose into Ropivacaine. Various studies have shown that addition of dextrose or glucose in local anaesthetic makes it heavy in comparison to cerebrospinal fluid [11]. Thus it helps local anesthetic to not spread in the cephalad spinal segments and reduces the side effects of high spinal block such as hypotension and nausea/vomiting.

The present study has shown that Ropivacaine group shows faster regression of sensory block. Thus it can be said that Ropivacaine can be a reliable option for short surgeries when given via intrathecal route. This fact was already been established in a previous study by Whiteside et al where they also concluded that the time for recovery with Ropivacaine was found less [12].

In Bupivacaine group the onset of motor blockgrade 3 was found earlier while the duration

of motor block grade 1 as well as the time taken for the mobilization was found longer. On the other hand in Ropivacaine group; onset of motor block grade 3 was late but duration of motor block grade 1 was shorter. The most interesting fact is that the time for mobilization and micturition was significantly shorter in Ropivacaine group. Thus it can be inferred that for day care short procedures Ropivacaine can be a good choice.

The hemodynamic parameters of two groups like pulse rate, mean systolic pressure and mean diastolic blood pressure were found comparable. This fact coresponds a previous study done by J.F. Luck who reported similar hemodynamic profile in Ropivacaine group where hyperbaric solutions of racemic Bupivacaine, Ropivacaine and Levobupivacaine were compared in spinal anaesthesia for caeserean section [13].

No analgesic drug was given as premedication in any of the groups. So it can be presumed that the drug used in spinal anaestheia were the sole reason for producing sensory analgesia in each group. It was seen that Bupivacaine produces analgesia for a longer time than Ropivacaine. This explains the early requirement of rescue analgesic drug in Ropivacaine group. This can also be understood by the early sensory regression in Ropivacaine group, which can be responsible for early onset of pain in postoperative period.

Ropivacaine group shows lower incidence of nausea, vomiting and pruritus. This can also be explained by shorter duration of sensoryas well as motor block by Ropivacaine. However the incidence of adverse effects was very small, so larger trials are needed to further verify the fact.

Conclusion

This study verifies that hyperbaric solution of both drugs Bupivacaine and Ropivacaine produce anaesthesia of good quality in which lower abdominal procedures of short duration can be performed. Ropivacaine is especially suitable for short day care procedures as time of mobilization, micturition is shorter and incidence of adverse effects is less. However larger sample size studies are required to establish the facts.

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