Does Ropivacaine Causes less Spinal Induced Hypotension than Bupivacaine in Caesarean Section: A Randomised Study.

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ABSTRACT

Introduction: Hypotension during spinal anaesthesia remained one of the most common complications since decades. Various factors such as posture, fluid status, and characteristics of local anaesthetic affect the overall incidence of hypotension in a parturient. This study was conducted to compare the incidence of spinal induced hypotension with 0.75% isobaric ropivacaine-fentanyl and 0.5% hyperbaric bupivacaine-fentanyl combination. **Methods:** 80 ASA I & II parturient were randomly divided into two groups to receive either 10 mg hyperbaric bupivacaine(0.5%)+ 25 µg fentanyl(BF) or 15 mg isobaric ropivacaine(0.75%)+ 25 µg fentanyl(RF).The sensory and motor block characteristics, haemodynamic parameters as well as any adverse effects were recorded. **Results:** Sensory block onset time was 4.5±1.2 min in BF v/s 6.6±1.8 min in RF group. Time to achieve maximum cephalad spread was 8.9±1.5 min in BF v/s 12.6±2.2 min in RF. Onset of motor block was significantly faster in group BF (2.6±1.3 min in BF v/s 5.1±1.3 min in RF). Time to first analgesic requirement was 243.8±20.1 min in BF v/s 236.3±12.4 min in RF. Haemodynamic parameters were more stable in RF. **Conclusion:** Intrathecal isobaric Ropivacaine-fentanyl combination is a suitable option for caesarean section as it shows less incidence of hypotension with adequate analgesia.

Keywords: Bupivacaine, caesarean section, hypotension, intrathecal, isobaric, ropivacaine.

INTRODUCTION

Spinal anaesthesia is an accepted safe technique for caesarean section worldwide. Bupivacaine is most commonly used local anaesthetic for central neuraxial blockade since few decades. Ropivacaine is also used by number of investigators in the form of hyperbaric or plain solution, with or without adjuvant for caesarean section.[1–4] Bupivacaine has quick onset, high potency, and long duration of action but has been associated with prolonged motor block and risk of central nervous system (CNS) and cardiac toxicity. Ropivacaine on the other hand, has low potency, produces an equivalent sensory but shorter motor blockade than intrathecal bupivacaine.[5] The quicker regression of motor block lead to early mobilization and early recovery.[6] Incidence of toxicity is also less with ropivacaine due to higher plasma concentration threshold for CNS and cardiovascular toxicity.[7,8] Further, addition of opioids such as fentanyl improves the intra-operative and early postoperative quality of subarachnoid block for caesarean section.[9-12]

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In caesarean section, the block characteristics such as onset and duration of analgesia, haemodynamic stability and side effects play an important role in final outcome of newborn in relation to neurobehavioral responses and hence APGAR score.[1,13] The maternal hypotension caused during spinal anaesthesia reduces the uterine perfusion pressure similar to aortocaval compression. Vasopressors with pure α adrenergic effect further increases the uterine vascular resistance and lowers the uterine blood flow. Therefore, the purpose of this study was to compare 15 mg of 0.75% isobaric ropivacaine and 10 mg of 0.5% hyperbaric bupivacaine with fentanyl as an adjuvant in subarachnoid block for their role in spinal induced hypotension(SIH).

MATERIALS AND METHODS

Eighty ASA physical statuses I or II parturient scheduled for elective caesarean delivery at term using spinal anaesthesia were enrolled in the study. Written informed consent was obtained from each patient. Patients with complicated pregnancies as multiple pregnancies, foetal distress and suspected foetal abnormality were excluded. Randomisation was done by computer generated random numbers table. Patient received 10 mg Hyperbaric Bupivacaine (0.5%) + 25 µg Fentanyl (BF) or 15 mg Isobaric Ropivacaine (0.75%) + 25 µg Fentanyl (RF).All standard monitors were attached including electrocardiograph, pulse oximeter and non-invasive blood pressure monitor. IV access was secured and each patient received oxygen via Hudson mask at the rate of 6 L/min till the end of

surgery. Premedication with ranitidine 50 mg I.V. & metoclopramide 10 mg I.V was done along with co-loading with lactated Ringer's solution @ 20 ml/kg. Before the commencement of anaesthesia, patients were instructed in the methods of sensory and motor assessments, and baseline measurements were made. Sensory changes were recorded by assessing changes in pinprick sensation using a needle protruding 2 mm through a guard. Modified Bromage scale was used to grade motor block (0=able to lift the extended leg at the hip, 1=able to flex the knee, but not lift extended leg, 2=able to move the foot only, 3=unable to move even the foot). After infiltrating the skin at the puncture site with lidocaine 2%, lumbar puncture was performed in the sitting position with a 25-gauge Quincke-Babcock spinal needle, using a midline approach at the L3-4 inter vertebral space. After confirming free flow of CSF, drugs were injected over approximately 15 Sec. Patients were turned supine immediately after spinal injection. Sensory and motor assessments were performed every 2 min until maximum cephalad spread achieved. Surgery was allowed to commence if the dermatomal level of loss of discrimination to pinprick was at or above T7. Thereafter, the blocks were assessed at 15-min intervals until complete recovery of motor function and regression of sensory loss to L1 dermatome. Baseline non-invasive maternal mean blood pressure (MAP) and heart rate (HR), and peripheral oxygen saturation (SpO2) were measured. After performing spinal block, these parameters were recorded every 2.5 min in the first 30 min, every 10 min thereafter. In cases where adequate level of blockade was not achieved within a maximum time period of 30 minutes, general anaesthesia was given and is regarded as "failure".
SIH was defined as ≥20% decrease from baseline MAP. Bolus i.v. mephentermine of 6 mg was used to treat hypotension. Maternal bradycardia was defined as HR<50 beat/min and treated with i.v. atropine of 0.5 mg. Amount of mephentermine and atropine used were recorded. Onset of anaesthesia was assessed by the time for sensory block to reach at T7 and maximum block height achieved was also noted. To assess the duration of the sensory block, time for regression to L1 and duration of analgesia (time to first analgesic requirement) were compared. Time to achieve maximum motor block, duration of motor block along with any side effects were also noted.
Sample size calculation was used PS Power and Sample Size Calculator (Version 3.0.43; Dupont WD, Plummer WD). On the basis of pilot studies, 35% decrease in the incidence of hypotension was observed (Primary objective). Keeping α error of 5%, β error of 20% and adding 10% for attrition, a total of 40 patients per group was included. Analyses were performed with Microsoft Excel and SPSS version 19.0 (SPSS Inc., Chicago, IL). Results were expressed as median (range) or mean±standard deviation. Statistical comparisons were performed with the chi square test, Student's *t*-test, Fisher's exact test, and the Mann-Whitney *U*-test, as appropriate.

RESULTS

There was no significant difference between the groups with regard to age, height, weight, gestational age and duration of surgery [Table 1]. The median dermatomal level showing the maximum cephalad spread of sensory block (T4), was statistically similar between the groups [Table 2] & [Figure 1]. However, time to achieve a maximum cephalad spread of sensory block was significantly longer in Group RF compared to group BF (12.6±2.2 min. in RF and 8.9±1.5 min. in BF; p< 0.05). Group RF needed significantly longer time to achieve sensory block height at T7 dermatome than Groups BF(6.6±1.8 min. in RF while 4.5±1.25 min. In group BF; p<0.05). The degree of median maximum motor block achieved was 3 (Bromage Scale) in both the groups. There was a significant difference in the Group RF compared to Group BF with respect to time to achieve maximum motor block (Group BF 2.6±1.11 min while RF required 5.1±1.34 min; p<0.05). The duration of motor block was markedly shorter in the ropivacaine group (122.3±10.9 min) when compared to bupivacaine group (177.8±11.9 min) [Table 2]. Time to regression of sensory block to L1 dermatome was 216.5±16.7 min in BF and 208.5±10.5 min in RF. Duration of analgesia was 243.8±20.1 min in BF 236.3±12.4 men in the RF group [Table 2] & [Figure2].

Table 1: Patient characteristics.

Variable	Group BF(*n=40*)	Group RF(*n=40*)	P value
Age (years)	26.4±3.7	25.7±3.7	0.78
Height (cm)	157±6.7	156.5±6.5	0.67
Weight (kg)	55.0±8.8	55.0±6.9	1.00
Gestational age(weeks)	39.4±1.6	38.7±1.5	0.84
Duration of surgery (min)	73.0±12.7	78.5±10.1	0.07

n = no. Of patients; *significant

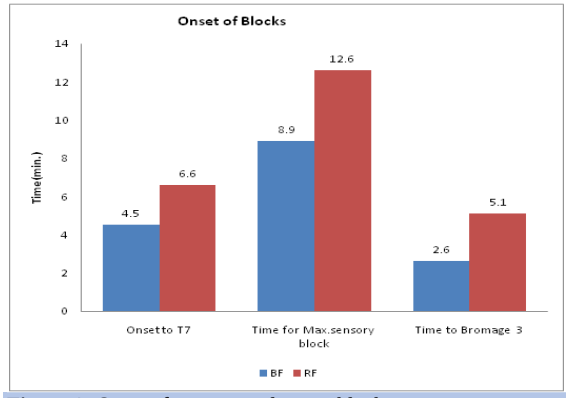

Figure 1: Onset of sensory and motor block.

The incidence of hypotension was more in the hyperbaric bupivacaine group (65%) compared with the isobaric ropivacaine group (30%), requiring significantly higher doses of mephentermine in-group BF [Table 3] & [Figure 1]. Moreover, the onset time of hypotension was earlier in the bupivacaine group corresponding to initial 5 to 17 minutes as compared to 22.5 to 27.5 minutes in the ropivacaine group [Table 4]. Anaesthesia success rate within both the groups was similar; no failure was recorded in any group. No significant adverse effects recorded.

Table 2: Sensory and motor block characteristics.

Variable	Group BF(*n=40*)	Group RF(*n=40*)	P value
Maximum cephalad spread of sensory block(median dermatome, range)	T4(T3-T5)	T4(T4-T6)	-
Maximum cephalad spreadof sensory block (min)	8.9±1.5	12.6±2.2	**0.023***
Time to achieve sensory block at T7 (min)	4.5±1.2	6.6±1.8	**0.033***
Recovery to L1 (min)	216.5±16.7	208.5±10.5	0.081
Duration of analgesia (min)	243.8±20.1	236.3±12.4	0.076
Onset of motor block to Bromage 3 (min.)	2.6±1.3	5.1±1.3	**0.014***
Recovery to bromage 0 (min.)	177.8±11.9	122.3±10.9	**0.039***

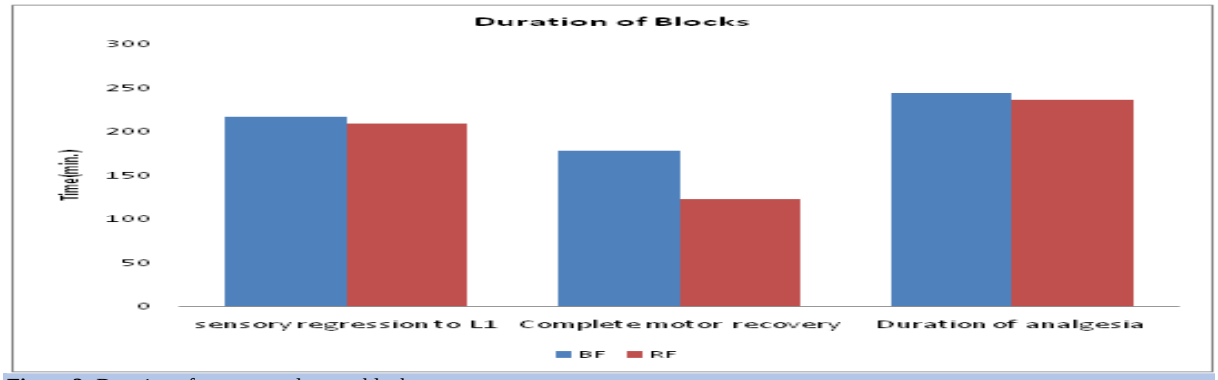

Figure 2: Duration of sensory and motor block.

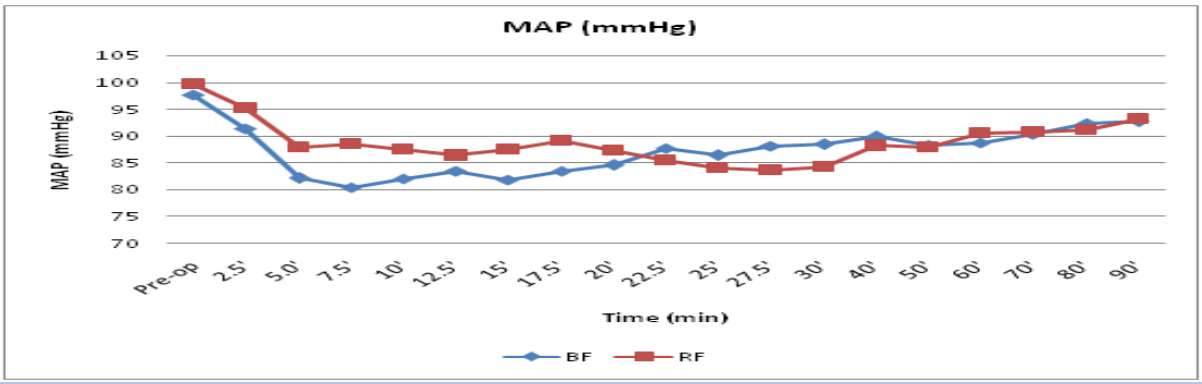

Figure 3: Mean arterial pressure (MAP) variations with time.

Table 3: Side effects

Variable	Group BF*(n=40)*	Group RF*(n=40)*	P value
Nausea/vomiting	10/2	8/4	0.07
Hypotension	26	12	< 0.05*
Shivering	8	6	0.11
Pruritus	0	0	1.00

n = no. of patients; *significant

Table 4: Variation of mean arterial pressure (MAP) with time

TIME (minutes)	MAP Group BF(mm Hg) (mean ± SD)	MAP Group RF(mm Hg) (mean ± SD)	p Value
Pre op	97.7 ± 5.03	99.74 ± 2.99	0.15
2.5	91.31 ± 4.95	95.24 ± 0.95	0.14
5.0	82.12 ± 6.20	87.94 ± 8.61	**0.00***
7.5	80.41 ± 6.64	88.56 ± 6.02	**0.00***
10.0	82.035 ± 5.34	87.44 ± 3.60	**0.02***
12.5	83.39 ± 3.73	86.36 ± 5.29	**0.02***
15.0	81.88 ± 4.82	87.49 ± 6.40	**0.00***
17.5	83.485 ± 4.07	89.11 ± 4.76	**0.00***
20.0	84.55 ± 4.71	87.36 ± 3.03	0.46
22.5	87.76 ± 2.88	85.50 ± 2.84	**0.00***
25.0	86.37 ± 2.10	84.06 ± 4.01	**0.00***
27.5	88.125 ± 2.06	83.65 ± 3.30	**0.00***
30.0	88.415 ± 1.86	84.21 ± 4.52	0.75
40.0	89.825 ± 2.96	88.20 ± 2.28	0.05
50.0	88.315 ± 3.08	87.94 ± 2.73	0.01
60.0	88.715 ± 3.44	90.60 ± 2.06	0.04

*Statistically significant

DISCUSSION

In our study Isobaric, ropivacaine showed significantly decreased incidence of hypotension but with the slightly slower onset and shorter duration of block characteristics in comparison to bupivacaine.

In the present study, we use ropivacaine 15 mg to compare bupivacaine 10 mg on the basis of previous studies[1,14-18] such as Chung et al[1] used 18 mg hyperbaric ropivacaine while McNamee et al[14] used 18.75 mg isobaric ropivacaine. Wahedi et al., Malinovsky et al., and Van Keef et al., used 15 mg of isobaric ropivacaine; on the other hand Gautier et al., used only the 14mg of ropivacaine for various lower limb surgeries[15-18].Variability in level of block with isobaric drugs along with higher ascend than expected levels in full term pregnant patients were found with other studies[13,19] which poses challenge for the anesthetists. Furthermore, bupivacaine and ropivacaine at all concentrations are hypobaric at 37°C.[20] So, addition of fentanyl, which is also known to be hypobaric, to a local anaesthetic renders the subsequent mixture even more hypobaric that may result in a higher cephalad spread, when administered in the sitting position.[19-21] To avoid unpredictable cephalad spread, we used lower doses as in some previous isobaric studies. We chose a different dose because equipotency ratio of ropivacaine is 1.5 times to bupivacaine.[16,18,22,23] In a recent study Khaw et al[5] determined the ED50, ED90, and ED95 of ropivacaine to be 16.7, 24.5, and 26.8 mg, respectively. Besides, addition of 25 µg fentanyl allows a reduction of nearly 50% of the dose of ropivacaine required for the ED90.[12,24,25]

In our study all the parturient achieved adequate anaesthesia, no failure was recorded in any group. Median maximum sensory block height was T4 in both groups compared to Gunaydin et al[20] who found a median sensory level of T3. Onset of sensory block at T7 and time for maximum cephalad spread were longer in the Group RF than in the Group BF like few previous studies but this is not of much significance except in emergency cases where immediate delivery has to be done.[20,26] Onset and duration of motor blockade was also found to be significantly faster and longer in bupivacaine group in concordance with previous studies.[18,20]

Recovery of sensory block to L1 and duration of analgesia was found to be similar in both groups comparable to the study of Gunaydin et al.[20]

There was no significant difference in pulse rate between the two groups throughout the study period, which is in agreement to the study by Ogun et al.[27] In our study the mean arterial pressure(Figure 3) decreased significantly in Group BF as compared to RF Group that is in contrast to study by Ogun et al[27] which showed no significant difference between two groups as they have used isobaric bupivacaine. Hypotensive episodes were significantly higher with bupivacaine as compared to ropivacaine and it was comparable to the results of Ogun et al.[27] In our study, 65% patients in Group BF suffered from hypotension in contrast to 30% in Group RF. Furthermore, it was in the initial 20 minutes in bupivacaine group, the period when baby is usually not delivered. As hyperbaric bupivacaine is the most commonly used drugs in caesarean section, its early onset can affect the neonatal outcome due to decreased uteroplacental perfusion. Many of the studies in the past have emphasized the role of hypotension on neonatal outcome, but not in relation to timing of hypotension. Breebart et al[28] using 15 mg ropivacaine observed no case of hypotension in first 20 min in ropivacaine group. The delayed hypotension of ropivacaine can be explained by its isobaric nature and typical characteristics.

Local anaesthetics providing adequate intrathecal anaesthesia without compromising early ambulation could be preferred for caesarean section.[20] Ropivacaine with more differential blockade and lower incidence of hypotension &systemic toxicity might offer advantage over racemic bupivacaine particularly for caesarean under CSE.[29] Furthermore, delayed onset of hypotension in ropivacaine may provide an edge over bupivacaine.

CONCLUSION

In conclusion, isobaric ropivacaine-fentanyl is more favourable combination owing to its equivalent analgesia but minimal hemodynamic instability in caesarean section.

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