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Original article

Does the maternal position at the time of administration of subarachnoid block with plain Ropivacaine affect the hemodynamics? A comparative evaluation of the sitting versus lateral position

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ABSTRACT

Background: Subarachnoid block is the preferred anesthesia in the parturient undergoing elective caesarean section. The ideal position for the induction of subarachnoid block in a parturient is not standardized and its effect on the hemodynamics is conflicting. **Methods:** A prospective randomized single blinded study was carried out on 40 parturients. The parturient were allocated to two groups of 20 each, who received 12 mg of 0.75% plain Ropivacaine intrathecally in either the modified sitting or the lateral position. The intra-operative hemodynamic parameters, characteristics of block, amount of Ephedrine used, neonatal condition (Apgar score), nausea, vomiting and parturient comfort were evaluated. **Results:** As compared to the lateral group, a greater fall in mean arterial pressure (P=0.001) and systolic blood pressure (P=0.002) was observed in the sitting group. The mean amount of Ephedrine used was also greater in the sitting group (P=0.011).The time to achieve a sensory level of T6 was earlier (P value<0.001) and the highest sensory level achieved was greater in the sitting group (P value=0.002). The incidence of nausea (P=0.002) and vomiting (P=0.008) was more in the sitting group. However, the parturient were more comfortable receiving the block in sitting position (P value<0.001) and the overall neonatal outcome was good in both the groups. **Conclusions:** We conclude that even though the sitting position was comfortable while administering a subarachnoid block, maintaining the lateral position at the time of subarachnoid administration provided significantly greater hemodynamic stability.

KEYWORDS: Subarachnoid block, maternal position, hemodynamics, Ropivacaine

INTRODUCTION

Subarachnoid block is the preferred anesthesia in the parturient posted for elective caesarean section but intra-operative hypotension remains a significant drawback [1-3]. Despite prophylactic measures, a 30% to 90% incidence of hypotension has been reported [1,2]. It may be either due to the cephalad spread of the intrathecal local anesthetic or aortocaval compression by the gravid uterus [1]. The intrathecal spread of the local anesthetic is influenced by its dose, baricity and the parturient position during and immediately after the subarachnoid block for hyperbaric solutions [1,4].

Patient position immediately after administration of a subarachnoid block has no effect on the intrathecal spread of an isobaric local anesthetic and hence no effect on the block characteristics [5,6]. Plain Ropivacaine has been shown to be nearly isobaric with respect to the cerebrospinal fluid (CSF) of a pregnant woman and would have minimal effect on the level of block for a given dose [5,6].

On comparing the sitting versus lateral position at the time of administration of a subarachnoid block, greater comfort and hemodynamic stability has been reported with the lateral position by some authors [1,7,8] while, other authors have found less hypotension and higher maternal satisfaction with induction in the sitting position [9-13].Thus, the choice of maternal position affects the intra-operative hemodynamics which is of significant concern for both the mother and the neonate especially in the high risk obstetric scenario.

Objectives: To evaluate and compare the effect of lateral and sitting position during establishment of spinal anesthesia on the hemodynamics, Ephedrine use and level of sensory block using Roivacaine in a parturient scheduled for elective caesarean section.

MATERIALS AND METHODS

Study Design: Cohort After taking institutional ethics committee approval, a prospective, randomized, single blinded study was conducted in the Department of Anesthesiology, Maulana Azad Medical College and Lok Nayak Hospital, New Delhi, India on 40 ASA I/II parturients, undergoing elective caesarean section. A detailed pre-anesthetic check-up including history, physical examination and routine investigations as guided by age was carried out and written informed consent was taken from all the parturients. Parturients with preeclampsia, essential hypertension, any febrile illness, hypersensitivity to Ropivacaine, any obvious spinal deformity or contraindication to spinal anesthesia and height less than 148 centimeters or greater than 164 centimeters were excluded from the study.

Allocation of groups: All parturients were randomly (computer generated random number table) allocated by the primary investigator to receive intrathecal plain Ropivacaine in the lateral or sitting position according to the group assignment.

Group L (n=20): All parturients in this group were positioned in the lateral position with knee and hip joint in flexion and received intrathecal 1.6ml of 0.75% plain Ropivacaine.

Group S (n=20): All parturients in this group were positioned in the modified sitting position with feet stretched horizontally along the axis of the operating table and back facing towards the anesthetist and received intrathecal 1.6ml of 0.75% plain Ropivacaine.

Anaesthetic technique: All parturients received routine acid aspiration prophylaxis 60 minutes prior to surgery. In the operating room, routine monitors were applied and baseline parameters: systolic blood pressure, diastolic blood pressure, heart rate and arterial oxygen saturation were recorded in the supine position by the investigator. After recording these parameters, the investigator was asked to leave the operating room. The parturient was preloaded with 20 ml/kg of Ringer's Lactate over 15 minutes preceding the block. With the help of a trained assistant the parturient was positioned into either left lateral or sitting position according to randomization. Subarachnoid block was administered in all the parturients using a 25 gauge Quincke Babcock needle through the midline approach at the L3-L4 intervertebral space.

After free flow of clear CSF, 12 mg (1.6ml) of 0.75% plain Ropivacaine was administered at a rate of 0.2 ml/second. Immediately afterwards, the parturient was returned to the modified supine position with a 12 centimeters wedge under the right buttock. The time taken to make the parturient supine after administration of the subarachnoid block was recorded. The investigator who was blind to group allocation was now called back to collect the intra-operative data. Systolic blood pressure (SBP), mean arterial pressure (MAP) and heart rate (HR) were recorded every 1 minute for the first 10 minutes, at 3 minutes interval for the next 20 minutes and at 5 minutes interval thereafter. Hypotension was defined as a fall in systolic blood pressure >20% of the baseline value or <90 mmHg or mean arterial pressure fall >20% of base line.

Bradycardia was defined as heart rate <60/min. The lowest measurements for SBP, MAP and HR intra-operatively were recorded. Hypotension was treated with 5mg bolus of Ephedrine if a rapid infusion of 250 ml Ringer's Lactate failed to correct the hypotension. Assessment of sensory block was carried out using loss of fine touch sensation to pin prick and sensory level was determined every 2 minutes till 15 minutes from subarachnoid block. Time taken to achieve a sensory level of T6 was recorded and the sensory level after 15 minutes of subarachnoid block was recorded as the final upper sensory level of block.

Motor block was assessed using modified Bromage Score (1 = able to raise legs above table, 2 = able to flex knee, 3 = able to move feet only, 4 = no movement in legs or feet). Time taken to achieve the score of 4 was recorded. If after 15 minutes of subarachnoid block, a sensory block of T6 and modified Bromage Score of 3 were not achieved, general anesthesia was administered to the parturient. Neonatal assessment was done using Apgar score at 1 and 5 minutes. Additional data collected included nausea, vomiting and patient comfort.

STATISTICAL ANALYSIS: Statistical analysis was done using SPSS statistical software version 15 and a p value<0.05 was considered statistically significant. Mean arterial pressure was taken as a primary parameter. Using data from a previous study a difference of 1.2 mmHg in mean arterial pressure between the two groups was found to be significant.[1] With reference to this difference, the total minimum required sample size with a power of study to be 95% at 5% level of significance was calculated to be 40.

So the minimum required sample size in either group was 20 parturients each. Unpaired t test/Man-Whitney test was applied to compare the quantitative variables between two groups (Hemodynamic parameters, amount of Ephedrine used and APGAR score) while Chi square/Fisher's Exact test for comparing qualitative variables between the two groups (Characteristics of block, nausea, vomiting and patient comfort).

RESULTS

20 parturients were studied in each group. No parturient was excluded due to inadequate block. Demographic characteristics were similar in both the groups (Table 1). In the group S, the mean time taken to make the parturient wedge supine after administering the block was significantly less as compared to the group L (Table 2).

Table 1: Demographic characteristics of study subjects

	group S	group L	p-value
Age (years)	25.20±3.22	24.55±2.98	0.256
Height(centimetres)	153.75±2.59	153.60±2.28	0.424
Weight (kilograms)	63.23±2.69	64.33±2.36	0.356

Table 2: Time to supine, Hemodynamic parametres, Ephedrine use, APGAR Score

	group S	group L	p-value
Time taken to supine position (seconds)	8.50±0.76	9.55±0.83	< **0.001**
Mean baseline SBP (mmHg)	123.90±3.32	123.80±3.11	0.461
Mean baseline MAP (mmHg)	87.45±3.36	87.35±3.92	0.466
Mean baseline heart rate (beats per minute)	85.05±6.89	85.10±6.47	0.491
Lowest mean SBP (mmHg)	86.90±9.97	98.45±13.19	**0.002**
Lowest mean MAP (mmHg)	62.40±12.69	73.60±8.96	**0.001**
Lowest mean heart rate (beats per minute)	74.95±6.12	75.55±6.15	0.379
Mean amount of Ephedrine used (milligrams)	10.31±4.64	5.00±0.00	**0.011**
Mean Apgar score at 1 minute	8.40±0.82	8.95±0.22	**0.003**
Mean Apgar score at 5 minutes	9.00±0.00	9.00±0.00	-

The mean baseline hemodynamic parameters (systolic blood pressure, mean arterial pressure and heart rate) were statistically comparable between both the groups (Table 2). In the group S, a statistically significant fall in the SBP and the MAP was observed as compared to the group L (Table 2). This is depicted by the comparison of the mean values of the lowest SBP (P=0.002) and the lowest MAP (P=0.001) recorded (Table 2). Out of the 20 parturients in the group S, 16 parturients (80%) were observed to have developed hypotension whereas only 5 (25%) out of the 20 parturients developed hypotension in the group L. However no episode of bradycardia was seen in either of the groups. The mean amount of Ephedrine used to treat the hypotension episodes was more in the group S compared to the group L (P=0.011) (Table 2).

The time to achieve a sensory level of T6 was significantly less in the group S as compared to the group L (P<0.001) (Table 3). The parturients in the group S had a higher cephalad spread of block than the group L. All the parturients in the group S had a sensory block higher than T6, whereas only 13 out of the 20 parturients in the group L had a sensory block higher than T6 (P=0.002).In the group S, 9 parturients (45%) achieved a sensory block up to T4 compared to only 1 parturient (5%) in the group L (P=0.002). Also in the group S, in 3 parturients (15%) a level of T3 was reported and in 1(5%) the block was as high as T2. The time taken to achieve a Modified Bromage Score of 4 was similar in both the groups (Table 3).

Table 3: Block characteristics

Highest sensory block achieved	group S		group L		p-value
	n	%	n	%	
T2	1	5%	0	0%	0.156
T3	3	15%	1	5%	0.146
T4	9	45%	1	5%	**0.002**
T5	7	35%	11	55%	0.102
Mean time to achieve a block of T6 (minutes)	4.05±0.89		5.65±0.93		<**0.001**
Mean time to modified Bromage score of 4 (minutes)	7.25±1.65		7.05±1.57		0.348

The difference in the mean APGAR scores at one minute between the two groups was statistically significant but as the score was >8 in both the groups this was of little clinical significance. At five minutes, all the neonates had an Apgar score of 9 in both the groups and the overall neonatal outcome was good (Table 2).

In group S, 60% (12) of the parturients had nausea and 25% (5) of the parturients had episodes of vomiting (P=0.008) as compared to nausea in only 20% (4) in the group L (P=0.002). However there were no other complications such as shivering, syncope etc in any of the parturient in both the groups (Table 4). On analyzing the patient comfort score, the parturients reported more comfort sitting position compared to the lateral position (P < 0.001) (Table 4) during administration of the block.

Table 4: Complications, Patient Comfort among the study subjects

	group S	group L	p-value
Nausea (%) (n)	60(12)	20(4)	**0.002**
Vomiting (%) (n)	25(5)	0(0)	**<0.001**
mean patient comfort rating	1.95±0.51	1.25±0.44	**<0.001**

DISCUSSION

The major factors affecting the intrathecal spread of a fixed dose of local anesthetic are its baricity and the patient position with other factors such as speed of injection and patient characteristics remaining constant [4,17]. There is no ideal standardized position for administration of a subarachnoid block (SAB) in a parturient and various studies report conflicting results for the effect of posture on the hemodynamics in a parturient for caesarean section.

Many studies have demonstrated better hemodynamic effects with intrathecal hyperbaric Bupivacaine in the sitting position while a higher incidence of hypotension is reported in the lateral position [9-13]. In the sitting position, the hyperbaric solution has been seen to have a delayed cephalad spread of the intrathecally by virtue of the gravitational effect, resulting in a lower sensory block and lesser hypotension. Further, in most of the above studies [10-13] a needle through needle technique was used for administration of CSE wherein the epidural catheter is threaded in after administration of SAB that would result in an inevitable delay in moving the parturient to a supine position after administration of SAB. This may have further retarded the cephalad spread of the hyperbaric solution in the sitting position.

However, Yun et al used hyperbaric intrathecal Bupivacaine and reported a significantly greater duration and severity of hypotension in the sitting position as compared to the lateral position [8]. They postulated that this conflicting result could be due to sympathectomy induced venous pooling in the lower extremities in the conventional sitting position with the legs hanging by the side of the table [8].

Even without the SAB induced sympathectomy, the incidence of syncope caused by orthostasis, as well as a decrease in cardiac output and uterine blood flow has been found to be greater in the conventional sitting position than in the lateral recumbent position in parturients [21,22]. Since this might have confounded the results, in our study, we chose to maintain a modified sitting position as described by Tashayod et al [16].The parturient in our study was positioned in the modified sitting position with the legs stretched horizontally along the length of the table to prevent the venous pooling and orthostasis.

Ideally, the parturient position should not influence the level of the block when using an isobaric solution of a local anesthetic. While using 0.5% plain Bupivacaine for single shot SAB in 100 parturients, Obasuyi et al reported a higher incidence of hypotension in the modified sitting position as compared to the lateral position [1]. Since the CSF density of 0.5% plain Bupivacaine (0.99944g/ml at 37^oC) is slightly hypobaric with respect to CSF of a parturient (1.00030g/mL) [18,19] a more cephalad spread was to be expected with the parturient in the sitting position.[18]

A previous study has shown that intrathecal 0.75% plain Ropivacaine behaves as an isobaric solution in a parturient [24]. We compared the lateral and modified sitting position using a fixed dose of 0.75% plain Ropivacaine.

In our study, the primary parameter for analysis of hemodynamics was the MAP. A statistically significant decrease in the MAP and SBP was observed in parturients in the group S as compared to the group L. The parturient in the group S were observed to have a faster onset of sensory block as well as a higher sensory block as compared to the group L. Previous studies have shown that following a sensory block higher than T6, hypotension is more frequent [20]. The significantly faster onset of sensory block in the group S, as well as a greater incidence of sensory level above T4 may explain the difference in the incidence of hypotension between the groups. Our results are similar to those of Obasuyi et al and Hallworth et al who also reported a higher incidence of hypotension in the modified sitting position as compared to the lateral position with the use of plain bupivacine [1,7].

In our study, we had used a modified sitting position to prevent orthostasis and a nearly isobaric solution of local anesthetic but we observed a greater hypotension in the sitting position as compared to the lateral position. There are few studies that have used plain 0.75% Ropivacaine for single shot SAB in parturients. The baricity of plain 0.75% Ropivacaine is nearly isobaric with respect to the CSF of the parturient at 22^0C but becomes slightly hypobaric at

37^0C (0.99953mg/ml) when injected intrathecally as seen in our study [18].

Thus, our study shows that 0.75% plain Ropivacaine behaves similar to 0.5% Bupivacaine as a hypobaric solution in parturients. This would also explain the greater cephald spread and higher incidence in hypotension in the sitting group in our study.

The amount of Ephedrine used corresponded to the incidence and magnitude of hypotension following the administration of subarachnoid block with a significantly higher requirement in the sitting group.

Although, a significant number of parturient attained a sensory block height of T4 in the sitting group compared to the lateral group, there was no incidence of bradycardia in either groups and the mean heart rate was comparable in both the groups. The parturients in our study were young and fit with good compensatory sympathetic activity and in the presence of anxiety, which is present to some degree in the parturients scheduled for surgery, increased sympathetic discharge might counteract the effect of a high block on the hemodynamics [13]. It has also been reported that, high sympathetic blockade involving the T1–T4 fibers may leave some sympathetic activity intact [1].

The time taken to achieve a Modified Bromage Score [1] of 4 was similar in both the groups and comparable to other studies [9,11]. The incidence of nausea and vomiting was significantly more in the sitting group and corresponded to the accompanying higher incidence of hypotension. The periods of hypotension were not associated with syncope or shivering in any of the groups. This correlation of a higher incidence of hypotension with a higher incidence of nausea or vomiting in a particular group was also demonstrated by Patel et al [10].

The difference in the mean APGAR scores at one minute between the two groups was statistically significant but as the score was more than 8 in both the groups, this was of little clinical significance. At five minutes, all the neonates had an APGAR score of 9 in both the groups and the overall neonatal outcome was good. This may be explained by the fact that only healthy women who were not in labor and who were presumed to have normal utero-placental perfusion were enrolled in the study. Also, hypotension lasting less than 4 minutes is generally well tolerated by the healthy fetus [23].

CONCLUSION

We conclude that even though plain 0.75% Ropivacaine is considered nearly isobaric, when administered intrathecally it behaves as a hypobaric solution leading to a higher sensory block and accompanying greater hypotension, the lateral position should be preferred as it provides significantly greater hemodynamic stability especially when we are using slightly hypobaric intrathecal solutions for SAB in a parturient. This is particularly significant for the high risk parturients who are at a greater risk for fetal hypoxia.

Competing interest: The authors declare that they have no competing interests.

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