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A study to evaluate hemodynamic effects of lateral and sitting position during induction of spinal anesthesia for lower segment caesarean section

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Abstract
Background: *Regional anesthesia is preferred by most anesthesiologists for the majority of caesarean sections. Sympathetic block and hypotension as a result of spinal anesthesia can cause hypoperfusion of the uterus and placenta. The aim of our study was to compare hemodynamic parameters during left lateral and sitting positions during spinal anesthesia to facilitate lower segment caesarean sections.*
Methods: *One hundred twenty-two ASA physical status I and II parturients undergoing elective lower segment caesarean sections were randomly allocated to group A (Sitting) and group B (Left lateral) and given 2 ml (10 mg) of 0.5% hyperbaric bupivacaine each in L_{3-4} interspace. Blood pressure, heart rate and oxygen saturation were recorded. Time taken to achieve sensory level, time to onset of first episode of hypotension, total number of episodes of hypotension, total dose of ephedrine consumed, umbilical artery pH and neonatal APGAR scores at one and five minutes were recorded.*
Results: *The time taken to achieve T_4 sensory level and time to first episode of hypotension were significantly more in sitting position ($p=0.00$). The number of patients experiencing hypotension, number of hypotensive episodes and total ephedrine requirement were significantly more in lateral position ($p<0.05$). Neonatal outcome was comparable in both the groups.*
Conclusion: *While adequate sensory level for caesarean section is attained quicker in left lateral position as compared to sitting position, hemodynamic stability is better in sitting position. However, neonatal outcome is comparable in both the positions.*
Keywords: *Caesarean section, Hypotension, Maternal position.*

Introduction

Regional anesthesia is preferred by most anesthesiologists for the majority of caesarean sections. The importance of this can be seen in the Report of Confidential Enquires into Maternal Deaths in which it was reported that of the direct maternal deaths attributed to anesthesia, majority were associated with difficulties during general anesthesia.[1] Although a number of regional anesthesia techniques are available, spinal anesthesia is particularly popular because it is fast, easy to perform, has rapid onset with provision of dense neural blockade and provides excellent intraoperative analgesia.[2]

Sympathetic block and hypotension as a result of spinal anesthesia can cause hypoperfusion of the uterus and placenta. The extent to which the sympathetic chain is blocked is related to the degree of cephalad spread of local anesthetic in the subarachnoid space.[3] In pregnant women, greater sensitivity to local anesthetics results in higher blocks, and compounded by the effects of aortocaval compression, hypotension occurs with greater frequency and severity.[2]

In literature, studies of administration of spinal anesthesia in different maternal positions have shown variable results on hemodynamic parameters, therefore, this study was planned to evaluate hemodynamic parameters in left lateral and sitting positions during spinal anesthesia for caesarean section.

Method

This prospective randomized study was conducted after obtaining approval from the institutional ethics committee. One hundred twenty-two American Society of Anesthesiologists physical status I and II parturients undergoing elective lower segment caesarean section were randomly allocated to group A (sitting) and group B (left lateral). A detailed pre-anesthetic examination with complete blood count and urine examination was carried out on the day prior to surgery. A written informed consent was taken from all the patients after explaining them the entire procedure to be followed in the study. All the patients were premedicated with tablet ranitidine 150 mg on the night before surgery and on the morning 1.5 hours before surgery.

Exclusion criteria included patient refusal, infection at the local site, contraindication to regional anaesthesia, age of parturient <18 years, allergy to bupivacaine, Preeclampsia, febrile patient, gestational age <36 weeks, Intrauterine growth retardation, failure to achieve desired level of spinal blockade and failure to identify L_{3-4} space.

Upon arrival in the operating room, pre-induction monitors including non-invasive blood pressure, six lead ECG and pulse oximetry were connected. Intravenous access was secured with an 18 G venous cannula on the dorsum of non-dominant hand. Parturient was positioned by a trained assistant in either sitting or left lateral position as per the lots. After cleaning and draping the back in a complete aseptic manner, L_{3-4} spinal space was identified and local anesthesia with 2% plain lignocaine was administered. Lumbar subarachnoid space was reached using a 27 G pencil point (pencan) spinal needle with the bevel of needle facing upwards. After ensuring a clear and free flowing cerebrospinal fluid, 2 ml of 0.5% hyperbaric bupivacaine solution was injected. Co-loading with 15 ml kg^{-1} of 0.9% normal saline was done. The parturients were made to lie down supine with a 15^0 wedge under the right hip. Sensory level was checked by inability to sense cold temperature using an ice cube and motor level by modified Bromage scale (1=able to raise legs, 2=able to flex knee, 3=able to move feet only, 4=no movement in legs or feet). When the sensory level reached T_4 surgery was commenced. Oxygen was administered via a face mask to all the parturients to maintain oxygen saturation above 94%.

Non-invasive blood pressure, heart rate and oxygen saturation were recorded every one minute for next 10 minutes and every five minutes later on till the completion of surgery. Hypotension was defined as fall in systolic blood pressure < 20% of the baseline value and was managed with injection ephedrine 6 mg IV and bolus of 250 ml crystalloid. Bradycardia was defined as heart rate < 60 beats per minute and was managed by injection atropine IV in increments of 0.6 mg. Time take to achieve sensory level, time of onset of first episode of hypotension, total number of episodes hypotension and bradycardia and total dose of ephedrine and atropine consumed were recorded. Any other side effects such as nausea, vomiting, shivering, dizziness and difficulty in breathing were also noted and managed appropriately. Additional data that was recorded included APGAR scores of neonates at 1 and 5

minutes, umbilical artery pH and incidence of post dural puncture headache, with each parturient followed up to postoperative day 3 for the same.

Statistical Analysis

Primary outcome measures included Incidence and onset of hypotension in the two groups. The secondary outcome measures noted were time taken to achieve sensory level, total dose of ephedrine used, neonatal outcome and incidence of post dural puncture headache in the two groups. With power of the study being 80% and 5% alpha error, the sample size came out to be 122 patients, Sixty-one patients in each group. At the end of study, all data was compiled and analysed in Statistical Package for Social Sciences (SPSS) version 16.0 using unpaired t test and chi square test for proportions. A p value of <0.05 was considered statistically significant.

Results

The demographic data was comparable in both the groups (Table 1). The time taken to reach a sensory level of T_4 and the time to first episode of hypotension was significantly more in sitting position as compared to lateral position (Table 2; $p<0.05$). The number of patients experiencing hypotension, number of hypotensive episodes and the total number of ephedrine bolus requirement were significantly more in lateral position as compared to sitting position following induction of spinal anesthesia (Table 3; $p<0.05$).

Neonatal outcome was comparable in both the groups (Table 3; $p>0.05$). There was no incidence of post dural puncture headache in any parturients.

Table 1: Demographic Data

Variables	Group I (Mean±SD)	Group II (Mean±SD)	p value
Age (years)	27.51±3.67	27.03±3.49	0.46
Weight (kg)	66.72±10.55	64.87±9.33	0.31
Height (cm)	154.0±4.42	153.51±4.89	0.56

Table 2: Time taken to reach a sensory level of T_4 and the time to first episode of hypotension

	Group A (n=61) (Mean ± SD)	Group B (n=61) (Mean ± SD)	p value
Time taken to reach a sensory level of T4 (minutes)	7.02 ± 2.60	2.52 ± 1.13	**0.00**
Time to first episode of hypotension (minutes)	6.08±3.38	3.58±2.0	**0.00**

Table 3: Incidence of Hypotension, Ephedrine requirements and Neonatal outcome

	Group A (n=61) (Mean ± SD)	Group B (n=61) (Mean ± SD)	p value
Number of patients experiencing hypotension [number (%)]	32 (52.4%)	53 (86.8%)	0.00
Total number of episodes of hypotension per patient	2.0 ± 0.90	3.60 ± 1.20	0.04
Total amount of Ephedrine required (milligrams)	9.53 ± 5.62	14.38 ± 9.93	0.02
Umbilical Artery pH	7.30 ± 0.074	7.28 ± 0.074	0.08

Discussion

The results of our study demonstrate that the time to reach level of sensory analgesia to T_4 and the time to first episode of hypotension was faster in lateral position as compared to sitting position. Also, the number of patients experiencing hypotension and the number of hypotensive episodes were observed to be more in lateral position as compared to sitting position. Total amount of ephedrine required was also more in lateral position. The primary outcome in our study was to find out incidence and onset of hypotension in the sitting and lateral position. Policies to define hypotension and vasopressor administration vary according to institutes and study designs. We took fall of more than 20% from systolic blood pressure as definition of hypotension. In literature different investigators

have taken different cut off points to define hypotension. While majority define hypotension as fall in systolic blood pressure, few studies describe it in relation to fall in Mean Arterial Pressure (MAP). In a study by Hwang et al, hypotension was defined 20% fall from baseline MAP, but ephedrine was administered when mean BP decreased by more than 30% from baseline.[4]We used supine and left lateral positions for administration of spinal anesthesia. Interestingly previous studies assessing the effects of these positions for spinal anesthesia for caesarean section have shown variable results. Left lateral position has been shown to be more comfortable and maintain placental perfusion more effectively as compared to sitting position.[5] In literature both right lateral and left lateral positions have been used for administering spinal anesthesia for caesarean section. Law AC et al assessed the effect of right lateral versus left lateral position for induction of spinal anesthesia for caesarean section.[6] He observed that all parturients acquired a loss of cold sensation at T_4, 15 minutes after intrathecal injection; more parturients in the left lateral group did so at 5 minutes. The maximum level of sensory blockade, amount of fluid and vasopressor were similar in both groups. They concluded that both positions can be used equally well when hyperbaric bupivacaine and fentanyl are used in caesarean delivery under spinal anesthesia.[6] Chadwick found that when parturient is placed in left lateral position, there may be excessive hip flexion reducing maternal cardiac output. Moreover, use of left lateral position may be associated with increased incidence of unilateral block.[7] In our study, there was no incidence of unilateral block. In a recent commentary by Okusanya BO et al, it was inferred that no specific maternal position can be recommended for use during caesarean section, however it may be advisable to caution clinicians about the findings that compared with left lateral tilt, more hypotensive events occur in women who are operated with right lateral tilt.[8]

The results of our study are different from a study conducted by Hwang et al, where the authors observed that there was no significant difference in the lowest blood pressure, total ephedrine use or incidence of hypotension when spinal anesthesia is administered in sitting or lateral position.[4] The difference can be attributed to the fact that they maintained lateral position for 6 minutes after intrathecal injection of hyperbaric bupivacaine. Further the authors commented that maintaining prolonged lateral position resulted in a more gradual and higher cephalad sensory block, without an increase in the incidence of maternal hypotension. We used hyperbaric bupivacaine for spinal anesthesia in our study. In literature while majority of studies have used hyperbaric bupivacaine for spinal anesthesia, there are a few studies describing the use of isobaric and hypobaric bupivacaine. In some studies, use of plain bupivacaine is shown to be having unpredictable spread and greater inter patient variability.[9] Plain bupivacaine is usually considered isobaric in nature. However Pitaken et al commented that it is not accurate to use the term plain solution for the local anesthetic solutions, as several studies have confirmed that plain bupivacaine is indeed hypobaric in nature.[10] In another study by Imarengiaye et al, it has been shown that hypobaric bupivacaine increases the risk of maternal hypotension, thereby questioning its safety in sitting position.[11] The early onset of hypotension in patients who were administered spinal anesthesia in left lateral position as compared to sitting position can be explained by the early and greater spread of hyperbaric bupivacaine in the left lateral group, When spinal anesthesia is performed in the lateral position, there is both cephalad and caudal spread, whereas when used in sitting position, hyperbaric bupivacaine gravitates in the sacral region of dural sac.

Another factor which influences the spread of hyperbaric bupivacaine in lateral position is body shape. Males have broader shoulders as compared to hips. Therefore, their vertebral column tends to

have a head up tilt in the lateral position; in females reverse happens. This can also explain more cephalad spread of hyperbaric bupivacaine in lateral position as compared to sitting.[12]

The spread of local anesthetic is influenced by its baricity when injected into subarachnoid spread, thereby affecting the block height. The use of hyperbaric local anesthetic solutions is associated with more predictable spread as compared to iso or hypobaric local anesthetic. This is the reason that hyperbaric bupivacaine is more popular for spinal anesthesia for caesarean section. In some studies ethyl chloride spray or loss of sensation to pinprick has been used to assess the maximum level of sensory blockage.[13] Absence of sensation to light touch has also been used to assess the maximum level of sensory blockage. We used ice cube to assess the level of block as done in study by Hwang et al. It has been commented in one study that assessment of sympathetic block by cold test is better as it may have may have more relationship with hypotension.[4] Inglis et al in their study commented that occasionally a parturient may have an analgesic level to the T_4 dermatomal level, but still be aware of a blunt sensation to pinprick at T_{12} and in these circumstances, the parturient is more likely to feel discomfort. They assessed the block as (a) analgesic level –aware of pinprick, but no sensation of sharpness (b) anesthetic level – not aware of pinprick.[1] The incidence of maternal hypotension has been estimated to occur in 30%-90% of cases.[13] This produces unpleasant symptoms such as nausea, vomiting, and light headedness. More importantly, when severe and sustained, hypotension can impair uterine and intervillous blood flow and result in fetal acidosis and neonatal depression.[14] There is no consensus to the optimal mode of management. Prevention measures include fluid preload, left lateral tilt, and use of vasopressors.[14] Choice of type of fluid and vasopressor vary according to institutional protocol. Ephedrine has a strong β adrenergic and a weaker α-adrenergic effect making it very useful for management of maternal hypotension, but its use has been challenged because of potential complication that supra ventricular tachycardia, tachyphylaxis, and most importantly fetal acidosis.[14] Several studies demonstrated that phenylephrine use is associated with better neonatal outcome as compared with ephedrine. In fact, it has become firmly established as a vasopressor of choice for both prophylaxis and treatment of spinal hypotension on obstetrics, but the use of phenylephrine is associated with reflex bradycardia and reduction in maternal cardiac output.[15] To overcome such problems Cooper et al studied the effect of phenylephrine and ephedrine alone or in combination on maternal hypotension. They found a lower incidence of fetal acidosis in the groups receiving phenylephrine alone or in combination with ephedrine.[15] Several other studies confirmed that there is no use of combining two vasopressors.[16] Heesen et al in a recent editorial commented upon closed–loop systems with infusion pump that responds according to a programmed algorithm, by altering the administration of vasopressor.[17] A smart system was developed by other workers where 50 micrograms phenylephrine was administered when systolic blood pressure fell below 90% of baseline and if Bradycardia accompanied hypotension ephedrine was infused.[18] We used ephedrine in our study as per our institutional protocol. Moreover, we did not use prophylactic ephedrine. There are two more areas of debate. One is whether to use Infusion or manual boluses of vasopressor. Other is whether vasopressor should be used prophylactic or administered as and when indicated. Hessen et al have commented that infusion can reduce the workload of the anesthesiologist. Manual boluses of a vasopressor to treat hypotension or symptoms of nausea or vomiting can occupy attention of anesthesiologist.[17] However in our institute; it is a routine to use boluses as compared to vasopressor infusion. In accordance with Simin et al, we did not administer vasopressors as prophylaxis.[19] It was not considered ethically right as vasopressor could not be administered to a patient having

already tachycardia. Moreover, some clinical studies have not supported the prophylactic use of vasopressors for prevention of spinal hypotension.[19] It was agreed recently that the ideal vasopressor regimen should allow careful titration to each individual parturients need, according to changes in haemodynamic parameters.[19]

Although there was more incidence of hypotension in the lateral as compared to sitting position, neonatal outcome was comparable in both the groups. Our finding is supported by the study done by Maayan et al who investigated the extent and risk factors for hypotension among women undergoing elective caesarean section, and whether maternal hypotension has any impact on perinatal infant outcome. This was retrospective analysis of 919 mother-infant pairs after elective caesarean section that involved the use of regional anaesthesia. Data collection included information on maternal blood pressure during the caesarean section procedure and any infant perinatal complications. They found that one-half of the mothers underwent a decrease in their mean arterial blood pressure by more than or equal to 30%. The risk factors for hypotension included preoperative hypertension, older age, type of spinal anesthesia, and a higher infant birth weight. A drop in the maternal mean arterial blood pressure exceeding 30% or even 50% compared with the preoperative value was not found to predict any perinatal complications. They concluded that despite a very high prevalence of maternal hypotension during caesarean sections, term infants tend to tolerate this placental blood perfusion challenge without any major sequel.[20] The limitation in our study was that we did not assess the comfort of the patients and their satisfaction in both the positions even though none of the patients requires any supplemental anesthesia In a study by Vincet et al, it was observed that the lateral position is more comfortable for the parturient as compared to other positions.[8] Placental perfusion is also maintained more effectively in lateral position as compared to sitting position.[6,7] However lateral position is usually associated with occurrence of excessive hip flexion resulting in reduction of maternal cardiac output. Moreover, when patients are made supine from lateral position with a wedge under the right hip, unilateral blocks may occur. To reduce this, it has been suggested that spinal anesthesia may be induced with the parturient in the right lateral position.[4]

We used single shot spinal anesthesia for our patients. In literature majority of the times combined spinal epidural technique has been used for lower segment caesarean section. This is said to be a better technique in comparison with single shot spinal anesthesia as supplementation of inadequate block can be achieved via the epidural route. Moreover, if surgery gets prolonged because of any reason, sensory analgesia can still be maintained. In literature failure rate of spinal anesthesia has been reported from 0.46% to as high as 35%.[21] There was no failure of spinal anesthesia in our study.

Conclusion

Although there is more incidence of hypotension in the lateral as compared to sitting position, when spinal anesthesia is administered using 0.5% hyperbaric bupivacaine in parturients undergoing elective caesarean section, it does not have any adverse effect on neonatal outcome. Any of the two positions can be used for administration of spinal anesthesia depending upon comfort of the parturient and preference of anesthesiologist.

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