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Comparison of the Hemodynamic Changes in Normotensive and Severe Preeclamptic Pregnant Woman Posted for Cesarean Section under Subarachnoid Block

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Abstract
Background: *Anaesthetic approach to caesarean section in severely pre-eclamptic patients has considerably changed during the last few decades. Spinal anesthesia is widely regarded as a reasonable anesthetic option for cesarean delivery in severe preeclampsia, provided there is no indwelling epidural catheter or contraindication to neuraxial anesthesia. The aim of this study was to compare the haemodynamics between normal healthy parturients and patients with severe pre-eclampsia undergoing LSCS under spinal anaesthesia.*
Materials and Methods: *Spinal anesthesia was performed in two groups of parturients (31 in each group) with singleton pregnancy posted for elective LSCS. Heart rate and blood pressure were recorded before spinal anesthesia and thereafter at 3 minute intervals upto 60 minutes. Hypotension was defined as MAP <30% of the baseline or a decrease in SBP to < 100 mm Hg over the same time interval and was treated with 50 mcg phenylephrine i.v.*
Results: *The incidence rate of hypotension among the preeclamptic patients was lower than that of the healthy parturients (P <0.05). The total doses of IV Phenylephrine for treating hypotension were significantly lower among the preeclamptic patients (72 mcg in preeclamptic patients versus 188 mcg in normotensive patients) (P <0.05). There was no statistical difference in the neonatal outcome and APGAR score in the study groups.*
Conclusion: *Spinal anaesthesia in preeclampsia patients is associated with better perioperative hemodynamic stability, less hypotension and less vasopressor consumption.*
Keywords: *Preeclampsia, Cesarean, Anaesthesia, Spinal, Hypotension.*

Background

Anaesthetic approach to casarean section in severely pre-eclamptic patients has considerably changed during the last few decades. Though spinal anaesthesia is often the preferred technique for caesarean delivery[1,2], it was not initially preferred for severely pre-eclamptic women due to significant intravascular volume deficits related to widespread arteriolar vasoconstriction. Because of the probable difficult airway management and the haemodynamic consequences of laryngoscopy and tracheal intubation, general anaesthesia was usually chosen only when regional techniques were contraindicated[3].

During the last few decades, epidural anaesthesia was preferred over spinal anaesthesia in pre-eclamptics for cesarean section due to the fear of sudden and extensive sympathetic block in them causing dangerous hypotension compromising both mother and foetus. Also, large volumes of fluids administered to treat this hypotension could potentially cause pulmonary oedema[3,4].

However, several studies now show that, women with severe pre-eclampsia are at a lower risk of hypotension than normotensive women[2,3]. Other studies show that the incidence and severity of hypotension is similar in severe pre-eclamptics having a caesarean delivery under spinal anaesthesia compared with epidural anaesthesia[5,6].

The aim of this study was to compare the haemodynamics between normal healthy parturients and patients with severe pre-eclampsia undergoing LSCS under spinal anaesthesia.

Materials and Methods

After obtaining approval from the hospital ethical committee and written and informed consent from the participants, 62 parturients with singleton pregnancy posted for elective LSCS were selected for this study and divided into two groups of 31 women each. Group A consisted of parturients with severe pre-eclampsia and Group B of normal healthy women.

Severe preeclampsia was defined as systolic blood pressure (SBP) ≥160 mm Hg, diastolic blood pressure (DBP) ≥110 mm Hg, or both[7]. The pharmacologic treatment of hypertension before the procedure was done as per hospital protocol. The severely pre-eclamptic women requiring antihypertensive therapy were started on tablet labetalol 100 mg TDS orally. Magnesium sulfate therapy was started as per hospital protocol (4 gm 25% $MgSO_4$ i.v over 20 min followed by 5gm 50% $MgSO_4$ 4 hourly in alternate buttocks).

Baseline BP was measured as the mean of the three readings taken 5 min after arrival in the operation theatre and before doing any invasive procedures. Prehydration was done with 10 ml/kg body weight of lactated Ringer (RL) solution. After proper asepsis and draping, both groups were administered spinal anaesthesia with 0.5% hyperbaric bupivacaine and Inj fentanyl 25mcg as per hospital protocol. Patients were placed supine with left lateral tilt of the OT table and received oxygen 4 Lt/min by facemask.

The maternal parameters HR, SBP, DBP and MAP were recorded at 3 minute intervals from the induction of spinal anaesthesia upto 60 mins. Oxytocin 3 IU was given iv (over more than 15 sec) immediately after delivery of the head of the baby and assessed for 3 min. If uterine tone was inadequate, 3 IU oxytocin intravenous rescue dose was given (maximum 2 doses).

Hypotension was defined as MAP <30% of the baseline or a decrease in SBP to < 100 mm Hg over the same time interval. Incidence of hypotension was treated with 50 mcg phenylephrine i.v bolus, and repeated at 5 min intervals if required. Bradycardia (HR<60 beats/min) if associated with hypotension was treated with Inj Atropine 0.6mg i.v. The amount of Inj Phenylephrine and Atropine (if needed) was noted. Apgar score at 1 and 5 min, birth weight of the babies and placental weight were also noted.

Student t-test, Chi-square test and Wallis test were used to calculate the statistical significance in the study groups considering a P value of <0.05 as significant. IBM SPSS 21.0 software was used for performing statistical analysis.

Results

The study groups A and B were comparable in terms of age, weight, height, ASA status (I and II), duration of pregnancy (37.67±1.07 and 37.93±0.77) and the volume of RL preloading (568.38±36.79 and 556.77±36.09).

The baseline heart rate was similar in both groups (p>0.05). The baseline SBP, DBP and MAP values were higher in the severely preeclamptic group compared to the normotensive group (P<0.05).

Statistical analysis of the SBP, DBP and MAP characteristics shows that there is a significant difference in the change in blood pressure from their baseline values between the two groups following the administration of spinal anaesthesia (Fig 1-6).

The maximum value of SBP, DBP and MAP after SA in group A was significantly higher compared to group B (P<0.05).

The minimum value of SBP, DBP, MAP was smaller in group B.

On comparison of the fall in blood pressure from the baseline in group A and group B it was seen that the maximum and average change in SBP, DBP and MAP in GROUP B was significantly higher statistically than group A (P<0.05.)

The percentage (%) fall in MAP from the baseline between the two study groups was also found to be statistically significant (p< 0.05). Fall in MAP (%) was significantly higher in group B compared to group A (Fig 7).

Thus the magnitude of the decrease in blood pressure was significantly smaller in preeclamptic group.

The increase in HR was of larger magnitude in group B. There was statistical difference in the heart rate pattern in both the study groups (p<0.05).

The amount of phenylephrine consumption was significantly higher in GROUP B (Fig 8).

The placental weight was found to be less in patients of group A than in group B.

There was no incidence of neonatal depression in both the study groups. There was no statistical difference in the neonatal outcome and APGAR score in the study groups.

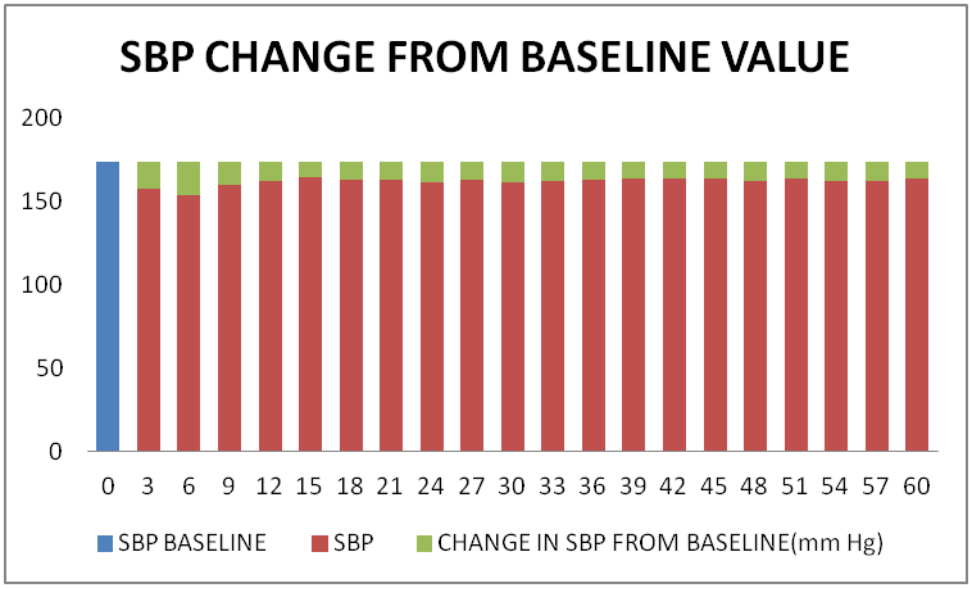

Fig 1: change in SBP from baseline GROUP A after SA

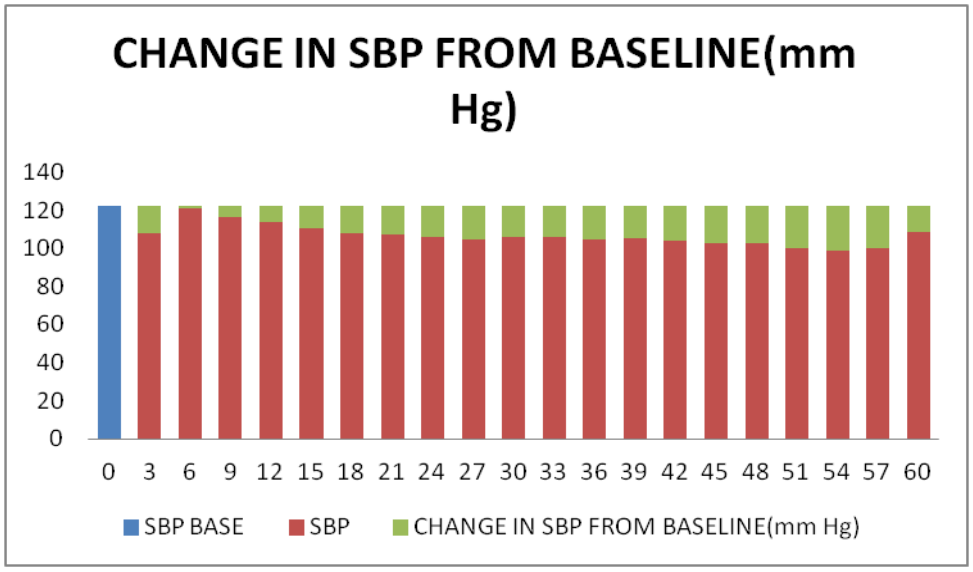

Fig 2: change in SBP from baseline GROUP B after SA

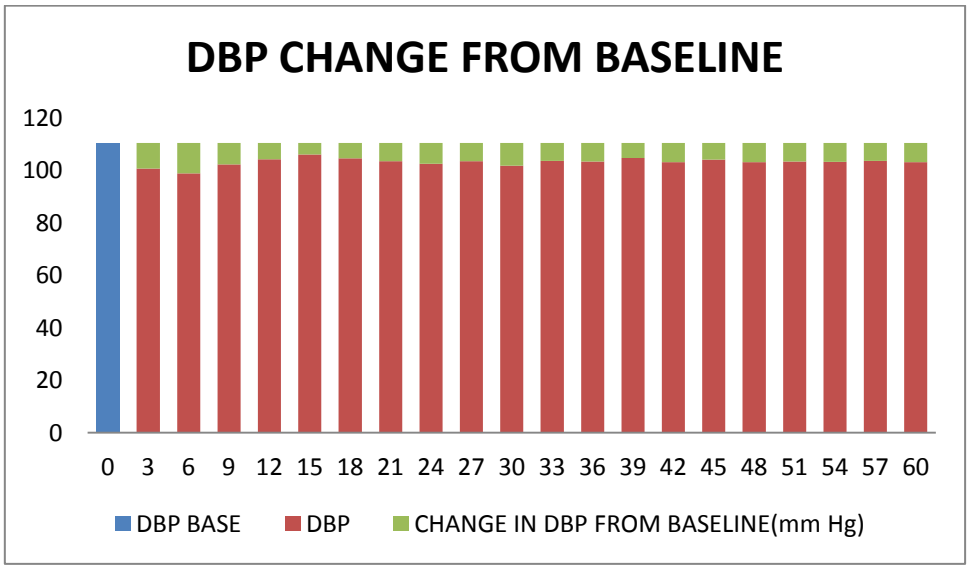

Fig 3: change in DBP from baseline GROUP A after SA

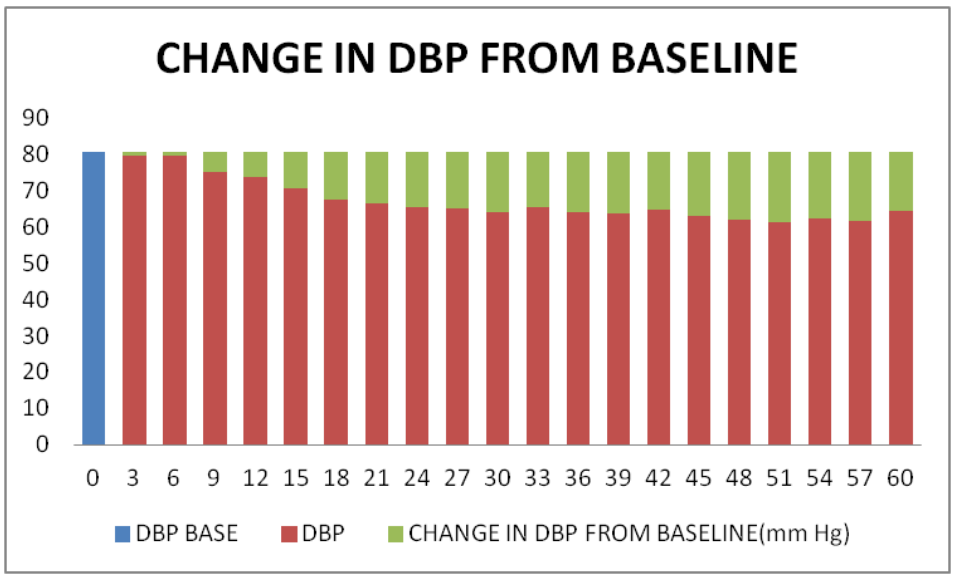

Fig 4: change in DBP from baseline GROUP B after SA

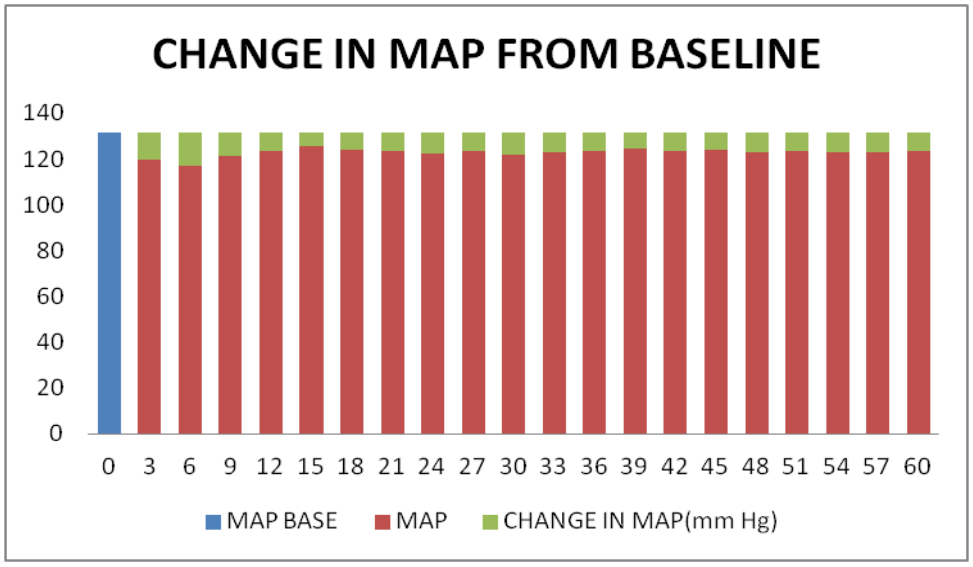

Fig 5: change in MAP from baseline GROUP A after SA

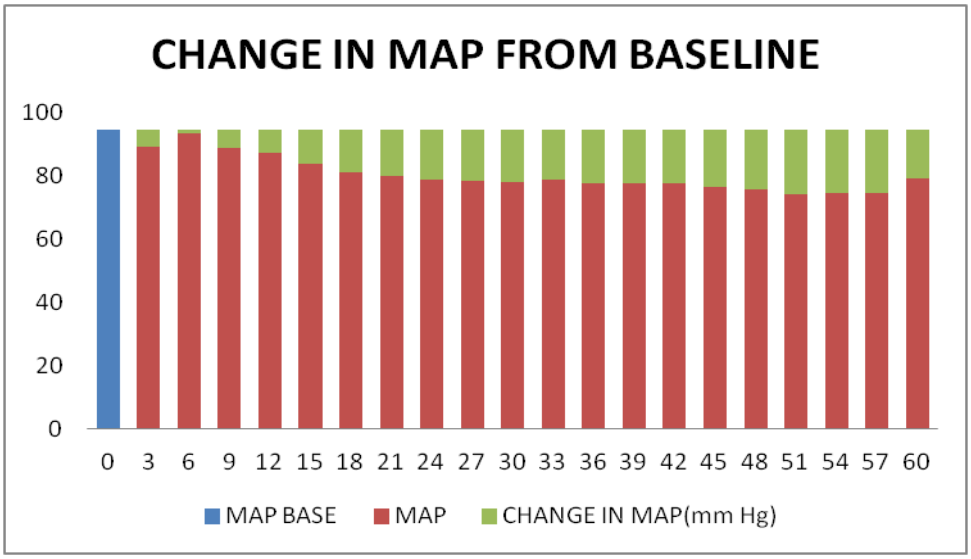

Fig 6: change in MAP from baseline GROUP B after SA

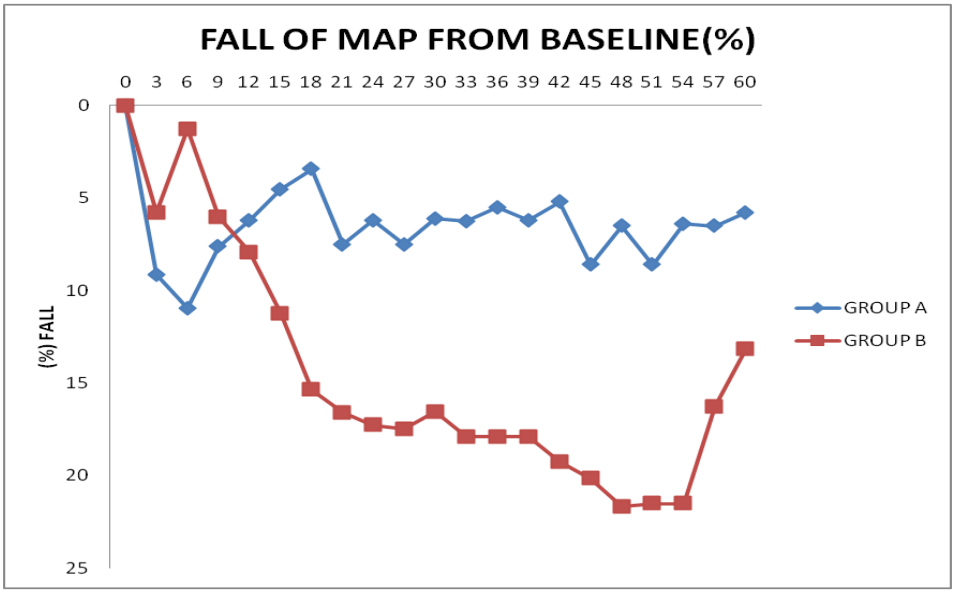

Fig 7: trend in fall of MAP from baseline.

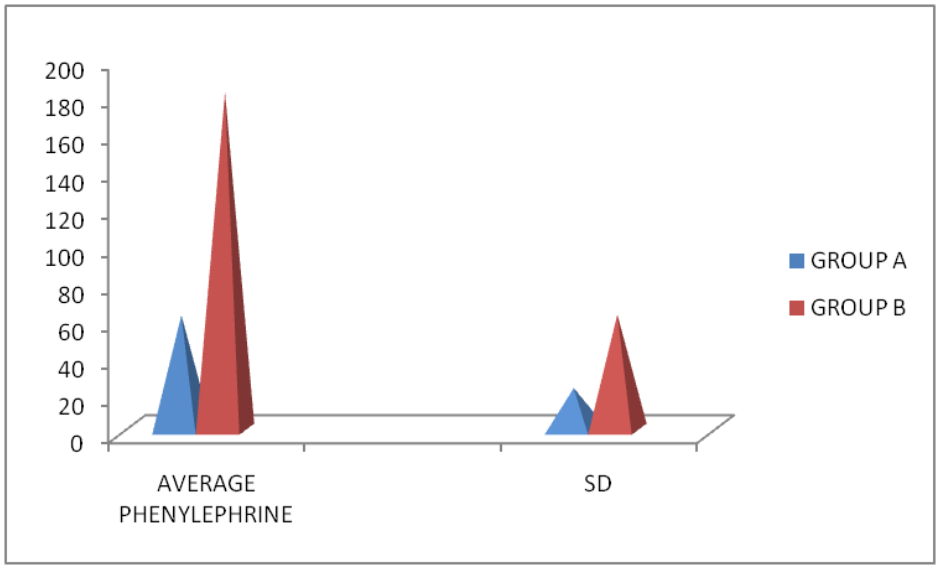

Figure 8: Distribution of phenylephrine consumption in the two groups.

Discussion

The choice of anaesthesia for caesarean section is determined by multiple factors, including the indication for operation, its urgency, patient and obstetrician preferences, and the skills of the anaesthesiologist. Both general and central neuraxial anaesthesia are being used for caesarean section. Though spinal anaesthesia is one of the most popular and commonly used anaesthetic technique for caesarean section, it is not without unwanted side effects with the most common among them being hypotension[9].

In the past, epidural anaesthesia was preferred over spinal anaesthesia in preeclamptics for caesarean section because of the fear of causing dangerous hypotension. In the last two decades, several studies have shown that, women with severe preeclampsia appear to be at lower risk of hypotension than normotensive women having caesarean delivery under spinal anaesthesia.

This prospective observational study was carried out to reevaluate the safety and haemodynamic status of patients with severe preeclampsia undergoing caesarean section under spinal anaesthesia.

After spinal anaesthesia, the maximum and average change in SBP, DBP and MAP from baseline values was higher statistically in group B than group A ($P<0.05$). The increase in HR also was of larger magnitude in group B.

The incidence of clinically relevant hypotension leading to phenylephrine requirement was lower in the severely preeclamptic group A as compared to normotensive group B, which is statistically significant ($p<0.05$).

Neonatal outcome was similar in both the groups.

Our study had similar results to Aya et al[3] who found less decrease in DBP and MAP in patients with preeclampsia compared to normotensive women under SA. Baseline HR was similar in both study groups and there was increase in HR of higher magnitude in healthy parturients.

Saha et al[10] found that minimum SBP, DBP and MAP recorded were always higher in the preeclamptic group, in comparison to the normotensive group. The percentage fall in MAP calculated from baseline was also less in the preeclamptic group.

In their study, H Ishrat, A Raja et al[11]claimed that preeclamptic patients experience less hypotension than healthy parturients following spinal anaesthesia and fall in DBP and MAP was significantly less than in healthy controls. Baseline values of HR was similar in the 2 groups and the incidence of HR changes did not differ significantly among the study groups, albeit, the magnitude of increase in HR was larger in healthy patients. Our study results were also similar to their study.

Another similar study was done by Clark VA, Sharwood-Smith GH, Stewart AV et al[12].

Our study was also designed to rule out blood pressure difference between the preeclamptic and normotensive women due to aorto-caval compression, as we included only women whose baby weight was (2300±200) gm. This was done to control the uterine mass.

The baby weight of preeclamptic women compared to normotensive women was statistically not significant (p>0.05).

The placental weight was also taken into account. The preeclamptic group had less placental weight compared to the normotensive women which was statistically significant (p<0.05).

The reduced incidence of hypotension after spinal anaesthesia in severe pre-eclamptics in the earlier study done by Aya et al[3] was initially attributed to be due to the lower gestational age and weights in the preeclamptic parturients. The small uterine mass was thought to cause less aortocaval compression compared to the normotensive group[13]. However, this hypothesis was rejected after the study of Aya et al[2], which compared the incidence and severity of hypotension between severe pre-eclamptics and parturients with preterm pregnancy undergoing caesarean delivery with SAB. They concluded that small uterine mass was unrelated to the hypotension, and the probable reason behind less fall in blood pressure was altered vascular response mainly due to humoral factors.

Our study excluded any changes in blood pressure caused by differences in aorto-caval compression due to differences in uterine mass between the severely preeclamptic and the normotensive women during the procedure and thus corroborates with the study done by Ayaet al[2].

In our study, the incidence of clinically relevant hypotension leading to phenylephrine requirement was lower in the severely preeclamptic group compared to the normotensive group, which is statistically significant (p<0.05).

This result was similar to the study done by Dona Saha, Sarmila Ghosh et al[10] who also found significantly higher phenylephrine consumption in normotensive women. Aya et al[2,3] also found similar results when using ephedrine for treating hypotension following SA in severely preeclamptic and normotensive women.

In another study, Dyer et al[14] observed the hemodynamic responses to SAB for caesarean delivery in 15 severe pre-eclamptic parturients and used the beat-to-beat monitoring of cardiac output (CO) for this purpose. The effect to phenylephrine on CO was also observed. They concluded that the changes in CO after SAB in severe pre-eclamptics were insignificant, and the reduction in MAP was easily restored by phenylephrine without any decrease in maternal CO.

In normal pregnancy, increased synthesis of endogenous vasodilators like prostaglandins (PGs) and nitric oxide (NO) produces a vasodilated state, and there appears to be an increased dependence on sympathetic vasoconstriction for control of vascular tone. This explains the sudden and excessive hypotension after sympathetic blockade produced by SAB in them.

In pre-eclampsia, vascular endothelial damage occurs, which produces increased amount of endogenous vasopressors like thromboxane and endothelin that are responsible in maintaining vessel tone. Sympathetic block following SAB does not alter this vascular response, limiting the excessive fall of BP in pre-eclamptics.

According to several authors in normal pregnancy, there is reduced sensitivity to exogenous vasoconstrictors leading to increased vasopressor requirement to reverse the hypotensive effect after SAB. In preeclampsia, there is an increased sensitivity to vasoconstrictor agents, and hence less vasopressor is required[2,3,10,12,15].

We compared the neonatal outcome by measuring the APGAR score at 1 min and 5 min after the delivery of the baby. There was no statistical difference between group A and group B regarding the APGAR score (p>0.05). This also corroborates with the studies by authors who found similar neonatal outcome in preeclamptic

women and normotensive women after SA[2,3,10, 14,16,17].

In conclusion, the present study shows that though fall in blood pressure occurred in both the study groups after SA, hypotension was significantly less in severe preeclamptics than in healthy pregnant women and no adverse effects were noted in both the groups. In addition, phenylephrine requirements were also less in preeclamptic parturients and neonatal outcome was the same in the two groups.

Thus, spinal anaesthesia is a good choice for CS when compared to GA or EA for patients with severe preeclampsia as it is simple, rapid, cost effective, safe and has a high intensity of block.

Conclusion

The present study is in agreement with the recent evidences that, spinal anaesthesia is associated with better perioperative hemodynamic stability, lower risk of hypotension and vasopressor requirements in comparison to the rates of healthy subjects, and could be safely used in patients with severe preeclampsia undergoing cesarean delivery.

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