Comparison of the Hemodynamic Changes in Normotensive and Severe Preeclamptic Pregnant Woman Posted For Cesarean Section under Spinal Anaesthesia

Abstract: Background: Spinal anesthesia is widely considered a technique of choice for cesarean delivery. But due to fear of sudden and extensive sympathetic blockade, spinal anesthesia may not be considered safe in severe preeclampsia. Objectives: The aim of the present study was to compare the heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), incidence of hypotension, phenyl ephrine requirement and neonatal outcome between normotensive and severe pre-eclamptic women undergoing cesarean section under spinal anesthesia. Material and Methods: A total of 35 severe pre-eclamptic (BP > 160/110 mmHg) 3 (Group A) and 35 healthy parturients (group B), meeting the inclusion criteria were included in the study. After preloading with 10 ml/kg of ringer lactate (RL) solution spinal anesthesia was administered with 12.5 mg of hyperbaric bupivacaine. 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 intravenously (i.v). Apgar score was noted 1 and 5 min after birth. Results: The incidence rate of hypotension among the preeclamptic patients was lower than that of the healthy parturients (55.6% vs. 34.1%). The minimum SBP, DBP, and MAP recorded were lower in normotensive, and the difference between two groups was statistically significant. The mean phenylephrine requirement in the normotensive group (151.1 ± 70) was significantly greater (P < 0.0001) than that of pre-eclamptic group (48.3 ± 35). 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: Pre-eclamptics experienced less hypotension following subarachnoid block (SAB) than normotensives and required less phenylephrine with comparable fetal Apgar scores. Keywords: pre-eclampsia, phenylephrine, Apgar, hemodynamic changes, subarachnoid block.

INTRODUCTION
Preeclampsia/eclampsia is the third leading cause of maternal morbidity and mortality globally. There is an acceptable change in the practice of obstetrics anesthesia from general to spinal anesthesia for Cesarean section (Aya, A. G. et al., 2003). Risks related to airway edema, difficulty with the airway or failed intubation, hypertensive exaggerated response to direct laryngoscopy, and risk of aspiration pneumonitis, associated with general anesthesia are the factors that most anesthetists are concerned about in severe preeclamptic patients (Chumpathong, S. et al., 2016). However, spinal anesthesia has not yet been very acceptable choice for severe eclampsia due to the fear of sudden and extensive sympathetic blockade following subarachnoid block (SAB) that may result in severe hypotension which might compromise maternal and fetal safety (Banerjee, A. et al., 2010). It was in this context that the present study was done to compare the hemodynamics, incidence of hypotension, phenyl ephrine requirement and neonatal outcome between normotensive and severe pre-eclamptic women undergoing cesarean section under spinal anesthesia.

MATERIAL AND METHODS
After obtaining approval from the hospital ethical committee, written and informed consent was obtained from 70 non-laboring parturients of American Society of Anesthesiologists (ASA) grade I or II of age 18-30 years, weight 45-70 kg. with singleton pregnancy posted for elective LSCS.
They were divided into two groups of 35 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 associated with proteinuria > 5 g in 24 hours. Parturients with cardiac disease, chronic hypertension, renal disease, diabetes mellitus, coagulopathy (platelet counts < 50,000/mm³), placental abruption, severe fetal distress, a history of allergy to local anesthetics, oliguria of less than 500 mL in 24 hours or persistently < 30 mL/hour, cerebral or visual disturbances, pulmonary edema, hemodynamic instability, local infection of the spinal injection site, and those who refused SAB were excluded from the study. 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% MgSO4 i.v over 20 min) followed by 5gm 50% MgSO4 4 hourly (in alternate buttocks) for seizure prophylaxis. All parturients were premedicated with oral ranitidine (150 mg) and oral metoclopramide (10 mg) 2 hours prior to the surgery. In addition, antihypertensive medication was continued in pre-eclamptic parturients. After establishing IV access with 18 G cannula prehydration was done with 10 ml/kg body weight of lactated ringer (RL) solution over 15 - 20 minutes. All baseline monitors were attached. 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.

After proper asepsis and draping, SAB was given using 26G -spinal needle at L3-4 interspace in sitting posture with 12.5 mg hyperbaric 0.5% bupivacaine. Patient was then placed supine with a 10-cm wedge under the right buttock to prevent aortocaval compression. Ringer’s Lactate was infused at the rate of 5 ml/kg/h. Surgery was allowed as soon as sensory block reached T2. 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). Heart rate and blood pressure were recorded before performing spinal anesthesia and at two-minute intervals for 15 minutes after the block, and then every five minutes until the end of the surgery. Hypotension was defined as more than 30% decline in mean arterial blood pressure (MAP) compared to the baseline in both the groups (or systolic blood pressure (SBP) < 100 mmHg in healthy parturients) and was treated with 50 mcg phenylephrine i.v bolus. Bradycardia (HR < 60 beats/min) if associated with hypotension was treated with injection atrooprine 0.6 mg i.v. (maximum 1.8 mg). Lowest SBP, DBP, and MAP were noted for each patient and for the HR both the lowest and highest values were recorded. The total amount of phenylephrine consumed was also recorded. Apgar score at 1 and 5 min and gestational age of the baby were also compared. Both the study groups had adequate block for cesarean section and none of the participant was excluded from the study due to inadequate block.

Statistical Analysis

Data was compiled in Microsoft Excel worksheet using the Statistical Package for Social Sciences (SPSS) version 20. Data were explored for normally using Kolmogrov-Smirnov test and Shapiro-Wilk test. Categorical data were summarized as percentages. Comparisons between the 2 groups with respect to normally distributed numeric variables were done using the Independent t-test. Non normally distributed numeric variables were compared by Mann-Whitney test. For categorical variables, differences were analyzed with chi square test and Fisher’s exact test when appropriate. P-values <0.05 were considered significant.

RESULTS

There was no statistically significant difference between two groups regarding their demographic data (Table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>GROUP A (n= 35)</th>
<th>GROUP B (n= 35)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>27.94 ± 4.01</td>
<td>27.91 ± 3.58</td>
<td>0.971</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65.72 ± 6.80</td>
<td>66.90 ± 6.65</td>
<td>0.403</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158.47 ± 6.30</td>
<td>159.10 ± 5.87</td>
<td>0.172</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>37.44 ± 1.25</td>
<td>38.56 ± 1.63</td>
<td>0.926</td>
</tr>
</tbody>
</table>

The baseline SBP, DBP, and MAP were higher in the pre-eclamptic group. The mean baseline HR was comparable between the two groups.

The SBP, DBP and MAP all decreased from the baseline in both the groups following SAB. However, in the preeclamptic parturients, mean SBP, DBP and MAP were higher than the corresponding values among non-preeclamptic parturients following spinal anesthesia at each point of time. The incidence rate of hypotension in the preeclamptic patients (55.8%) was less than that of the healthy parturients. Phenylephrine consumption was significantly less in pre-eclamptic group as compared to the normotensive group. There was no incidence of neonatal depression in both the study groups. There was

---

Table 1: Demographic Profile of Study Population

---
no statistical difference in the neonatal outcome and Apgar score in the study groups.

**RESULTS**

All 70 patients selected were included in the study. Parturients in the two groups were comparable regarding age, weight, height, and gestational age of fetus (Table 1). The baseline SBP, DBP, and MAP were higher in the pre-eclamptic group. The mean baseline HR was comparable between the two groups. The mean lowest SBP and MAP measured among the preeclamptic patients was consistently higher than the corresponding values among the healthy parturients and the difference was statistically significant (Table 2). Furthermore, the total doses of IV phenylephrine for treating hypotension were significantly lower for the preeclamptic patients than for the normotensive patients and the difference was highly significant (p< 0.0001). Neonatal Apgar scores were slightly lower for preeclamptic group but the difference was not significant statistically.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>GROUP A (n=35)</th>
<th>GROUP B (n=35)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of MAP hypotension %</td>
<td>13 (37.1)</td>
<td>20 (57.1)</td>
<td>0.036</td>
</tr>
<tr>
<td>Mean HR after SA (beats/minute)</td>
<td>89.21 ± 12.33</td>
<td>90.40 ± 9.96</td>
<td>0.35</td>
</tr>
<tr>
<td>Lowest SBP mmHg</td>
<td>118 ± 16.8</td>
<td>98 ± 11.3</td>
<td>0.021</td>
</tr>
<tr>
<td>Lowest DBP mmHg</td>
<td>68.5 ± 15.3</td>
<td>48.5 ± 10.2</td>
<td>0.034</td>
</tr>
<tr>
<td>Lowest MAP mmHg</td>
<td>84.2 ± 13.6</td>
<td>65.9 ± 11.1</td>
<td>0.008</td>
</tr>
<tr>
<td>Phenylephrine consumption (µg)</td>
<td>49.3 ± 34.35</td>
<td>150.1 ± 71.1</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Apgar Score 1 min</td>
<td>8.2 ± 1.6</td>
<td>8.4 ± 0.5</td>
<td>0.76</td>
</tr>
<tr>
<td>5 min</td>
<td>8.8 ± 1.4</td>
<td>9.4 ± 0.6</td>
<td>0.36</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Over decades epidural anaesthesia was preferred over spinal anaesthesia in preeclamptics for caesarean section owing to fear of causing hypotension that might compromise mother and fetus as well as pulmonary oedema resulting from large volumes of fluid resuscitation (Banerjee, A. et al., 2010). However, a few studies have shown that the two techniques produce a similar incidence and severity of hypotension in preeclamptic parturients (Hood, D. D., & Curry, R. 1999; & Visalyaputra, S. et al., 2005). Because of its simplicity, faster onset, lower dose of injected local anesthetic (which decreases the chances of systemic toxicity), and less tissue trauma caused by the use of a smaller gauge spinal needle, spinal anesthesia for severe preeclampsia is being widely accepted as technique of choice for neuraxial anesthesia.

In this study, we compared the hemodynamic effects and vasopressor requirement after SAB between normotensive parturients and severe pre-eclampsics undergoing cesarean section under spinal anesthesia. The present study shows that though fall in blood pressure occurred in both the study groups after SA, hypotension was significantly less in severe preeclampsics 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. 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. The study results were similar with the study of Aya et al., comparing the incidence and severity of hypotension and ephedrine consumption in 30 pre-eclamptics and 30 healthy parturients (Aya, A. G. et al., 2003). They found that SAB induced hypotension was less in pre-eclamptics group and they required significantly less ephedrine to treat it. Other studies too have reported similar results (Clark, V. A. et al., 2005; Ishrat, H. M., & Raja, A. T. 2007; Sivevski, A. et al., 2019; Moshiri, E. et al., 2017; & Mitra, M. et al., 2016).

In the study conducted by Saha et al., found that minimum SBP, DBP and MAP recorded were always higher in the preeclamptic group, in comparison to the normotensive group (Saha, D. et al., 2013). The percentage fall in MAP calculated from baseline was also less in the preeclamptic group. Dyer et al., observed the hemodynamic responses to SAB for cesarean delivery in 15 severe pre-eclamptic parturients and used the beat-to-beat monitoring of cardiac output (CO) for this purpose (Dyer, R. A. et al., 2008). They concluded that the changes in CO after SAB in severe pre-eclamptics were insignificant, and the reduction in MAP was easily managed by phenylephrine without any fall in maternal CO. Contrary to our results, Mendes et al., found that there was no significant difference in the lowest mean drop of SBP and DBP after spinal anesthesia between preeclamptic and healthy parturients (Mendes, F. F. et al., 2011).

In normal pregnancy, increased production of endogenous vasodilators like prostaglandins (PGs) and nitric oxide (NO) produces a vasodilated state, and there is 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 (Aya, 2010).
In preeclampsia, vascular endothelial damage occurs leads to increased amount of endogenous vasoconstrictors like thromboxane and endothelin that are responsible in maintaining vascular tone. Sympathetic block after SAB does not change this vascular response, thereby limiting the excessive drop BP in pre-eclamptics (Aya, A. G. et al., 2003; & Redman, C. W. G., & Sargent, I. L. 2003). In normal pregnancy, there is decreased sensitivity to exogenous vasoconstrictors resulting in increased vasoconstrictor requirement to reverse the hypotensive effect after SAB. In preeclampsia, there is a higher sensitivity to vasoconstrictor agents, and less vasoconstricor is required (Saha, D. et al., 2013; Nikooseresh, M. et al., 2016; & Nag, D. S. et al., 2015). Even with varying incidence of hypotension and IV phenylephrine to treat it, we found comparable and good neonatal outcome in both the groups in respect to Apgar score at 5 min after birth.

The limitation of this study was the small sample size, observational study design which was difficult to control all possible co-founders (like oxytocin), and the use of non-invasive blood pressure measurement which might miss some data that can be noticed in invasive blood pressure measurement.

### CONCLUSION

Hypotension following spinal anesthesia is less frequent and less severe in preeclampsia patients and requires lower dose of phenylephrine than normotensive pregnant women with comparable neonatal outcomes. Hence, spinal anesthesia could be safely used in patients with severe preeclampsia undergoing cesarean delivery.

### REFERENCES


