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## The incidence and magnitude of hemodynamic changes after subarachnoid block in patients with pre-eclampsia undergoing caesarean section at LD Hospital SMHS GMC Srinagar: An observational study

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### Abstract

**Aim:** The aim of this study is to determine the incidence and magnitude of hemodynamic changes after subarachnoid block in patients with pre-eclampsia undergoing caesarean section.

**Methods:** A prospective observational study was conducted at LD Hospital SMHS GMC Srinagar, India, to determine the incidence of hypotension and the magnitude of hemodynamic changes following spinal anesthesia in pre-eclampsia and non-preeclampsia parturient who underwent caesarean section, from September 2018 to August 2019. 50 participants were enrolled in the pre-eclampsia group and 50 participants were enrolled in non-preeclampsia groups with a proportion of 1:1 ratios respectively. In the operation theatre, baseline hemodynamic variables (SBP, DBP, MAP, and HR) were recorded. The total intraoperative fluid consumption, total estimated blood loss, the weight of the new born were documented as well.

**Results:** A total of 100 parturient were enrolled (50 non-preeclampsia and 50 pre-eclampsia parturient) in this study. The mean gestational age at the time of Caesarean section was significantly lower in the pre-eclampsia group:  $38.36 \pm 1.53$  weeks in non-preeclampsia versus  $37.84 \pm 1.35$  weeks in pre-ecliptics,  $p = 0.001$  (Table 1). However, there was no statistically significant difference in the mean weight of the new born between groups;  $p = 0.37$ . The median upper sensory level at the time of skin incision was higher in the pre-eclampsia parturient compared to those with non-preeclampsia and this difference was statistically significant (T5 vs. T6;  $p = 0.029$ ). Non-preeclampsia parturient received a higher volume of preload fluid compared with pre-ecliptics ( $613.99 \pm 276.69$  ml VS  $559.76 \pm 322.78$  ml;  $p = 0.003$ ) and there was a statistically significant difference in intraoperative intravenous fluid consumption between groups, which was higher in non-preeclampsia compared to pre-eclampsia parturient ( $1718.87 \pm 345.79$  vs  $1487.63 \pm 421.77$ ;  $p = 0.001$ ).

**Conclusion:** The incidence and magnitude of spinal anesthesia induced hypotension in parturient who underwent caesarean section were less in pre-ecliptics than in non-preeclampsia parturient.

**Keywords:** Spinal anesthesia, hypotension, caesarean section, pre-ecliptics

### Introduction

Pregnancy-induced hypertension is a major cause of morbidity and mortality in obstetrics, complicating 3% - 8% of pregnancies. Severe pre-eclampsia poses a dilemma for anaesthesiologists, and there is some controversy about the best anaesthetic technique for caesarean delivery in such cases<sup>[1, 2]</sup>. Because of the risks related to airway edema, difficulty with the airway or failed intubation, hypertensive response to direct laryngoscopy, and aspiration pneumonitis, general anesthesia is associated with more untoward outcomes in this particular group of patients<sup>[3, 4]</sup>. When there is no contraindication for performing regional anesthesia, risk-benefit considerations strongly favour neuraxial techniques over general anesthesia for caesarean delivery in cases of severe pre-eclampsia. Regional anesthesia techniques have been widely used recently, however, spinal anesthesia, once considered contraindicated due to the common belief that the sudden and extensive sympathetic blockade following the subarachnoid block would result in severe hypotension and compromise utero placental blood flow in this group of patients<sup>[5-8]</sup>. Although controversial, some studies have shown the effectiveness of colloid loading on reducing the incidence of hypotension in spinal anesthesia<sup>[9-10]</sup>. But vasopressor agents and volume

loading, which are commonly used to manage spinal anesthesia-induced hypotension, could put the pre-eclampsia patients at increased risk of hypertension and pulmonary edema.<sup>6</sup> Recent evidence has challenged this view, suggesting that spinal anesthesia may in fact be an appropriate choice for pre-eclampsia women when caesarean delivery is planned, as long as neuraxial anesthesia is not contraindicated (e.g., coagulopathy, eclampsia with persistent neurological deficits etc)<sup>[2, 5, 8]</sup>.

## Materials and Methods

A prospective observational study was conducted at LD Hospital SMHS GMC Srinagar, India, to determine the incidence of hypotension and the magnitude of hemodynamic changes following spinal anesthesia in pre-eclampsia and non-pre-eclampsia parturient who underwent caesarean section, from September 2018 to August 2019 after taking the approval of the protocol review committee and institutional ethical committee.

## Methodology

We hypothesized pre-eclampsia parturient are at high risk of spinal anesthesia induced hypotension than non-pre-eclamptics. ASA II and ASA III parturient were included in this study. Parturient with cardiac disease, twin pregnancy, total spinal, chronic hypertension, gestational hypertension, superimposed hypertension, renal disease, diabetes mellitus, coagulopathy (platelet count  $< 80 \times 10^9/L$ ), active labour, eclampsia, abruption placentae, placenta prevail, any adjuvant added with local anesthetics were excluded. Variables like age, height, BMI, ASA status, gestational age, and amount of fluid preloaded, amount of fluid consumed Intraoperatively, the weight of the neonate, upper sensory level of the spinal block at the time of skin incision, position during and after the spinal procedure were studied. 50 participants were enrolled in the pre-eclampsia group and 50 participants were enrolled in non-pre-eclampsia groups with a proportion of 1:1 ratios respectively.

In the operation theatre, base line hemodynamic variables (SBP, DBP, MAP, and HR) were recorded. Baseline BP was taken as the mean of the two readings measured 1 min apart and 5 min after the parturient arrived in the operation theatre and before doing any invasive procedures. After spinal anesthesia SBP, DBP, MAP, and HR were recorded every 2 min for 30 min and every 5 min thereafter until the end of surgery. Patients were monitored with non-invasive automated blood pressure cuffs, ECG, and pulse-oximetry. The data collectors have assessed the upper level of sensory block bilaterally by pinprick at the time of skin incision and it was documented. The total intraoperative fluid consumption, total estimated blood loss, the weight of the new born were documented as well. The data collection technique was a combination of chart review, observation, and interview using a pre-tested questioner that was developed in English language Software and exported to SPSS version 21 statistical software for further analysis. The data was tested for normality with Shapiro Wilkson U-test and normally distributed data was compared by using the independent student's t-test and expressed as mean  $\pm$  SD. Whereas non-normally distributed data was compared using

the Mann-Whitney U-test and expressed as medians (IQR). Fisher's exact test was used for intergroup comparisons of proportion. All *P* values  $< 0.05$  were considered statistically significant. The research was undertaken after obtaining proper ethical committee clearance from ethical review board and after taking a written informed consent from each of study participants.

## Results

A total of 100 parturient were enrolled (50 non-pre-eclampsia and 50 pre-eclampsia parturient) in this study. There were no statistically significant differences in socio-demographic and anaesthetic characteristics of parturient such as; age, weight, height, the volume of 0.5% plain bupivacaine, and speed of spinal administration between groups (Tables 1 and 2). The majority of pre-eclampsia parturient were ASA II and the remaining were ASA III, while, all parturient in the non-pre-eclampsia group were ASA II, and this difference was statistically significant between groups;  $p < 0.001$  (Table 1).

The mean gestational age at the time of caesarean section was significantly lower in the pre-eclampsia group:  $38.36 \pm 1.53$  weeks in non-pre-eclampsia versus  $37.84 \pm 1.35$  weeks in pre-eclampsia;  $p = 0.001$  (Table 1). However, there was no statistically significant difference in the mean weight of the new born between groups;  $p = 0.37$  (Table 1).

The median upper sensory level at the time of skin incision was higher in the pre-eclampsia parturient compared to those with non-pre-eclamptics and this difference was statistically significant (T5 vs. T6;  $p = 0.029$ ) (Table 2). The baseline SBP, DBP, MAP, and heart rate were higher in parturient with pre-eclampsia than the corresponding values among the non-pre-eclampsia parturient (Table 3).

Non-pre-eclampsia parturient received a higher volume of preload fluid compared with pre-eclampsia ( $613.99 \pm 276.69$  ml VS  $559.76 \pm 322.78$  ml;  $p = 0.003$ ) (Table 4) and there was a statistically significant difference in intraoperative intravenous fluid consumption between groups, which was higher in non-pre-eclamptics compared to pre-eclampsia parturient ( $1718.87 \pm 345.79$  vs  $1487.63 \pm 421.77$ ;  $p = 0.001$ ) (Table 4). The mean duration of surgery was comparable between the two groups (Table 4).

In the pre-eclampsia parturient, mean SBP and DBP were higher than the corresponding values among non-pre-eclampsia parturient following spinal anesthesia at each point of time and the same fashion was happening to MAP, which was at a higher level in pre-eclampsia parturient than non-pre-eclampsia parturient.

The incidence of hypotension in non-pre-eclampsia parturient (58%) was higher than that of pre-eclampsia parturient (30%) (Table 5), despite the former receiving more volume of intravenous fluid ( $1718.87 \pm 345.79$  vs  $1487.63 \pm 421.77$ ;  $p = 0.001$ ) (Table 4). There was also a decrease in blood pressure after spinal anesthesia in both groups, but the magnitude of blood pressure falls were significantly greater in the non-pre-eclampsia parturient compared to those with pre-eclampsia:  $28.54 \pm 6.23$  Vs  $22.77 \pm 2.98$  for SBP,  $27.18 \pm 4.07$  Vs  $4.93 \pm 4.79$  for DBP, and  $25.65 \pm 2.32$  Vs  $22.27 \pm 16.15$  for MAP ( $p < 0.001$ ) (Table 5).

**Table 1:** Maternal and neonatal characteristics

| Variable                                 | non-preeclampsia (n=50) | Pre-eclampsia (n=50) | p-value |
|--|-------------------------|----------------------|---------|
| Age(year) <sup>a</sup>                   | 28.23±3.25              | 28.69±4.23           | 0.87    |
| Weight (kg) <sup>a</sup>                 | 65.12±8.12              | 66.54±8.36           | 0.43    |
| Height (cm) <sup>a</sup>                 | 163.02±5.69             | 163.13±6.98          | 0.18    |
| BMI (kg/m <sup>2</sup> ) <sup>a</sup>    | 24.87±3.63              | 24.79±3.29           | 0.87    |
| ASA status n(%)                          |                         |                      | <0.001  |
| ASAI                                     | 50(100)                 | 35(70)               |         |
| ASAI                                     |                         | 13(31.7)             |         |
| Nulliparous n (%)                        | 22(44)                  | 25(50)               | 0.31    |
| Gestational age (week) <sup>a</sup>      | 38.36 ± 1.53            | 37.84 ± 1.35         | 0.001   |
| Weight of the new born (kg) <sup>a</sup> | 3.23±0.52               | 2.99±0.55            | 0.37    |
| Previous caesarean section (%)           |                         |                      |         |
| Yes                                      | 15(30)                  | 10(20)               | 0.293   |
| No                                       | 35(70)                  | 40(80)               |         |

**Table 2:** Anesthetics characteristics and procedural position of parturient

| Variable   | Non-preeclamptic (n=50) | Pre-eclampsia (n=50) | p-value |
|--|-------------------------|----------------------|---------|
| Volume of injected bupivacaine (ml) <sup>a</sup>           | 2.45±0.32               | 2.32±0.32            | 0.52    |
| Dose of 0.5% plain bupivacaine (mg) <sup>a</sup>           | 11.59±1.33              | 11.25±1.33           | 0.53    |
| Speed of spinal administration (ml/sec) <sup>a</sup>       | 0.19±0.12               | 0.22±0.09            | 0.36    |
| Upper sensory Level <sup>b</sup>                           | T6(T4-T6)               | T5(T4-T6)            | 0.029   |
| Position during spinal procedure n (%)                     |                         |                      |         |
| Sitting  | 49(98)                  | 45(90)               | 0.27    |
| Lateral  | 1(2)                    | 5(10)                |         |
| Position after spinal procedure n (%)                      |                         |                      |         |
| Supine   | 49(98)                  | 50(100)              | 0.43    |
| Left Lateral tilt  | 1(2)                    | 0 (0)                |         |
| Parturients treated with adrenaline Intraoperatively n (%) |                         |                      |         |
| Yes  | 2(4)                    | 50(100)              | 0.51    |
| No   | 48(96)                  | 0 (0)                |         |

**Table 3:** Baseline hemodynamic characteristic of the parturient

| Variable                           | Non-preeclampsia(n=50) | Pre-eclampsia (n=50) | p-value |
|------------------------------------|------------------------|----------------------|---------|
| Baseline SBP (mmHg)                | 119.53±10.66           | 135.88±11.98         | 0.001   |
| Baseline DBP (mmHg)                | 76.32±8.12             | 86.36±11.21          | 0.001   |
| Baseline MAP (mmHg)                | 82.20±8.25             | 85.78±11.24          | 0.22    |
| Baseline heart rate (beats/minute) | 96.97±16.12            | 99.87±21.36          | 0.33    |

**Table 4:** Fluid consumption, estimated blood loss and surgical conditions

| Variable                         | Non-preeclampsia (n=50) | Pre-eclampsia (n=50) | p-value |
|----------------------------------|-------------------------|----------------------|---------|
| Crystalloid preload(ml)          | 613.99±276.69           | 559.76±322.78        | 0.003   |
| Intraoperative IV fluid(ml)      | 1718.87±345.79          | 1487.63±421.77       | 0.001   |
| Estimated blood loss(ml)         | 382.96±134.12           | 379.02±132.74        | 0.878   |
| Duration of surgery(minute)      | 43.89±11.75             | 42.68±9.16           | 0.567   |
| Experience of obstetrician(year) | 2.93±0.67               | 3.00±0.84            | 0.596   |
| Experience of anaesthetist(year) | 3.42±1.39               | 3.71±1.27            | 0.268   |

**Table 5:** Incidence and magnitude of hemodynamic changes following spinal anesthesia

| Variable                                     | Non-preeclampsia (n=50) | Pre-eclampsia(n=50) | p-value |
|--|-------------------------|---------------------|---------|
| Incidence of hypotension n (%) <sup>b</sup>  | 27(58)                  | 15(30)              | 0.031   |
| Lowest SBP after SA (mmHg)                   | 86.87±2.74              | 108.12±11.22        |         |
| Decrease from baseline % <sup>a</sup>        | 28.54±6.23              | 22.77±2.98          | <0.001  |
| Lowest DBP after SA (mmHg)                   | 57±8.02                 | 64±54               |         |
| Decrease from baseline % <sup>a</sup>        | 27.18±4.07              | 24.93±4.79          | <0.001  |
| Lowest MAP after SA (mmHg)                   | 62.99±7.59              | 66±0.00             |         |
| A decrease from baseline % <sup>a</sup>      | 25.65±2.32              | 22.27±16.15         | <0.001  |
| Mean HR after SA (beats/minute) <sup>a</sup> | 91.40±9.21              | 88.21±13.33         | 0.47    |
| 20% decrease in HR n (%)                     | 45(90)                  | 36(72)              | 0.069   |
| 20% increase in HR n (%)                     | 5(10)                   | 14(28)              | 0.57    |

## Discussion

During Caesarean section, hypotension following spinal

anesthesia was the commonest complication related to maternal morbidity and mortality.<sup>9-11</sup> Because of

inconsistent definitions, the reported incidence of hypotension after spinal anesthesia in Caesarean section varies between 7 and 89.2% [9, 10, 12-14]. There was a wide spread belief that pre-eclampsia parturient were considered at higher risk of profound hypotension following spinal anesthesia [14-16]. This concern may often frighten anaesthetists from choosing spinal anesthesia for caesarean section in pre-eclampsia parturients [11, 14, 15]. Nikooseresht M *et al.* found that SBP, DBP, and MAP measured at the baseline were higher for the patients with pre-eclampsia, and the lowest mean SBP, DBP, and MAP measured among the pre-eclampsia patients were higher than the corresponding values among the healthy parturients [14]. This finding was in line with our study result. In this study, the incidence of hypotension in non-preeclampsia parturient (58%) was higher than that of pre-eclampsia parturient (30%). The discrepancy in the incidence of hypotension related to pre-eclampsia related factors. Despite the sympathetic block due to spinal anesthesia, because of exaggerated vasoconstriction, pre-eclampsia parturient can still maintain their vascular tone that caused only a limited decrease in blood pressure.

Following spinal anesthesia, the mean SBP, DBP, and MAP measured at different time points were higher in pre-eclampsia parturient than the corresponding values among non-preeclampsia parturient. But this difference was insignificant between groups at 14, 18, 22, 24, 26, 35 min in SBP, at 8 and 40 min in DBP, at 10, 14, 24, 35 min in MAP, and thereafter to the end of surgery. Whereas, the mean pulse rate was comparable between groups at different time points after SA. Mitra M *et al.* found significant differences in SBP, DBP, and MAP at each point of time in both groups [17]. The possible explanation for this discrepancy might be the employment of invasive blood pressure monitoring in their study, in contrast to our study.

Similar to our study Aya AG *et al.* found that severely pre-eclampsia patients had a less frequent incidence of clinically significant hypotension compared to healthy parturient (16.6% versus 53.3%;  $P = 0.006$ ) [18]. The incidence of hypotension among pre-eclampsia parturient in our study was higher than Aya AG *et al.* The likely reason may be the use of different criteria for defining hypotension (20% versus 30% decline to baseline MAP) and the use of the small volume of preload in our study participants compared to Aya AG *et al.* (565.38ml±318.4 vs 1653ml±331).

In contradiction to our result; Mendes *et al.* reported that there was no statistically significant difference regarding the occurrence of hypotension after spinal anesthesia between severely pre-eclampsia and healthy parturient. But the incidence rate of hypotension was high in both groups (84 and 70%,  $p = 0.45$ ) [19]. This difference may be due to the intraoperative administration of intravenous nitro-glycerine in pre-eclampsia parturient in their study.

Sivevski A *et al.* [11] found that the percentage of fall of BP from baseline were significantly greater in the healthy parturient compared to those with pre-eclampsia (25.8%±10.1 vs. 18.8%±17.0 for SBP, 28.5%±8.8 vs. 22.5%±10.4 for DBP and 31.2%±14.2 vs. 18.2%±12.6% for MAP,  $p < 0.05$ ). Likewise, another study conducted by Saha D *et al.* found that the percentage of fall of DBP and MAP calculated from the baseline was also less in the pre-eclampsia group (34.5 and 33% in normotensive as opposed to 30.3 and 32.3% in pre-ecliptics, respectively) [20]. The result of our study was in accordance with the above

findings.

Unlike our study, Mendes *et al.* found that there was no significant difference in the lowest mean drop of SBP and DBP after spinal anesthesia between pre-eclampsia and healthy parturients [19]. This difference may be due to standardized fluid management and administration of potent direct vasodilator during surgery (intravenous nitroglycerine) in pre-eclampsia parturient in their study. In this study, a decreasing dose of 0.5% bupivacaine was practiced for the Caesarean section. However, the incidence of hemodynamic change had not a significant difference (10 mg versus 12.5mg). This finding was corresponding with a study done by Moshiri E *et al.* [21]. The result of our study showed that the mean gestational age in parturient with pre-eclampsia was considerably different compared with those of the non-preeclampsia parturient. This finding was in line with a study done by Sivevski A *et al.* [11].

Comparable to Sivevski A *et al.* [11] finding the result of our study showed that there was a statistically significant difference regarding the volume of preload taken between groups, which was higher in non-preeclampsia parturient compared to pre-eclampsia parturients (613.99±276.69 ml VS 559.76±322.78 ml;  $p = 0.003$ ). In our study, intraoperative fluid consumption was lower in pre-eclampsia parturients compared with non-preeclamptic parturients (1718.87±345.79 vs 1487.63±421.77;  $p = 0.001$ ). This result was in line with Nikooseresht M *et al.* [14]. Similar to a study done by Lavie A *et al.* [22] in our study, the total estimated blood loss was comparable between groups, and no blood products were required throughout the procedure. Nikooseresht M *et al.* also found that the surgical durations were comparable between two groups [14]. This finding was in line with our study result. In our study measurement of vasopressor consumption was difficult, due to the absence of standardized vasopressor usage in the hospital. Anaesthetists were trying to manage hypotension with fluids and me phentermine accordingly. In this study, two parturients in the non-preeclamptic group were treated with me phentermine but there were no parturients treated with me phentermine in the pre-eclampsia groups. However, this difference was not statistically significant ( $p = 0.57$ ). Even though our study does not quantify it, studies found that hypotension requiring vasopressor medication (ephedrine and phenylephrine) following spinal anesthesia was less common in parturient with pre-eclampsia than in non-preeclampsia parturients [11, 15, 17, 23-25]. 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 inability to quantify vasopressor consumption; due to lack of standardized vasopressor (ephedrine and phenylephrine) usage in the practice, which could affect the trends of hemodynamic change over time. As well the use of non-invasive blood pressure measurement in this study might miss some data which can be noticed in invasive blood pressure measurement.

## Conclusion

This study showed that the incidence and magnitude of spinal anesthesia induced hypotension in parturients who underwent caesarean section was less in pre-ecliptics than in non-preeclamptic parturients. In the pre-eclampsia group, patients also experienced spinal anesthesia induced hypotension, but the incidence and degree of hypotension was significantly lower than non-preeclamptic parturients.



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