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STUDY OF PERIOPERATIVE HEMODYNAMICS IN PREECLAMPTIC VERSUS NORMOTENSIVE PREGNANT WOMAN DURING CAESAREAN SECTION UNDER SUBARACHNOID BLOCK

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ABSTRACT

Introduction: Spinal anaesthesia complicates maternal hemodynamic and may expose the parturient to dangerous cardiovascular problems.

Aims: To compare the hemodynamic in normotensive and preeclampsia pregnant women posted for caesarean section under spinal anaesthesia.

Materials and methods: A prospective and comparative study carried out in Pregnant women of ASA physical status I and II or III, between 20 to 30 years of age, carrying single live, healthy fetus posted for elective caesarean section who satisfy the following inclusion and exclusion criteria. A total of 100 (Minimum of 50 in each group) pregnant women who scheduled to undergo elective caesarean section.

Results: Multigravida was observed in normotensive group subjects and primagravida was observed more in preeclampsia group subjects. The women in normotensive group had higher gestational ages, was statistically extremely significant. Mean height and weight in normotensive group and preeclampsia group had no statistical significance. The baseline heart rate, blood pressure were significantly higher in severe preeclamptic women and percentage decrease was statistically not significant. For the hypotension episodes, requirements of vasopressors, dose of vasopressor and IV fluids the difference between the groups was statistically significant.

Conclusion: Our findings have led us to conclude that spinal anesthesia does not cause precipitous drop in blood pressures in severe preeclamptic women as was once thought. Further studies are required to prove the same.
Keywords: Spinal anaesthesia, Hemodynamic, Hemodynamics, Hypotension.

INTRODUCTION

Pregnancy and childbirth-related complications are the leading cause of disability and death among women of reproductive age in developing countries. Hypertensive disorders affect up to 5-10% of pregnancies worldwide and it is major cause of prematurity and perinatal death in pregnancy and is responsible for a fifth to a third of all maternal deaths. Hypertension (HTN) is a clinical condition of persistent levels of systolic (≥140mmHg) and diastolic (≥90mmHg) blood pressure. It is classified as mild (SBP 140-149 and DBP 90-99 mmHg), moderate (SBP 150-159 and DBP 100- 109 mmHg) and severe (SBP ≥160 and DBP ≥110 mmHg).

Chronic hypertension is associated with preeclampsia, intrauterine growth restriction, and placental abruption. The frequency of pregnancy hypertension may be affected by characteristics of the mother, including her age, parity, genetic make-up and social class, diet, and season. Complications of hypertension in pregnancy are mainly miscarriage, premature delivery, restriction of fetal growth, detachment of the placenta, fetal distress, and diseases in vital organs after birth. In severe condition, disease progresses to preeclampsia, eclampsia, or hemolysis, elevated liver enzymes and low platelets (HELLP) syndrome, which are high-risk syndromes for maternal life.[1,2]

Spinal anesthesia almost always causes hypotension, cardiac output can be reduced by aortocaval compression and bradycardia with a reduction in cardiac output and severe hypotension can occur suddenly in a pregnant woman after the mother moves to the supine position. Hypotension after spinal anesthesia in severely preeclamptic patients may reflect the rapid onset of sympathetic blockade, underlying intravascular volume depletion and possible left ventricular dysfunction. There are concerns about the use of spinal anesthesia for patients with preeclampsia, superimposed spinal anesthesia–induced hypotension, preexisting uteroplacental hypoperfusion the risk of inducing hypertension or pulmonary edema while in the correction of hypotension.There are 3 ways to prevent hypotension after spinal block in the caval compression theory infusion of crystalloid or colloid was proposed to compensate for the venous blood said to be trapped in the legs, could increase cardiac output transiently. leg compression was attempted but was relatively ineffective, despite the success of the anti-G suit in preventing lower limb pooling and hypotension in aerospace medicine. The tilt man oeuvre was advocated to reduce caval occlusion. The original hypothesis underlying the mechanism of hypotension was that a reduction in central venous pressure would reduce cardiac output and arterial pressure. The use of sympathomimetic vasopressors to sustain arteriolar tone and arterial pressure has become the most important strategy for safe spinal anesthesia.[3,4]

MATERIALS AND METHODS

A prospective and comparative study carried out in the Modern Government Maternity Hospital, Petlaburj, Hyderabad, Telangana over a period of 18 months from October 2018 to May 2020.Pregnant women of ASA physical status I and II or III, between 20 to 30 years of age, carrying single live, healthy fetus posted for elective caesarean section who satisfy the following inclusion and exclusion criteria. A total of 100 (Minimum of 50 in each group) pregnant women who scheduled to undergo elective caesarean section.

Sample size calculations:

The study of Dona Saha, et al [5] observed mean values of minimum SBP, DBP, and MAP recorded during the observation period were always higher in the pre- eclamptic group (118.8

± 6.36, 71.2 ± 12.16, 74.2 ± 7.34, respectively) in comparison with normotensive group (91.9 ± 16.9, 48.76 ± 12.72, 53.7 ± 6.36, respectively). Taking these values as reference, the minimum required sample size with 99% power of study and 1% level of significance is 15 patients in each study group. To reduce margin of error, total sample size taken is 100 (50 patients per group).

Formula used:

For comparing mean of two groups $N>=2(\text{standard deviation})^2 *(Z\alpha + Z\beta)^2$ $(\text{mean difference})^2$Where $Z\alpha$ was value of Z at two-sided alpha error of 5% and $Z\beta$ is value of Z at power of 99% and mean difference is difference in mean values of two groups.

Inclusion criteria: ASAgradeI&IIorIII in 20 to 30 years of agescheduled to undergo elective caesarean section.

Exclusion criteria: ASA grade IV or greater, Chronic hypertension, DM, known cardiac disease, coagulopathy, renal disease, C.I. to SAB, Known sensitivity to study drugs.

The ethical clearance will be obtained from Ethics and Research Committee. Patients will be screened for the eligibility and those fulfilling the selection criteria and their caretakers will be briefed about the nature of the study. The patients/caregivers expressing their willingness to participate in the study will be enrolled after obtaining a written informed consent.

Once the patient was shifted to the operating room, standard monitors which included NIBP, pulse oximeter and ECG were connected to the patient. All the resuscitation equipment and the emergency drugs were kept ready. The anesthesia machine was also checked along with the oxygen delivery system.

Intravenous access was secured with 18G IV cannula. All patients were preloaded with lactated Ringer's solution, 15ml/kg body weight, before the anesthesia was administered. The preloading was done with patient in left lateral position and continuous monitoring of heart rate (HR) and blood pressure (BP). Baseline preoperative SBP, DBP, MAP and HR were calculated as mean of 3 consecutive measurements, 2 minutes apart.

Patients were reassured and explained about the technique. Spinal anesthesia was administered, with patient in left lateral position with knees and chin flexed over the abdomen. Under strict aseptic precautions, after skin infiltration with 1ml of 2% lignocaine, lumbar puncture was performed by midline approach by using disposable

Quincke Babcock spinal needle (25G) in L3-L4 intervertebral space. After free flow of CSF, 10 mg (2 ml) of hyperbaric bupivacaine, 0.5% was injected intrathecally and the patient returned to supine position with left uterine displacement. A 10-15 degree head down tilt was used to facilitate upward spread of local anesthetic. O2 support was given to each patient via Hudson’s mask at 4 L/min.

Level of anesthesia was tested with pin prick. With the onset of sensory blockade to T4-T6 level and grade III motor blockade (Bromage scale) surgery was started.

Patients with level above T4 and below T6 were excluded from the study. SBP, DBP, MAP and HR recorded every 2 min till the delivery of the baby and every 5 min thereafter till the completion of surgery. Spinal hypotension was defined as fall of greater than 30% mean arterial pressure (MAP) from baseline (considering that a decrease of 20% in MAP is usually a therapeutic goal in severe hypertension),58 and used IV Mephentermine in installments of 6 mg to treat hypotension, the dose was repeated after 2-3 min if necessary. Variables including demographic data, gestational age and APGAR scores were also studied.

Statistical analysis:

The data obtained was and entered Microsoft Excel Worksheet. Data collected in the study was analyzed and interpreted using statistical analysis system (SAS), version 9.2 software for windows version 10. Data was analyzed using Microsoft excel and SAS. Percentages and frequencies were used for categorical variables like sex, etc. Mean and standard deviation

will be used for continuous variables like Age, gestational age etc. Normality of data will be tested by Kolmogorov-Smirnov test. The normality was rejected hence non-parametric test were used.

Statistical tests will be applied as follows:

1. Quantitative variables will be compared using Unpaired t-test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups.
2. Qualitative variables will be compared using Chi-Square test /Fisher's exact test.

A two-sided p value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic descriptive statistics among the groups.

Age	**Mean±SD (Years)**	**p-value**
Normotensive Group	25.88±2.54	0.2594
Preeclampsia Group	25.32±2.56	
Total	25.60±2.55	
Gestational Age		
Normotensive Group	37.84±1.13	<.0001
Preeclampsia Group	35.22±0.95	
Total	36.53±1.68	
Height in cms		
Normotensive Group	159.44±4.4	0.3819
Preeclampsia Group	158.82±3.88	
Total	159.13±4.18	
Weight (in kg)		
Normotensive Group	66.52±4.87	0.0245
Preeclampsia Group	70.52±8.15	
Total	68.52±6.98	

The distribution of mean agedid not differ significantly between two study groups (P-value<0.05). The distribution of mean gestational age among the normotensive group cases studied was significantly higher compared to the preeclampsia group. Difference in gestational age was statistically significant. (P-value<0.05).

The distribution of mean height did not differ significantly between two study groups.

The distribution of mean weight among the normotensive group cases studied was significantly lower compared to the preeclampsia group. Difference in weight was statistically significant. (P-value<0.05).

Table-2: Distribution of Parity among the groups.

Category	**Parity**	**No. of Patients**	**Percentage**
Normotensive Group	Multigravida	31	62.00%
	Primagravida	19	38.00%
	Total	50	100.0%
Preeclampsia Group	Multigravida	20	40.00%
	Primagravida	30	60.00%
	Total	50	100.0

Multigravidas were more in normotensive group and primiparas were more in preeclampsia group. Difference in parity has statistical significance (P-value<0.05).

Table-3: Descriptive statistics of Heart rate (beats/min) among the groups.

Heart Rate	Category	Mean±SD (beats/min)	p-value
Baseline Heart Rate			
	Normotensive Group	88.12±11.73	0.0390
	Preeclampsia Group	93.86±13.47	
	Total	90.99±12.89	
Lowest Heart Rate	Normotensive Group	75.14±10.88	0.0129
	Preeclampsia Group	80.78±11.94	
	Total	77.96±11.71	
Decrease in Heart Rate	Normotensive Group	12.98±4.33	0.9669
	Preeclampsia Group	13.08±5.13	
	Total	13.03±4.72	
Percentage of Decrease in Heart Rate	Normotensive Group	-3.14±15.18	0.8604
	Preeclampsia Group	-3.83±14.21	
	Total	-3.48±14.63	

The distribution of mean heart rate among the normotensive group cases studied was significantly lower compared to the preeclampsia group. Difference in heart rate was statistically significant. (P-value<0.05). Difference in lowest heart rate was statistically significant. (P-value<0.05). The distribution of mean decrease in heart rate did not differ significantly between two study groups.The distribution of mean decrease in heart rate percentage did not differ significantly between two study groups.

Table-4: Descriptive statistics of Systolic Blood Pressure (mm Hg) among the groups.

Systolic Blood Pressure	Category	Mean±SD (mm Hg)	p-value
Baseline Systolic Blood Pressure	Normotensive Group	121.06±7.92	<.0001
	Preeclampsia Group	165.20±3.72	
	Total	143.13±23.02	
Lowest Systolic Blood Pressure	Normotensive Group	95.00±12.60	<.0001
	Preeclampsia Group	126.80±10.81	
	Total	110.90±19.80	
Decrease in Systolic Blood Pressure	Normotensive Group	26.06±13.28	<.0001
	Preeclampsia Group	38.20±10.81	
	Total	32.13±13.50	
Percentage of Decrease in Systolic Blood Pressure	Normotensive Group	38.7	7.35±22.51

	Preeclampsia Group	37	-6.37±23.36
	Total	38.7	-6.86±22.83

The distribution of mean systolic blood pressure, mean lowest and mean decrease systolic blood pressure among the normotensive group cases studied was significantly lower compared to the preeclampsia group. Difference in systolic blood pressure was statistically significant. (P-value<0.05).

Table-5: Descriptive statistics of Diastolic Blood Pressure (mm Hg) among the groups.

Diastolic Blood Pressure	**Category**	**Mean±SD (mm Hg)**	**p-value**
Baseline Diastolic Blood Pressure	Normotensive Group	75.34±4.93	<.0001
	Preeclampsia Group	111.56±1.63	
	Total	93.45±18.56	
Lowest Diastolic Blood Pressure	Normotensive Group	59.70±8.57	<.0001
	Preeclampsia Group	86.18±10.32	
	Total	72.94±16.32	
Decrease in Diastolic Blood Pressure	Normotensive Group	15.64±7.94	<.0001
	Preeclampsia Group	24.26±10.60	
	Total	19.95±10.27	
Percentage of Decrease in Diastolic Blood Pressure	Normotensive Group	-4.98±22.82	
	Preeclampsia Group	-0.10±24.07	0.2566
	Total	-2.54±23.47	

The distribution of mean diastolic blood pressure, mean lowest and mean decrease diastolic blood pressure among the normotensive group cases studied was significantly lower compared to the preeclampsia group. Difference in diastolic blood pressure was statistically significant. (P-value<0.05).

Table-6: Descriptive statistics of Mean Arterial Pressure (mm Hg) among the groups.

Mean Arterial Pressure	**Category**	**Mean±SD (mm Hg)**	**p-value**
Baseline Mean Arterial Pressure	Normotensive Group	90.44±5.25	<.0001
	Preeclampsia Group	128.54±2.09	
	Total	109.49±19.55	
Lowest Mean Arterial Pressure	Normotensive Group	70.36±9.87	<.0001
	Preeclampsia Group	99.66±9.85	

	Total	85.01±17.69	
Decrease in Mean Arterial Pressure	Normotensive Group	20.08±9.64	0.0002
	Preeclampsia Group	28.88±9.55	
	Total	24.48±10.52	
Percentage of Decrease in Mean Arterial Pressure	Normotensive Group	-6.76±23.69	0.2699
	Preeclampsia Group	-2.73±23.71	
	Total	-4.75±23.66	

The distribution of mean arterial pressure, lowest and decrease mean arterial pressure among the normotensive group cases studied was significantly lower compared to the preeclampsia group. Difference in mean arterial pressure was statistically significant. (P-value<0.05).
The distribution of mean decrease in mean arterial pressure percentage did not differ significantly between two study groups.

Table-7: Descriptive statistics of Hypotensive episodes among the groups

Category	Hypotension	No. of Patients	Percentage
Normotensive Group	Present	17	34.00%
	Absent	33	66.00%
	Total	50	100.0%
Preeclampsia Group	Present	8	16.00%
	Absent	42	84.00%
	Total	50	100.0%

After spinal anaesthesia, in normotensive group out of 50 women 17(34%) women developed hypotension and in preeclampsia group out of 50 women 8 (16%)women developed hypotension which is statistically significant.

Table-8: Descriptive statistics of requirement of Vasopressor among the groups

Category	Vasopressor Requirement	No. of Patients	Percentage
Normotensive Group	Present	17	34.00%
	Absent	33	66.00%
	Total	50	100.0%
Preeclampsia Group	Present	8	16.00%
	Absent	42	84.00%
	Total	50	100.0%

After spinal anaesthesia required vasopressor is statistically significant.

Table-9: The dosage of vasopressor required compared in both groups.

Category	Vasopressor Dose	No. of Patients	Percentage	Mean±SD (mg)	p-value
Normotensive	0 mg	33	66.00%	10.59±3.91	

Group	5 mg	4	8.00%		0.0011
	10 mg	7	14.00%		
	15 mg	6	12.00%		
	Total	50	100.0%		
Preeclampsia Group	0 mg	45	90.00%	5.00±0.00	0.0011
	5 mg	5	10.00%		
	Total	50	100.0%		

The dosage of vasopressor required was greater in normotensive group compared to preeclampsia group. In normotensive group the dosage of vasopressor used was 10.59±3.91 mg and in preeclampsia group it was 5.00±0.00 mg. The P value was 0.0011 and the difference between the groups was statistically significant.

Table-10: Descriptive statistics of requirement of intravenous fluids and blood loss among the groups

Intravenous fluids in ml	**Mean±SD**
Normotensive Group	1544.00±85.50
Preeclampsia Group	1450.00±76.93
Total	1497.00±93.70
Blood loss in mL	
Normotensive Group	494.72±60.11
Preeclampsia Group	699.62±58.77
Total	597.17±118.74

The requirement of IV fluids was greater in normotensive group compared to preeclampsia group. The P value was <0.0001 and the difference between the groups was statistically significant. The blood loss during caesarean delivery was lesser in normotensive group compared to preeclampsia group. The P value was <0.0001 and the difference between the groups was statistically significant.

DISCUSSION

In present study patients recruited in the study in both cases group and controls group were age and sex matched subjects. The mean age of the subjects in normotensive group was 25.88±2.54 years. The mean age of the subjects in preeclampsia group was 26.92±5.73 years. The overall mean age of the subjects (including both groups) was 25.60±2.55 years. In Ishrat et al[6]study, the mean age was 32.5±6.5 years in normotensive group and 30.7±5.8 years in preeclampsia group. The women in both groups in Ishrat et al study was older than the women in present study. The difference in age in this study was not significant.

There were a greater number of multigravidas in normotensive group (i.e. 31 subjects) and a greater number of primagravida in preeclampsia group (i.e. 30 subjects) which was significant. Preeclampsia is more common in first pregnancy and risk of developing SPE in subsequent pregnancies is 33%.60 The most common indication for LSCS in normotensive group was history of previous caesarean section and this accounts for a greater number of multiparas in this group.

The women in normotensive group had higher gestational ages, mean; 37.84±1.13 weeks, compared to preeclampsia group, mean; 35.22±0.95 weeks which was statistically extremely significant. severe preeclamptic women have their pregnancies terminated at an early gestational age due to various complications for maternal and fetal indications. In Ishrat et

al[6] study, mean gestational age in normotensive group was 37.0±2 weeks and in preeclampsia group was 33.2±1.9 weeks which was also statistically significant.

The mean height in normotensive group and preeclampsia group was 159.44±4.49 cms and 158.82±3.88 cms respectively. This difference had no statistical significance. The mean weight in normotensive group and preeclampsia group was 66.52±4.87 kgs and 70.52±8.15 kgs respectively. This difference had statistical significance. Severe preeclamptic women have water accumulation in the third space leading to pedal edema and sometimes generalized edema. Increase in weight gain of more than 2 kg/week is also a known risk factor for developing PE. This may explain the finding of larger weights in preeclampsia group women. In Ishrat et al study, the women in both groups had larger mean weights than women in present study but it had no significance.

The baseline heart rate was significantly higher in severe preeclamptic women (93.86±13.47 beats/min vs. 88.12±11.73 beats/min). The fall in heart rate was also higher in preeclampsia group women. But the percentage decrease did not reach clinical significance.

The baseline systolic blood pressure was significantly higher in severe preeclamptic women (165.20±3.72 mm of Hg vs. 121.06±7.92 mm of Hg). The fall in systolic blood pressure was also higher in severe preeclamptic women. But the percentage decrease did not reach clinical significance. In Ishrat et al [6] study, mean baseline systolic blood pressure was, preeclampsia group; 165±18 mm of Hg vs. normotensive group; 130±7.5 mm of Hg and their findings mirrored ours.

The baseline diastolic blood pressure and mean arterial pressure were significantly higher in severe preeclamptic women. There was a significant decrease in both these parameters after spinal anaesthesia. The fall in diastolic blood pressure was significantly greater than mean arterial pressure. But the fall in both variables was less in preeclampsia group subjects. The percentage decrease in diastolic blood pressure was by, preeclampsia group; -0.10±24.07 vs. normotensive group; - 4.98±22.82 and in MAP by, preeclampsia group; -2.73±23.71 vs. normotensive group; -6.76±23.69. In Ishrat et al series, the observations were similar to our study.

Hypotension was significantly higher in normotensive group women, 17 vs. 8 in preeclampsia group. It was 2 times more common in normotensive women. In the Ishrat et al series also, severe pre eclamptic patients had significantly less incidence of clinically significant hypotension. In the study of Aya et al, the risk of hypotension was almost six times less in severely preeclamptic patients. This was also seen in the study by Gogarten W.[7]

Normotensive women of normotensive group required significantly more vasopressors than severe preeclamptic women of preeclampsia group. The mean dose of Mephentermine needed was 10.59±3.91 mg (normotensive group) vs. 5.00±0.00 mg (preeclampsia group). In the Ishrat et al study, ephedrine was used. Preeclampsia group required significantly less ephedrine, 6.5±1.2mg vs. 11.7±6.5 mg in normotensive group. Similar findings were seen in the studies by Aya et al and Gogarten W.[7]

Preeclampsia group women required significantly lesser amounts of IV fluids compared to normotensives. (Normotensive group; 1544.00±85.50 ml vs. preeclampsia group; 1450.00±76.93 ml. In Ishrat et al[6] series, requirement of IV fluids was not studied. In both

the studies, no instances of pulmonary edema was seen which is always a concern in women with increased third space. In study by Aya et al, similarly a smaller fluid volume (1653±331 ml vs. 1895±150 ml; p = 0.005) was required in severe preeclamptic women. The blood loss during caesarean delivery was lesser in normotensive group compared to preeclampsia group. In normotensive group the mean blood loss was 699.62±58.77 ml and in preeclampsia group it was 1450.00±76.93. The difference between the groups was statistically significant.

Our finding was supported by Tamiru et al[8]. on 84 parturients undergoing cesarean section, which showed a higher incidence of hypotension in the normotensive group compared to the preeclamptic group. However, the mean change of heart rate from 18 min to the end of the surgery showed a significant difference between the groups with a *p*- value less than 0.05. This result was contradicting previous work [9,10,11]. This might be due to vasopressor consumption in our study.

The difference in hypotension incidence is caused by factors connected to preeclampsia. The possibility is that chronic vasoconstriction is partially caused by damaged vascular endothelium, as observed in preeclampsia, which produces more endogenous vasopressors like thromboxane and endothelia [12].

In contrast to normal pregnancy, where the altered vascular tone, decreased response to endogenous vasopressors, and increased synthesis of vasodilator prostaglandins and nitric oxide make them particularly sensitive to spinal anesthesia and cause hypotension after spinal anesthesia, this phenomenon does not change after SA in preeclampsia, resulting in fewer hemodynamic changes [13]

Our findings have led us to conclude that spinal anesthesia does not cause precipitous drop in blood pressures in severe preeclamptic women as was once thought. Further studies are required to prove the same.

CONCLUSION

In present study baseline heart rate, blood pressure were significantly higher in severe preeclamptic women and percentage decrease was statistically not significant. For the hypotension episodes, requirements of vasopressors, dose of vasopressor and IV fluids the difference between the groups was statistically significant. Further studies were required to study the long-term effect of haemodynamic parameters in normotensive and preeclampsia pregnant women posted for caesarean section under spinal anaesthesia on drop in blood pressures.

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