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A RANDOMISED CONTROL STUDY OF PERFUSION INDEX AS A PREDICTIVE PARAMETER OF HYPOTENSION

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Abstract

Background and aims: Perfusion index (PI) is a new parameter and good indicator of systemic vascular resistance and can foretell hypotension. The association between baseline PI with intraoperative hypotension after SAB in LSCS was aimed in this study. **Materials and Methods:** A total of 108 parturients will be divided into two groups on the basis of baseline PI. Group I will include parturients with PI of ≤3.5 and Group II, parturients with PI values >3.5. Subarachnoid block will be performed with 10 mg of injection bupivacaine 0.5% (hyperbaric) at L3–L4 or L2–L3 interspace. Hypotension was defined as mean arterial pressure <65 mm of hg. Statistical analysis was performed using the Shapiro:Wilks test. Independent sample t:test, Chi-square test, For the analysis, we used a statistical method called Repeated measures ANOVA (RMANOVA) on coefficient was done to assess the correlation between baseline PI and hypotension. Data was analyzed using IBM SPSS version 29.0. **Results:** The incidence of hypotension in Group I was 18.5% (10/54) compared to 53.5 29/54). ($P < 0.001$, odds ratio –0.07). In Group I, six patients had one episode of hypotension, three patient had two episodes, and one patient had three. In Group II fifteen patients had one episode of hypotension, 13 patients had two episodes, one patient had three episodes, and one patient had four episodes. Eighty:one percent of patients in Group I had no hypotension. Fifty five percent of patients in Group II had multiple episodes of hypotension ($P < 0.001$).

Measurements: Haemodynamic variables like Pulse rate, Systolic pressure, Diastolic pressure, Mean Arterial Pressure, perfusion index, and complications like nausea, vomiting, hypotension, bradycardia will be recorded.

Introduction

In parturients posted for elective lower segment cesarean section,the ease of administration, faster onset of action, and the ability to provide adequate surgical anesthesia with addition of postoperative analgesia makes the subarachnoid block (SAB) the anesthetic technique of choice for elective cesarean delivery([1])Hypotension following spinal anaesthesia results from the sympathectomy,decreased vascular tone and decreased cardiac output[[2]] Pregnant women are more sensitive to local anaesthetics, less responsive to vasopressors and have lower mean arterial pressure (MAP) at term.[[1,2]] Hence, parturients can develop profound hypotension following central neuraxial blockade for the lower segment caesarean section (LSCS).

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Perfusion index (PI) is defined as the ratio of pulsatile blood flow to non:pulsatile blood flow in the peripheral vascular tissue, measured using a pulse oximeter based on the amount of Infrared light absorbed.[3,4] Hence, PI can be used to assess perfusion dynamics and is being considered as a non:invasive method to detect the likelihood of development of hypotension and hence with appropriate treatment with fluids and vasopressors can improve maternal and foetal outcomes

METHODS

Written informed consent was taken from the study participants. Patients satisfying inclusion and exclusion criteria after preanesthetic evaluation patients was monitored with electrocardiography, automated NIBP, and pulse oximetry (SpO2) for baseline values and intraoperative monitoring. This was a double: blinded study. Inclusion criteria included Asa I and II,Age 18 to 40 years, American Society of Anesthesiologists (ASA)I, II patients who were planned for elective LSCS,and those giving informed written consent. Patients with placenta previa, Pre:eclampsia, Gestational diabetes mellitus, Body mass index (BMI) >40 kg/m2,Cardiovascular disease, Hypothyroidism, Hyperthyroidism, Essential hypertension were excluded. The perfusion index was measured in the left index finger in left lateral position using a specific pulse oximeter by anesthesiologist, who was not involved in the further intraoperative monitoring. Those with a baseline perfusion index of ≤3.5 fell into Group I and those with a perfusion index of >3.5 fell into Group II.[7] Intravenous (IV) access was established in the left upper limb and preloaded with 500 ml of Ringer lactate over 20 min and the baseline values were recorded. While administering neuraxial blockade, the pulse oximeter was disconnected to prevent observer bias and SpO2 was recorded using a different pulse oximeter. Spinal anaesthesia was performed by an anaesthesiologist blinded to the baseline PI values, using Quincke's 25: gauge spinal needle in left lateral decubitus position with 10 mg of injection bupivacaine 0.5% (hyperbaric) at the L3–L4 or L2–L3 interspace. The parturient was returned to the supine position with a left lateral tilt of 15° to facilitate left uterine displacement. The pulse oximeter will be reconnected to monitor the patient till the end of surgery. Oxygen was given through face mask at 4 L/min. Ringer's lactate was administered at a rate of 100 ml/10 min. The level of sensory block was checked 5 min after the spinal injection with a cold swab. If a T6 sensory block level was not achieved, these parturients was excluded from the study and managed according to institutional protocol. Maximum cephalad spread was checked 20 min after SAB. NIBP, heart rate (HR), respiratory rate (RR), SpO2 and PI was recorded at 3 min intervals after the SAB up to 15 min and then at 5 min intervals by the same anaesthesiologist who administered SAB till the end of surgery. Hypotension was defined as a decrease in MAP <65 mm of Hg and treated with IV bolus of 6 mg injection ephedrine and 100ml of Ringer lactate. Bradycardia was defined as HR <55 beats/min and treated with injection atropine 0.6 mg IV bolus. Following extraction of the baby, Injection oxytocin 10 units will be given as uterotonic following baby extraction at a rate of 200 mU/min as a separate infusion. Patients requiring additional oxytocics and or additional surgical interventions excluded from the study. The incidence of other side effects such as nausea, vomiting will be recorded. Statistical Analysis: Quantitative and continuous data were summarized using Mean ± SD. Qualitative categorical data were analyzed using frequency and percentages. The data was checked for normal distribution using the Shapiro:Wilks test. Independent sample t:test was used to compare the mean values between the groups at baseline for continuous variables. Chi:square test was used to compare the difference between the groups for categorical data. For the analysis, we used a statistical method called Repeated measures ANOVA (RMANOVA), which is a two: factor ANOVA with repeated measures. This method is also

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known as within: within: subjects ANOVA. We compared the mean differences between two groups split into two within: subjects factors: "time" and "Group". To test the difference across groups at each time point, we conducted post hoc t:tests. Furthermore, we used Bonferroni tests to determine which specific means differed. A P:value <0.005 was considered as statistically significant. Data was analyzed using IBM SPSS version 29.0.

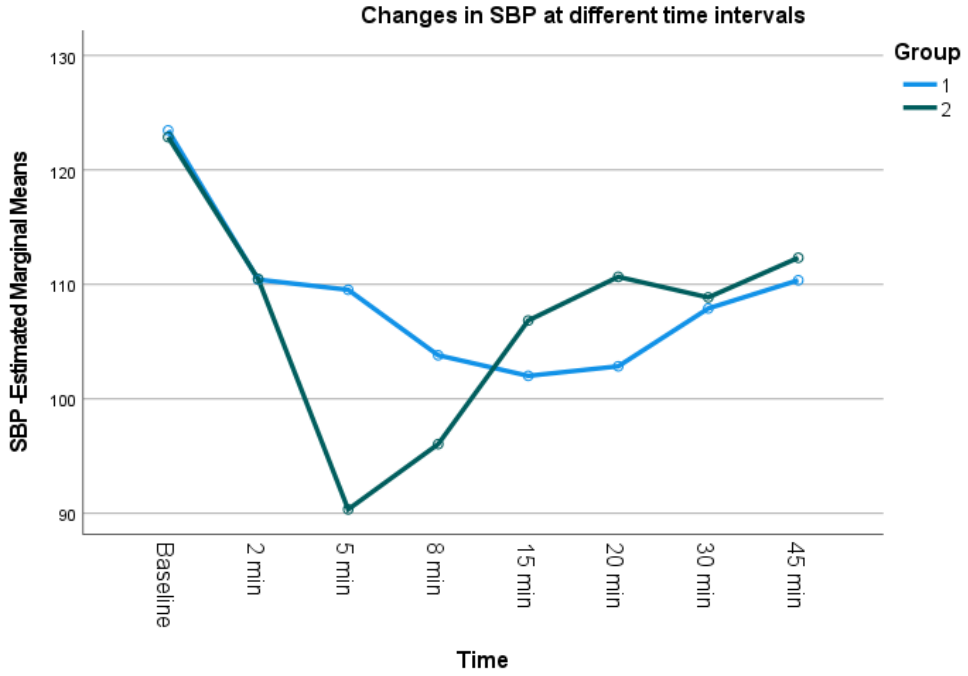
RESULTS

A total of 114 parturients were included in the study. Four parturients were excluded from the study due to an inadequate level of the spinal blockade, and two parturients had to be excluded due to the requirement of additional oxytocics, as the drugs administered could influence perfusion index. 54 were in Group I and 54 patients were in Group II for final analysis. The demographic parameters such as age and weight were comparable between the two groups. The average duration of surgery in both groups was comparable (Group I: 40.87 ± 11.14 min and Group II:44±14. The mean PI in Group I was2.739±0.5588, and in Group II was8.141±7.561. Intraoperatively, the HR was comparable between the two groups.

Table 1

	Group	**Mean**	**Std. Deviation**	P value
Weight	1	71.56	9.945	0.628
	2	70.63	9.858	
Age	1	25.43	5.134	0.348
	2	24.57	4.210	

no significant difference in age and weight was observed between the groups, the groups are comparable



Mauchly's Test of Sphericity not assumed(P<.001); Greenhouse:Geisser assumption

P value <0.001(time effect); P<0.001 (Time * Group effect); Adjustment for multiple comparisons: Bonferroni revealed that there overall was no significant difference between the groups(P=0.325).

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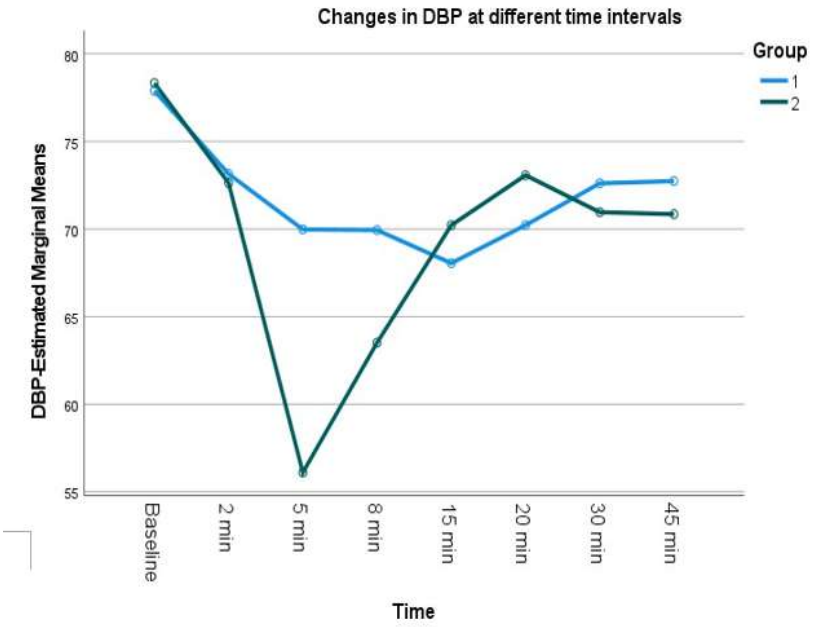
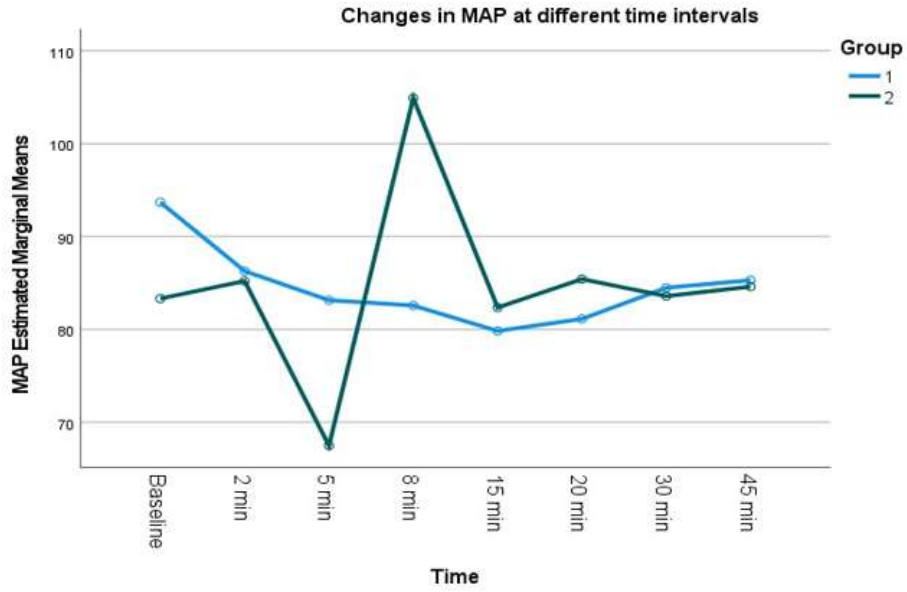


Mauchly's Test of Sphericity not assumed(P<.001); Greenhouse:Geisser assumption
P value <0.001(time effect); P<0.001 (Time * Group effect); Adjustment for multiple comparisons: Bonferroni revealed that overall there was a significant difference between the groups(P=0.019).



Mauchly's Test of Sphericity not assumed(P<.001); Greenhouse:Geisser assumption
P value <0.001(time effect); P<0.001 (Time * Group effect); Adjustment for multiple comparisons: Bonferroni revealed that there was no significant difference between the groups(P=0.951).

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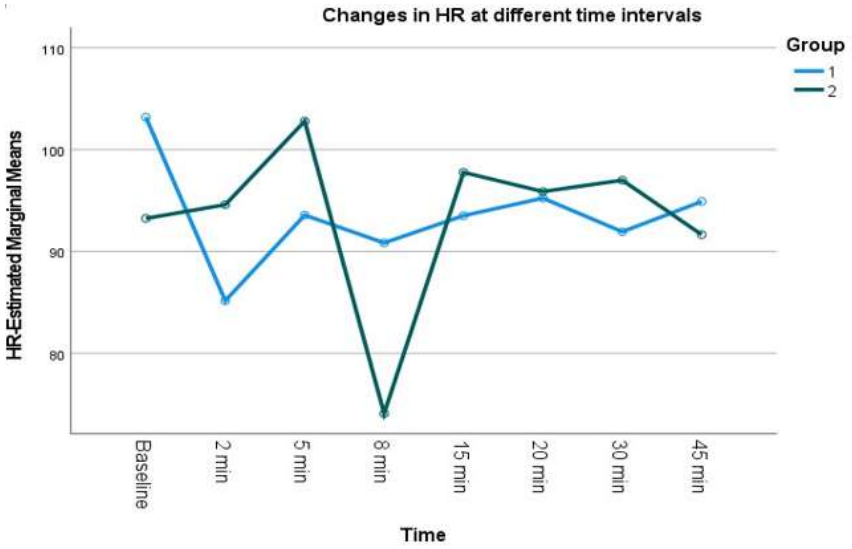

Mauchly's Test of Sphericity not assumed(P<.001); Greenhouse:Geisser assumption
P value <0.001(time effect); P<0.001 (Time * Group effect); Adjustment for multiple comparisons: Bonferroni revealed that overall there was no significant difference between the groups (P=0.880).

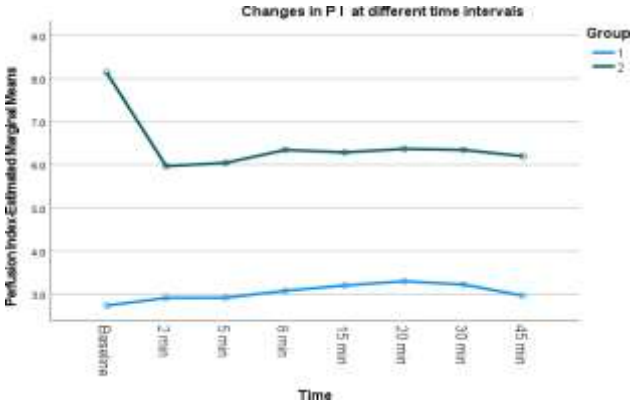

Table 2

PI	Group	Mean±SD	P value
PRE:OP PI	1	2.739±0.5588	<0.001
	2	8.141±7.5619	
PI 2	1	2.917±0.7033	<0.001
	2	5.970±1.0442	
PI 5min	1	2.920±0.7321	<0.001
	2	6.044±1.1546	
PI 8 min	1	3.081±0.5664	<0.001

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	2	6.344±0.9400	
PI 15 min	1	3.206±0.6808	<0.001
	2	6.289±1.0312	
PI 20min	1	3.302±0.7525	<0.001
	2	6.369±1.1240	
PI 30min	1	3.226±0.6890	<0.001
	2	6.344±0.9914	
PI 45 min	1	2.967±0.6871	<0.001
	2	6.198±0.9386	

Mauchly's Test of Sphericity not assumed(P<.001); Greenhouse:Geisser assumption
P value 0.107(time effect); P=0.033 (Time * Group effect); Adjustment for multiple comparisons: Bonferroni revealed that overall there was a significant difference between the groups (P<0.001).

Table 2

Hypotension episodes	Group 1	Group 2	Total
0	44(81.5%)	24(44.4%)	68(63.0%)
1	6(11.1%)	15(27.8%)	21(19.4%)
2	3(5.6%)	13(24.1%)	16(14.8%)
3	1(1.9%)	1(1.9%)	2(1.9%)
4	0	1(1.9%)	1(0.9%)
Total	54	54	108

P value – 0.002 significant. Table 3.

Table 3

Vasopressor	Group 1	Group 2	Total
0	45(83.3%)	25(46.3%)	70(64.8%)
6	6(11.1%)	14(25.9%)	20(18.5%)
12	2(3.7%)	13(24.1%)	15(13.9%)
18	1(1.9%)	1(1.9%)	2(1.9%)
24	0	1(1.9%)	1(0.9%)
Total	54	54	108

P value – 0.001 significant. Table 4

Table 4

Total fluid	Group 1	Group 2	Total
<900	11(20.4%)	0	11(10.2%)
900:1000	21(38.9%)	6(11.1%)	27(25.0%)
1000:1100	7(13.0%)	8(14.8%)	15(13.9%)

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1100:1200	6(11.1%)	9(16.7%)	15(13.9%)
1200:1300	6(11.1%)	19(35.2%)	25(23.1%)
1300:1400	3(5.6%)	7(13.0%)	10(9.3%)
>1400	0	5(9.3%)	5(4.6%)
Total	54	54	108

P value< 0.0001 significant.Table 5

The incidence of hypotension in Group I was 18.5% (10/54) compared to 53.5 29/54). This was clinically and statistically highly significant (P < 0.001, odds ratio –0.07). In Group I, six patients had one episode of hypotension, three patient had two episodes, and one patient had three. In Group II fifteen patients had one episode of hypotension, 13 patients had two episodes, one patient had three episodes, and one patient had four episodes. Eighty-one percent of patients in Group I had no hypotension. Fifty five percent of patients in Group II had multiple episodes of hypotension (P < 0.001). Intraoperatively, the HR was comparable between the two groups. The difference between the two groups with respect to systolic blood pressure (SBP), was comparable. The difference in SBP was most significant during5th, and 15 th min with values being lower in Group II than Group I, whereas difference in DBP was most significant during the 5^{h} min and the difference in MAP was most significant during the 5th, 8thmin.Perfusion index after adjustment for multiple comparisons Bonferroni revealed that overall there was a significant difference between the groups (P<0.001). The difference in perfusion index was most significant during the 2nd, 5th, 8th, 15th,20 thand 45th min with values being higher in Group II. Number of hypotension episodes were higher in Group II than Group I. Doses of vasopressors requirement were higher in Group II than in Group I. Amount of fluid requirement was higher in Group II than Group I.

Discussion

Hypotension following administration of spinal anaesthesia for caesarean delivery is common.(4) The incidence and severity of hypotension was higher in parturients whose baseline PI values were greater than 3.5 requiring higher amount of vasopressors and fluids(5).There is no definite monitoring system which may predict the likelihood of developing hypotension. The usefulness of perfusion index in predicting hypotension following spinal anaesthesia in casearean section.(6) has been evaluated by many studies. The principle of SpO2 is based on two light sources with different wavelengths 660 nm and 940 nm, emitted through cutaneous vascular bed of finger or earlobe.(3) The absorbance of both wavelengths has a pulsatile component, which represents fluctuations in the volume of arterial blood between the source and the detector. The non:pulsatile component is from connective tissue, bone and venous compartment. The perfusion index (PI) is the ratio of the pulsatile component (arterial) and non:pulsatile component of light reaching the detector.(3,4) The physiological changes of pregnancy include decrease in systemic vascular resistance, increased total blood volume and cardiac output.(2) Spinal anesthesia produces sympathectomy and decreasing peripheral vascular tone and increase pooling and pronounced hypotension. High baseline perfusion index are associated with lower peripheral vascular tone and increase in incidence of hypotension following spinal anaesthesia. PI has been used in the study by Mowafi *et al.*(6) that PI provides a non:invasive continuous measure of peripheral perfusion. PI has been used in the study to detect intravascular injection of the epinephrine: containing epidural test dose, hence its reliability to detect vasoconstriction has been demonstrated successfully. Ginosar *et al.*(6) demonstrated that an increase in PI following epidural anesthesia was a clear and reliable indicator of sympathectomy. Mehandale *et al.*(6) concluded in their study that the PI could predict hypotension following

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propofol induction in patients undergoing general anesthesia with a very high negative predictive value. yokose *et al.*[7] demonstrated that PI had no predictive value for hypotension in parturients undergoing LSCS following SAB. This discrepancy was attributed to various methodological differences, such as the definition of hypotension, co:loading with colloids and method of calculation of baseline PI. Toyama *et al.*[8] study chose the cut:off value of baseline perfusion index 3.5 for prediction of hypotension following spinal anaesthesia so as to identify parturients at risk for such hypotension. In patients needing drugs other than oxytocin and higher requirements were excluded. Carboprost, methylergometrine are powerful vasoconstrictors hence excluded. Limitations included patient movement, and any anxious patients causes change in systemic vascular resistance and perfusion index. Invasive monitoring for recording systemic vascular resistance, cardiac output, were unnecessary and avoided The baseline value of PI could have been affected due to aortocaval compression in supine position while recording baseline values. Arterial blood gas analysis for both the mother and foetus was not done which could have ruled out hypoxia resulting from hypoperfusion. Hypothermia causes vasoconstriction, since PI is dependent on the vascular tone of digital vessels, its role in predicting hypotension in these conditions is questionable. In conditions use of perfusion index where the tone of these vessels is affected is questionable and more studies regarding its use in other patients needs to be done before. It can be accepted as a reliable non: invasive tool to predict hypotension following spinal anaesthesia. In addition, further studies comparing PI with invasive and accepted tools of haemodynamic monitoring may throw more light regarding its utility

Conclusion

Perfusion Index (PI) is a good reliable non invasive tool for predicting hypotension in healthy parturients undergoing elective caesarean section under SAB. Baseline PI >3.5 are at higher risk of developing hypotension following SAB compared to those with baseline PI≤3.5.

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