

The Role of Perfusion Index to Determine Hypotension Induced by Spinal Anaesthesia for Caesarean Deliveries

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Abstract

Introduction: Hypotension following spinal anaesthesia results from the sympathetic blockade and decreased cardiac output. Non-invasive blood pressure (NIBP) measurement is the standard method of monitoring intraoperative hemodynamics. Perfusion index (PI) is a relative assessment of the pulse strength at the monitoring site. PI can be used to assess the perfusion dynamics due to changes in peripheral vascular tone which is a non-invasive method to detect hypotension following subarachnoid block. **Objective:** This study was aimed to investigate the correlation between baseline perfusion index and incidence of hypotension following spinal anaesthesia and also determine the diagnostic characteristics of PI. **Material & Method:** This prospective observational study was conducted among 56 parturients undergoing cesarean deliveries under subarachnoid block at R. L. Jalappa Hospital and Research Centre, Tamaka, Kolar during the period from 1st March 2023-31st July 2023. The parturients aged 20-35yrs and undergoing caesarean delivery under spinal anaesthesia. Patients with placenta previa, preeclampsia, gestational diabetes, cardiovascular or cerebrovascular disease, with BMI > 40 kg/m², Infection at local site, Lumbar spine deformity and patients refusal. Participants included in study after obtaining the informed consent and the hemodynamic parameters were measured which included mean arterial pressure, systolic blood pressure, diastolic blood pressure, saturation, heart rate and any adverse effects following spinal anaesthesia. **Groups:** two groups; group I with PI <3.5 and group II with PI >3.5. **Results:** The present study included total of 56 participants in present study with mean age of 24.6±3.54yrs. the cutoff suggested for PI was taken as 3.5. based on cutoff, group I included participants with <3.5PI and group II participants with >3.5PI. There was significant higher incidence of number of hypotension episodes in group II patients compared to group I patients.(p<0.05)The area undercurve for PI was found to be 0.858, with p<0.05. the sensitivity and specificity of baseline PI with cutoff of 3.5 was found to be 69.82% and 90.22% respectively to detect hypotension. **Conclusion:** The Perfusion index can be used as a important tool for predicting the hypotension in apparently healthy parturient undergoing caesarean section. The parturients with PI of more than 3.5 are at a higher risk of developing the spinal anaesthesia induced hypotension.

Keywords: Hypotension, Perfusion Index, Blood pressure, Non-invasive blood pressure.

Introduction:

Hypotension following spinal anaesthesia results from the sympathetic blockade and decreased cardiac output. Non-invasive blood pressure (NIBP) measurement is the standard method of monitoring intraoperative hemodynamics. Perfusion index (PI) is a relative assessment of the pulse strength at the

monitoring site. PI can be used to assess the perfusion dynamics due to changes in peripheral vascular tone which is a non-invasive method to detect hypotension following subarachnoid block.

Aim & Objective: Present study aimed to investigate the correlation between baseline perfusion index and incidence of hypotension following spinal anaesthesia and also determine the diagnostic characteristics of PI.

Objectives:

1. To investigate the correlation between baseline perfusion index and incidence of hypotension following spinal anaesthesia.
2. To check sensitivity and specificity of perfusion index in predicting hypotension following spinal anaesthesia.

Material & Method:

This prospective observational study was conducted among 56 parturients undergoing cesarean deliveries under subarachnoid block at R. L. Jalappa Hospital and Research Centre, Tamaka, Kolar during the period from 1st March 2023-31st July 2023.

Inclusion Criteria

1. Parturients aged 20 to 35 years
2. Parturients undergoing caesarean delivery under spinal anaesthesia

Exclusion Criteria

1. Patients with placenta previa, preeclampsia, gestational diabetes
2. Patients with cardiovascular or cerebrovascular disease
3. Patients with BMI > 40 kg/m²
4. Infection at local site
5. Lumbar spine deformity
6. Patient refusal

Methodology

Study design: Prospective observational study

Sample size:

As per study conducted by Dugappa DR et al.,

$P = 71.42\%$, $q = (100-p) = 28.58\%$

$L =$ allowable error = 12 %

Sample size is $n = pq/L^2 = 56$

Therefore sample size will be 56 for the study

Study duration:

5 months (1st March 2023-31st July 2023)

Method:

The study was conducted after obtaining approval by the Institutional Ethical Committee and an informed written consent were obtained from all parturients posted for cesarean delivery under subarachnoid block. Patients with placenta previa, preeclampsia, gestational diabetes, cardiovascular or cerebrovascular disease, with BMI > 40 kg/m², Infection at local site, Lumbar spine deformity and patients refusal. Participants included in study after obtaining the informed consent and the hemodynamic parameters were

measured which included mean arterial pressure, systolic blood pressure, diastolic blood pressure, saturation, heart rate and any adverse effects following spinal anaesthesia. Groups: two groups; group I with PI <3.5 and group II with PI >3.5. Hypotension was defined as drop of more than 20% in basal mean arterial pressure or systolic blood pressure less than 100mmHg or diastolic blood pressure less than 60mmHg or a drop in mean arterial pressure of < 65 mmHg. The hypotension was treated with 6 mg bolus doses of drug Inj. Mephentramine. Any untoward incident or side effects like nausea, vomiting, respiratory depression will be recorded and treated by the anaesthesiologist in charge of case.

Statistical analysis: All the data were entered in excel sheet and analysed using SPSS v23.0 operating on windows 10. The data were summarised as mean. Standard deviation, frequency and percentage. The summarised data were represented using tables. The mean difference between the continuous data were analysed using students unpaired t-test, categorical data using chi-square test and diagnostic accuracy by ROC curve with sensitivity, specificity, negative predictive value and positive predictive value, for all statistical purpose a p<0.05 was considered significant.

Result: The present study included total of 56 participants in present study with mean age of 24.6±3.54yrs. the cutoff suggested for PI was taken as 3.5. based on cutoff, group I included participants with <3.5PI and group II participants with >3.5PI.

	Median	IQR
Age	24 (21-27.4)	25 (22.1 – 28.3)
Height	155 (154-158)	158 (156-159)
Weight	68 (64.6-70.1)	67.1 (62.6-70.2)

Episodes of hypotension	Group I	Group II	p-value
0	25	8	0.01*
1	3	12	
2	1	4	
3	1	1	
4	0	1	
Total	30	26	

There was significant higher incidence of number of hypotension episodes in group II patients compared to group I patients.(p<0.05)

Area	Std. error	p-value	95% confidence interval	
			Lower bound	Upper bound
0.858	0.034	0.01*	0.778	0.912
Diagnostic characteristics		Percentage	CI with 95% CI	
Sensitivity		69.82	60.5 to 78.9	
Specificity		90.22	81.0 to 95.1	
NPV		72.66	65.2 to 80.4	
PPV		84.54	74.11 to 89.66	

The area undercurve for PI was found to be 0.858, with p<0.05. the sensitivity and specificity of baseline PI with cutoff of 3.5 was found to be 69.82% and 90.22% respectively to detect hypotension.

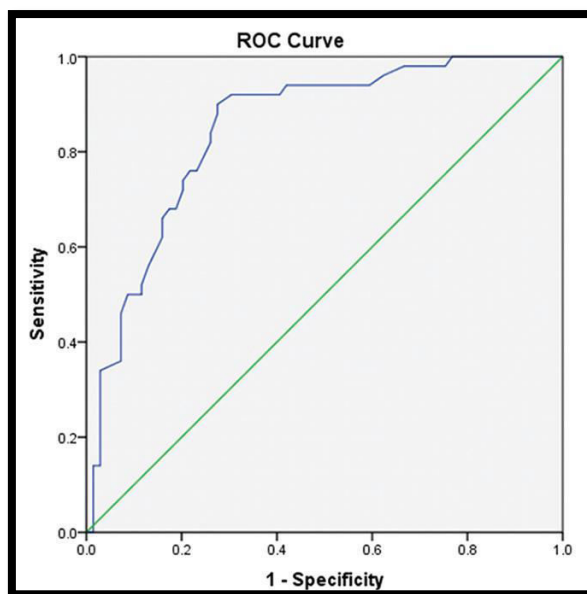


Figure 1: ROC curve

Discussion:

Hypotension following subarachnoid block is a result of sympathetic blockade leading to decrease in peripheral vascular resistance and tone leading to adverse fetal and maternal outcomes.¹ There is no definite monitoring system which may predict the likelihood of developing hypotension so that additional precautions may be taken. Studies have tried to evaluate the usefulness of perfusion index in predicting hypotension following spinal anaesthesia in casearean section.²

Perfusion index is the ratio of pulsatile blood flow to non-pulsatile blood flow in the peripheral tissue which is measured using a specific pulse oximeter that works on the principle of infrared rays. It is a real time non-invasive method of predicting perfusion state of the body.^{3,4}

The reduction of systemic vascular resistance may vary in parturients depending on various factors.⁵⁻⁹ This decrease in tone will correspond to higher perfusion index values due to increase in pulsatile component due to vasodilatation. Induction of a sympathectomy by spinal anaesthesia will cause a further decrease peripheral vascular tone and increase pooling and hypotension. Parturients with high baseline perfusion index are expected to have lower peripheral vascular tone and hence are at higher risk of developing hypotension following spinal anaesthesia.

In concordance to present study, Duggappa RD et al., documented higher incidence of the hypotension with PI >3.5 (71.42%) compared to <3.5% (10.5%), also documented the higher correlation of hypotension with perfusion index. The sensitivity and specificity of baseline PI with a cut-off of 3.5 was 69.84% and 89.29% respectively.¹⁰ Toyama et al. found a sensitivity and specificity of 81% and 86%, respectively, for baseline PI with a cut-off of 3.5 to predict hypotension, whereas in this study, the specificity was comparable, 89.29%, but sensitivity was lower, 69.84%.² Another study by Nandini MG et al., also documented higher incidence of hypotension in patients with PI more than 3.5 and the sensitivity and specificity for the 3.5 cut-off of PI was 85.7% and 60%, respectively.¹¹ PI has been used in the study by Mowafi et al. to detect intravascular injection of the epinephrine-containing epidural test dose, hence its reliability to detect vasoconstriction has been demonstrated successfully.¹² Ginosar et al. demonstrated that increase in PI following epidural anaesthesia was a clear and reliable indicator of sympathectomy.¹³

Limitation: the findings of study are significant; however, the few limitations of study include its small sample size and the single centric study. The findings can be strengthened by conducting in larger sample size.

Conclusion: The Perfusion index can be used as a important tool for predicting the hypotension in apparently healthy parturient undergoing caesarean section. The parturients with PI of more than 3.5 are at a higher risk of developing the spinal anesthesia induced hypotension.

Funding: Nil

Conflict of interest: Nil

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