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Original Research Article

Study to Evaluate Perfusion Index as Indicator of Hypotension Following Spinal Anaesthesia for Elective Caesarian Section

Qazi Abu Atif Amair

Post graduate (3rd year), Department of Anaesthesia, Khaja Banda Nawaz University, Faculty of Medical Sciences Kalaburgi, Karnataka-585104

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Corresponding author: Dr. Qazi Abu Atif Amair
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Abstract

Background: Post-spinal hypotension has a negative impact on parturients and fetal outcome. Parturients may suffer from nausea and vomiting, and the fetus will have acidosis and a lower Apgar score. Hence, prevention of hypotension will be safer for both mother and fetus.

Method: 60 (sixty) obstetric patients undergoing spinal anesthesia for cesarean section were studied. ASA grade II, BMI 35 kg/m², pleth variability index, and perfusion index were measured before and after spinal anesthesia. The data was analyzed using ROC and multiple linear regression.

Results: In the hypotension group, PVI and PI at one minute are higher than without-hypotension (controlled) group. PVI at one minute is an independent factor for predicting hypotension following spinal anesthesia ($p < 0.001$). It has significant sensitivity and specificity. The comparative study between the hypotension group and the controlled group had a significant p-value ($p<0.001$).

Conclusion: Baseline PVI is not a predictor of hypotension, but a one-minute PVI value >19.2 can predict hypotension following spinal anesthesia, and a one-minute PI ≥ 5.13 is more ideal to predict hypotension.

Keywords: Caesarian section, Spinal anesthesia, Pleth variability, Perfusion Index, haemodynamicity.

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Introduction

Spinal anesthesia is a commonly employed method for cesarean section owing to its advantages of reliability, rapid onset, and minimal transfer of drugs to the placenta [1]. However, spinal anesthesia-induced sympathicolysis is frequently associated with a higher incidence of hypotension [2]. The incidence of hypotension varies depending on the clinical definition employed, with the reported rates up to 74.1% [3]. Post-spinal hypotension can have a negative impact on parturient and fetal outcomes. For parturients, hypotension can lead to nausea and vomiting, which may be caused by reduced blood flow to the brainstem and vomiting center. Furthermore, hypotension can result in inadequate placental perfusion, leading to fetal acidosis and lower Apgar scores [4]. Management focusing on preventing hypotension instead of reacting to its occurrence is recommended. Hence an attempt is made to predict hypotension by variability index and perfusion index undergoing cesarean section.

Material and Method

60 (sixty) patients aged between 25-40 years admitted at KBN Hospital, Kalaburgi, Karnataka-585104, were studied.

Inclusion Criteria: Physical status ASA class II, gestation age 36-40 weeks, posted for LSCS under spinal anesthesia. The patients who gave their consent in writing for the study were selected.

Exclusion Criteria: Age <20 years, >40 years, weight <40 kg >90 kg, ASA-III, gestational age <36 or >40 weeks, allergy to study drugs, contraindications to spinal anesthesia. Patients with cerebrovascular or cardiovascular disorders, preeclampsia, placenta previa, gestational diabetes, high-risk pregnant women, and those requiring emergency LSCS were excluded from the study.

Method: 30 patients with hypotension were compared with no hypotension undergoing spinal anesthesia undergoing LSCS. Sample size was calculated by using Buder's formula. Pleth variability index can predict spinal anesthesia-induced hypotension in patients undergoing cesarean delivery [5]. Prevalence of hypotension: 64% Sensitivity=78.1%, specificity=83.3% at 95%

confidence interval. Every patient underwent physical examination and routine investigations as per the institutional protocol. Patients were kept nil per month for 8 hours prior to surgery. In the operating room, ASA standard monitors were attached. Baseline PVI, PI, HR, BP, and SPO2 were measured in a supine position with a 15° left lateral tilt to prevent aortocaval compression. PVI and PI are automatically and continuously measured using a Masimo finger pulse oximeter on the index finger. IV was administered. Spinal anesthesia was given with a 25G Quincke's spinal needle in a sitting position with 10 mg 0.5% heavy Bupivacaine and 20 mcg of Inj. Fentatocol of the institution. Spinal level, HR, SBP, MAP, SPO2, PVI, and PI were measured every minute for an initial 10 minutes and every 5 minutes up to 30 minutes in a supine position with a 15° left lateral tilt. The sensory level was checked using a spirit swab for a cold sensation.

The assessment of motor blockade was done using a modified Bromage scale. The surgery commenced once the T6 dermatomal level was achieved. After baby extraction, Inj. oxytocin was administered. Hypotension is defined as SBP<90 mm Hg/20% fall from baseline MAP<65 mmHg. Hypotension was treated with an Inj. ephedrine 6mg bolus and a fluid bolus of RL @ 10-15 ml/kg.

The duration of the study was from September 2024 to February 2025.

Statistical Analysis: The recorded data was tested for normal distribution by Kolmogorvsmirnov test. In variables with normal distribution, group comparison was done with an independent t-test. The Mann-Whitney U test was employed to analyze quantitative data that did not follow the normal distribution. The statistical analysis was carried out using SPSS software.

Observation and Results

Table 1: Study of Baseline parameter

BMI: 24.58 (±2.15) SPO2 (%) 98.5 (± 0.78), pulse rate (BPM) 90.30 (± 8.40), systolic BP (mm/Hg) 118.50 (± 7.55), Diastolic BP (mm/Hg) 75.30 (± 6.23), Mean Arterial Blood Pressure (mm/Hg) 90 (± 4), PVI 22.06 (± 3.41), PI 3.26 (± 2.50).

Table 2:

Comparative study of Baseline parameters and PVI and PI at one minute in subject with hypotension with no hypotension –

- Baseline heart rate: 92.83 (± 9.46) in hypotension, 83.13 (± 8.03) in no hypotension subjects, t test 3.65 and p<0.001.
- Baseline systolic BP: 118.18 (± 3.50) in hypotension group, 120.82 (± 5.82) in no hypotension group, t test 2.13 and p<0.001.
- Baseline Diastolic BP: 74.20 (± 3.52) in hypotension group, 77.60 (± 6.50) in no hypotension group, t test 2.85 and p<0.001.
- Baseline Mean Arterial Pressure: 88.86 (± 4.80) in hypotension group, 92.05 (± 5.20) in no hypotension group, t test 2.46 and p<0.001.
- Baseline PVI: 21.86 (± 0.52) in hypotension group, 23.04 (± 1.25) in no hypotension group, t test 4.77 and p<0.001.
- PVI at 1 minute: 19.28 (± 5.02) in hypotension group, 17.83 (± 6.28) in no hypotension group, t test 3.08 and p<0.001.
- Baseline PI: 3.10 (± 1.05) in hypotension group, 3.73 (± 2.35) in no hypotension group, t test 2.65 and p<0.001.
- PI at one minute: 5.13 (± 0.25) in hypotension group, 5.11 (± 0.55) in no hypotension group, t test 0.18 and p<0.85 (p value insignificant).

Table 1: Study of Baseline parameters

Baseline vitals	Mean (±SD)
BMI (Body mass Index) (kg/m2)	24.58 (± 2.15)
SPO2 (%)	98.50 (± 0.78)
Pulse rate (bpm)	90.30 (± 8.40)
Systolic Blood pressure (mm/Hg)	118.50 (± 7.55)
Diastotic Blood pressure (mm/Hg)	75.30 (± 6.23)
Mean Arterial Blood pressure (mm/Hg)	90 (± 4)
PVI	22.06 (± 3.41)
PI	3.26 (± 2.50)

PVI = Pleth Variability Index PI = Perfusion Index

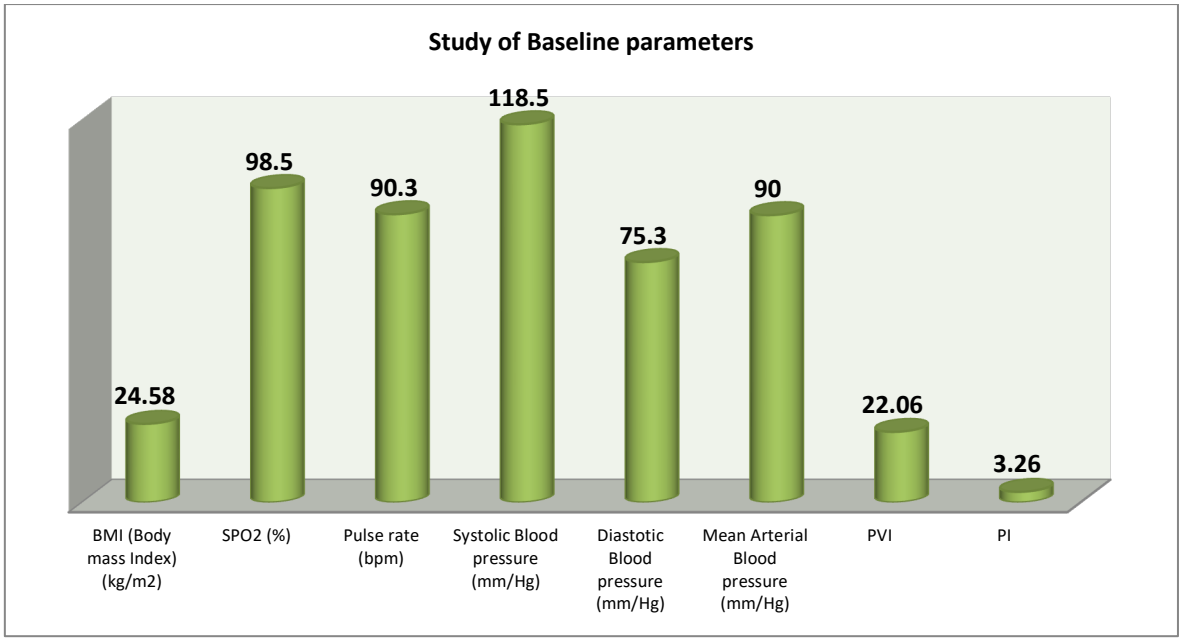

Figure 1: Study of Baseline parameters

Table 2: Comparative study of Baseline parameters and pleth variability Index (PVI) and perfusion Index (PI) at one minute in subjects with Hypotension and no Hypotension

Parameter	Hypotension	No Hypotension	t test	p value
Baseline heart rate	92.83 (±9.46)	83.13 (±8.03)	3.65	P<0.001
Baseline systolic P	118.18 (±3.50)	120.82 (±5.82)	2.13	P<0.001
Baseline Diastolic P	74.20 (±3.52)	77.60 (±5.50)	2.85	P<0.005
Baseline mean Arterial pressure	88.86 (±4.80)	92.05 (±5.20)	2.46	P<0.004
Baseline PVI	21.86 (±0.52)	23.04 (±1.25)	4.77	P<0.001
PVI at 1 minute	19.28 (±5.02)	17.86 (±6.28)	3.08	P<0.003
Baseline PI	3.10 (±1.05)	3.73 (±2.35)	2.65	P<0.001
PI at one minute	5.13 (±0.25)	5.11 (±0.55)	0.18	p>0.85

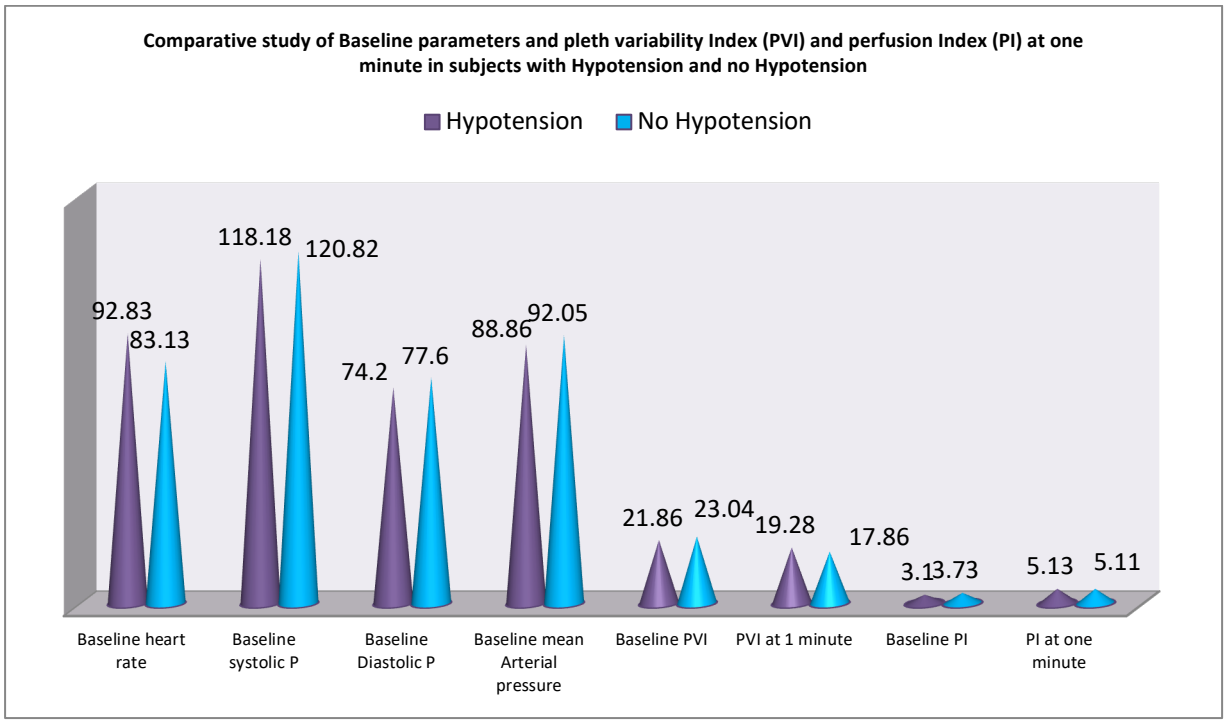

Figure 2: Comparative study of Baseline parameters and pleth variability Index (PVI) and perfusion Index (PI) at one minute in subjects with Hypotension and no Hypotension

Discussion

In the present role of variability index (PVI) and perfusion index (PI) for predicting hypotension following spinal anesthesia in patients undergoing cesarean section. In the baseline study of vitals, BMI was 24.5 (± 2.15), SPO2 was 98.50 (± 0.78), pulse rate (bpm) was 90.30 (± 8.40), SBP (mm/Hg) was 118.5 (± 7.55), DBP (mm/Hg) was 75.30 (± 6.23), MAP was 90 (± 4), PVI was 22.06 (± 3.41), and PI was 3.26 (± 2.50) (Table 1). In a comparative study of baseline parameters PVI and PI in hypotension with a controlled group. All baseline parameters were significant ($p<0.001$) except heart rate (Table 2). These findings are more or less in agreement with previous studies [6,7,8]. Hypotension following spinal anesthesia results from the blockade of pre-ganglionic sympathetic fibers and from blood pooling in blockade areas of the body. Changes in peripheral circulation are seen in normal pregnancy, viz., decreased peripheral vascular resistance, arterial and venous vasodilation, and increased intravascular volume. These changes further have an influence on the degree of hypotension that occurs after spinal anesthesia [9]. Hypotension may have adverse effects on maternal and fetal morbidity. During pregnancy, a significant decrease in vascular tone due to hormonal, metabolic, and physiological adaptation may lead to hypotension followed by spinal anesthesia. Many hemodynamic parameters are studied to predict hypotension, but no parameter can definitely predict the likelihood of hypotension. PI is a non-invasive and continuous method for assessing the peripheral tissue perfusion by calculating the ratio of arterial component and non-pulsatile components (venous capillary and other tissue) by oximeter detector [10]. The incidence of post-spinal hypotension varied from 13.7 to 76.7% (median 53.75%), likely due to differences in anesthetic dosage and definition of hypotension. The inclusion of the perfusion index as a diagnostic test demonstrated its potential benefit in improving the identification of parturients under spinal anesthesia. It is reported that positive prediction reports were 76%, whereas negative results were 21%. Nevertheless, PI offers a non-invasive and easily measurable parameter for indirectly assessing vascular tone and guiding prophylactic interventions to optimize hemodynamic stability following spinal anesthesia [11]. There is a positive correlation between PVI and PI, which enables us to predict hypotension.

Summary and Conclusion

In the present study it is indicated that the perfusion index showed a good predictive accuracy for hypotension with a pooled sensitivity and specificity of 78% and 83.1%, respectively. These findings suggest that the perfusion index may be a useful tool for predicting the development of hypotension in post-spinal anesthesia. However, it is important to consider heterogeneity among included studies. Further research is necessary to validate these findings and explore practical applications of the algorithm.

Limitation of study: Owing to remote location of research centre, small number of patients lack of latest techniques we have limited finding and results. This research work was approved by the ethical committee of KBN University, Faculty of Medicine Kalaburgi, and Karnataka-585104.

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