Anaesthesiology

EFFICACY OF PERFUSION INDEX DERIVED FROM PULSE OXIMETER IN PREDICTION OF HYPOTENSION FOLLOWING SPINAL ANAESTHESIA IN ELECTIVE CAESAREAN DELIVERY

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ABSTRACT

Background and Aims: Spinal anaesthesia is the commonest type of Anaesthesia used in Caesarean delivery. Baseline volume status is a known risk factor to affect the degree of hypotension, but baseline peripheral vascular tone may also have significant influence. Non-invasive blood pressure (NIBP) measurement is used as standard method of monitoring intraoperative and post operative haemodynamics. But it has the disadvantage of inability to measure beat to beat variation. Pulse oximetry is a simple, non-invasive, continuous, reliable, reasonably accurate, more economical method of measuring arterial oxygen saturation in all patient age groups. The Perfusion Index (PI) variable in pulse oximeter generally changes in proportion to peripheral perfusion. Hence in our study we have used PI as a predictor of hypotension following spinal anaesthesia in elective caesarean section. **Methods:** Based on the baseline perfusion index, 120 parturients were divided into two groups, parturients with baseline PI of ≤3.5 were categorised as Group A and those with PI of >3.5 as Group B. All parturients received standard monitoring after subarachnoid block 25G spinal needle and 10 mg 0.5% inj. Bupivacaine heavy. The primary objective of our study was to evaluate the role of baseline Perfusion index in prediction of hypotension following spinal anaesthesia in elective lower segment caesarean delivery and also to find out the correlation between baseline perfusion index and the incidence of hypotension in those patients. **Results:** The incidence of hypotension in group A was significantly lower in Group A as compared to Group B (18.4% vs. 65%, P <0.001). Total intravenous fluid transfused and Ephedrine dose required to treat hypotension was also significantly lower in Group A. (15% vs. 71.7% P <0.001) There was a significant positive correlation between perfusion index and hypotension episodes and ephedrine dose required to treat hypotension. **Conclusion:** Perfusion Index can be used for predicting hypotension in parturients undergoing elective lower segment caesarean delivery under spinal anaesthesia. Our results found out that parturients with baseline Perfusion index >3.5 are at a greater risk of developing hypotension following Spinal anaesthesia than compared to those with the baseline PI ≤3.5.

INTRODUCTION

Spinal anaesthesia is the commonest type of Anaesthesia used in Caesarean delivery. Spinal anaesthesia causes hypotension, which is due to the combination of decreased vascular resistance following sympathetic blockade and decreased cardiac output caused by peripheral pooling of blood in the blocked areas of the body.[1]

Baseline volume status is a known risk factor to affect the degree of hypotension, but baseline peripheral vascular tone may also have significant influence. Peripheral vascular tone has been found to be decreased in parturients at term, especially in those who are multiparous.[2] This decrease in peripheral vascular tone leads to the trapping of blood volume in the extremities and the sympathetic blockade due to spinal anaesthesia will further aggravate the blood pooling. Therefore, parturients with lower baseline vascular tone may be at an increased risk of developing hypotension after spinal anaesthesia.[3]

Non-invasive blood pressure (NIBP) measurement is used as standard method of monitoring intraoperative and post operative haemodynamics. But the limitation of this method is its inability to measure beat to beat variation of the blood pressure.

Pulse oximetry is a simple, non-invasive, continuous, reliable, reasonably accurate, more economical method of measuring arterial oxygen saturation in all patient age groups. [4] [5] Perfusion index is normally monitored with pulse oximeters. Perfusion Index or P.I. is the ratio of the pulsatile component of the blood flow to the non-pulsatile static component of the blood flow in a patient's peripheral tissue. The relationship of the pulsatile to the non-pulsatile components of blood at any particular site corresponds to PI at that particular site. The PI generally changes in proportion to peripheral perfusion. Hence PI can be used to assess the peripheral perfusion dynamics.[6][7][8]

Hence in our study we have used PI as a predictor of hypotension following spinal anaesthesia in elective caesarean section.

MATERIALAMD METHODS:

This prospective double blinded observational study was conducted in a tertiary care hospital after clearence from institutional ethical committee and written informed consent obtained from patients involved in the study between January 2018 - December 2018. 120 parturients between 20 and 35 years of age with singleton pregnancy belonging to American society of anaesthesiologists (ASA) physical class I and II posted for elective caesarean section under spinal anaesthesia were included in the studty. Parturients with Placenta previa, Cardiovascular or cerebrovascular disease, Preeclampsia or Gestational hypertension, Body mass index ≥40, Gestational diabetes mellitus, Gestational age <36 or >41weeks were excluded from the study.

All participants underwent preanaesthetic evaluation on the day prior to surgey and were prescribed tablet Ranitidine 150 mg and tablet Metoclopramide 10 mg.

On the day of surgery, all parturients were connected to standard monitoring with non invasive blood pressure, electrocardiogram, and pulse oximetry.

Perfusion index was measured in supine position using a specific pulse oximeter probe (Masimo Radical 7®; Masimo Corp., Irvine, CA, USA) in left index finger.

All the baseline values including PI was recorded in supine position by the anaesthesiologist who was not involved in further intraoperative monitoring of the patient. Based on the baseline perfusion index, parturients were divided into two groups, parturients with baseline PI of ≤3.5 are categorised as Group A and those with PI of >3.5 as Group B.

Intravenous (IV) access was established in the left upper limb. Every parturient was prehydrated with 500 ml of Ringer lactate over 20 minutes. The anaesthesiologist who was blinded to the baseline PI values performed spinal anaesthesia, using 25-gauge Quincke spinal needle in left lateral decubitus position with 10 mg injection 0.5%

hyperbaric Bupivacaine at L3–L4 intervertebral space. The parturient was returned to the supine position with a left lateral tilt of 15° to facilitate left uterine displacement. Oxygen was given at 4L/minute using venturi mask.

IV fluids replacement was done at 100ml/hour. The parturient was observed for vital parameters and the onset of spinal anaesthesia. The highest level of sensory block achieved was assessed with ice cube 5 minutes after intrathecal injection. Parturients with sensory block less than T6 dermatome were excluded from the study.

Non invasive blood pressure (NIBP), pulse rate, respiratory rate and oxygen saturation (SpO2) were recorded at 2 minutes intervals for the first 20 minutes followed by 5 min intervals till the end of surgery by the same anaesthesiologist who had administered Subarachnoid block. Hypotension was treated with bolus dose of 100 ml Ringer's Lactate (RL) and 6 mg injection Ephedrine given intravenously. Heart rate <50 beats/minute was treated with injection Atropine 0.6 mg intravenous bolus.

After extraction of the baby, Apgar score was recorded at 1st and 5th minute by a paediatrician not otherwise involved in the study. Injection oxytocin 10 units was given as uterotonic at a rate of 200 mU/minute using an infusion pump. Parturients requiring extra oxytocics or any additional surgical interventions were excluded from the study. Other side effects like nausea, vomiting were also recorded.

The primary objective of our study was to evaluate the role of baseline Perfusion index in the prediction of hypotension following spinal anaesthesia in elective lower segment caesarean delivery and also to find out the correlation between baseline perfusion index and the incidence of hypotension following spinal anaesthesia in elective lower segment caesarean delivery.

All the statistical analysis was done using the Statistical Package for Social Sciences (SPSS) for Windows software (trial version 22.0; SPSS Inc, Chicago). The results are given as mean and standard deviation (SD) for continuous variables while frequencies and percentages are used for categorical variables. To check for correlation between perfusion index and hypotension episode pearson correlation was used. Diagnostic accuracy, sensitivity and specificity of the perfusion index was evaluated using receiver operating characteristic curve (ROC). Student-t test was used to compare pulse rate and mean arterial pressures between two groups. P value of <0.05 was considered statistically significant.

RESULTS
The study involved 120 parturients. Based on the baseline perfusion index, parturients were divided into two equal groups, parturients with baseline PI of ≤3.5 were categorised as Group A and those with PI of >3.5 as Group B.

The patient demographics with respect to age, height, weight and ASA physical status were comparable between the two groups. All patients achieved adequate spinal block height above T6 at 5 minutes and the level of dermatomal height achieved was comparable between the two groups. There was no significant difference in the duration of surgery between the two groups. (Table1)

The Mean baseline perfusion index in Group A was 2.0(2±0.3) while in Group B it was 5.2 (5.2±0.9). Hence Mean baseline perfusion index was comparable between the two groups with P value of 0.001. Mean pulse rate and mean arterial pressure in both the groups did not differ significantly from each other during the course of anaesthesia. (Chart 1 and 2) The incidence of hypotension in group A was 18.4% as compared to group B 65% and this difference was statistically significant with P value < 0.00. (Chart 3) Total intravenous fluids transfused were comparable between the two groups. (1000.8±44.6 ml vs.1150±37 ml, p 0.012). (Table 2) The percentage of parturients requiring ephedrine dose for correction of hypotension was significantly more in group B as compared to group A. (71.7% vs. 15%, p <0.001) (Chart 4) There was a significant positive correlation between perfusion index and hypotension episodes and ephedrine dose requirement. The correlation between perfusion index and number of hypotension episodes was 57% (p value < 0.001) while the correlation between perfusion index and ephedrine dose requirement was 73.2% (p value < 0.001) (Chart 5 and 6) The cut off value of perfusion index 3.5 had the sensitivity of 65% and specificity 67%. Hence we can

conclude that using 3.5 as cut off for perfusion index is both sensitive and specific in predicting hypotension. (Chart 7)

Table 1. Duration of surgery profile in both groups

Duration of surgery	Group A N = 60	Group B N = 60	Total N = 120	P value
Mean±SD Range	49.2±4.4 40 - 55	49.6±3.0 46 – 57	49.4±3.8 40 - 57	0.508

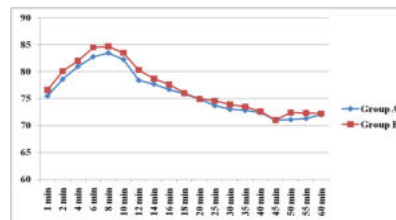**Chart 1. Comparison of Pulse rate during the course of anaesthesia in both groups**

Chart 2. Comparison of Mean arterial pressure during the course of anaesthesia in both groups
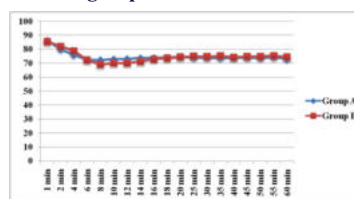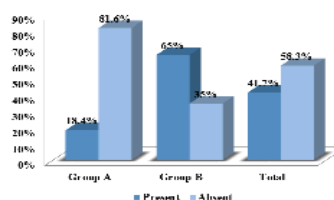

Chart 3. The Incidence of Hypotension in each group

Table 2. Fluid requirement in both groups

Fluid requirement	Group A N = 60	Group B N = 60	Total N = 120	P value
Mean±SD Range	1000.8±44.6 900 - 1050	1150±37 1000 - 1150	1010±42 900 - 1150	0.012

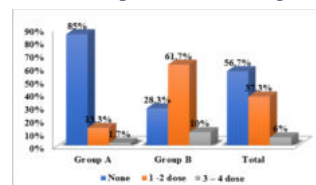**Chart 4. Ephedrine dose required in both the groups**

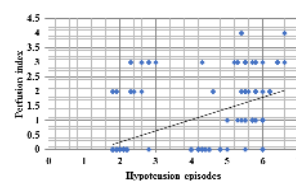**Chart 5. Correlation between perfusion index and hypotension episodes**

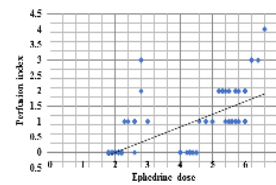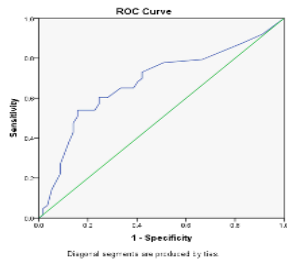**Chart 6. Correlation between perfusion index and ephedrine dose**

Chart 7. Sensitivity and Specificity of perfusion index

ROC Curve

DISCUSSION

Hypotension after administration of spinal anaesthesia for lower segment caesarean delivery is very common. There is no definitive monitoring system which may help to predict development of hypotension following subarachnoid block, so that additional precautions are taken. [4][5]

In our study, the incidence and severity of hypotension, vasopressor requirement were found to be higher in parturients with baseline Perfusion index values > 3.5.

Normal pregnancy is characterised by decrease in systemic vascular resistance, increase in cardiac output and total blood volume. The degree of reduction in systemic vascular resistance varies with each parturient depending on various factors. The decrease in the vascular tone will correspond to higher perfusion index values as there is increase in pulsatile component due to vasodilatation. Sympathectomy due to spinal anaesthesia (SA) will further decrease peripheral vascular tone leading to increased peripheral pooling of blood thereby causing severe hypotension. [6][7]

Parturients with higher baseline perfusion index are expected to have a lower peripheral vascular tone and thus they are at higher risk for developing hypotension following spinal anaesthesia.[8][9][10]

The cut-off value of baseline perfusion index for predicting spinal anaesthesia induced hypotension was chosen as 3.5 based on a study conducted by Toyama *et al,* where regression analysis and ROC curve analysis was done and concluded that a baseline perfusion index cut-off value of 3.5 can be used to identify parturients who are at higher risk for developing severe hypotension following spinal anaesthesia. [1]
The correlation between baseline PI >3.5 and probability of hypotension in our study was significant which was similar to the study conducted by Toyama *et al*.

Toyama *et al*. found a sensitivity and specificity of 81% and 86%, respectively, for baseline PI with a cut-off value 3.5 to predict hypotension, whereas in our study, sensitivity and specificity was 67% and 65% respectively. [1]

In our study, consumption of intravenous fluid was significantly higher than that in the study done by Toyama *et al*. This can be explained by the usage of intravenous fluid bolus and Injection Ephedrine for treating hypotension in our study while they have used Injection Phenylephrine only to treat hypotension.

Prostaglandins, Methylergometrine are very powerful vasoconstrictors and hence the patients receiving these drugs were excluded from the analysis as they can influence the observations.

Devika et al conducted the study to explore the predictive ability of Perfusion index following SAB in elective lower segment caesarean section. On Spearman rank correlation, they found out a highly significant correlation between baseline PI >3.5, number of hypotensive episodes, total dose of intravenous fluids and Ephedrine used to treat hypotension in their study.

A higher average vasopressor dose requirement was seen in parturients with baseline PI >3.5. Sensitivity and specificity of perfusion index in predicting hypotension was 89.29% and 69.84% respectively while in our study, sensitivity and specificity of perfusion index in predicting hypotension was found to be 67% and 65% respectively. The consumption of intravenous fluids in our study was similar to that of study done by Devika *et al*. [2]

Mowafi *et al*. used PI to detect intravascular injection of the epinephrine-containing epidural test dose, thereby demonstrating the reliability of PI to detect vasoconstriction . [4]

Ginosar *et al*. demonstrated that increase in PI following epidural anaesthesia was a clear and reliable indicator of sympathectomy. The results of our study also demonstrated the reliability of perfusion index in predicting hypotension following subarachnoid block. [8]

A study performed by Yokose M *et al* concluded that PI had no predictive value for hypotension in parturients undergoing LSCS following SAB. This may be explained due to different definition of hypoptension used as well as colloids used as co-loading fluid to treat hypotension in their study. [3]

CONCLUSION

We conclude from this study that Perfusion Index can be used for predicting hypotension in parturients undergoing elective lower segment caesarean delivery under spinal anaesthesia. Our results found out that parturients with baseline Perfusion index >3.5 are at a greater risk of developing hypotension following Spinal anaesthesia than compared to those with the baseline PI ≤3.5.

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