Original Research Article

Higher baseline perfusion index can predict hypotension in parturient undergoing elective lower segment caesarean section under spinal anaesthesia

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Abstract

Background: Elective Lower Segment Cesarean Section (LSCS) is commonly performed under spinal anaesthesia. Hypotension following spinal anaesthesia is common because sympathectomy causes vasodilation. The parturient has low systemic vascular resistance during the pregnancy. These combined vasodilatory effects can cause an increase in baseline Perfusion Index(PI). Various studies have been done using PI to predict hypotension. This study was designed to determine if baseline PI can be used to predict hypotension and to determine the cut off value of baseline PI in parturient undergoing LSCS under spinal anaesthesia. **Methods:** Fifty two ASA Class II patients undergoing elective LSCS under spinal anaesthesia were recruited for the study after the approval by the Institutional Ethics Committee. Informed consent was obtained. Baseline PI was measured and patients were divided into two groups. Patients with PI < 4.0 were assigned to Group I and those with PI >4.0 to Group II. Results were analyzed using Chi-square test, Spearman's coefficient of correlation and Receiver Operating Characteristic Curve (ROC). **Results:** There were 24 evaluable patients in each group. Twenty two patients in Group II developed hypotension compared to 4 patients in Group I (P<0.001). There was also a significant correlation between the baseline PI, incidence of hypotension, fluid boluses and dose of mephentermine administered (P<0.001). ROC yielded the cut off value of 4.05 with area under curve of 0.903 with 86% sensitivity and specificity for baseline PI. **Conclusion:** Higher baseline PI is associated with higher incidence of hypotension following spinal anaesthesia under LSCS.

Key words: Perfusion Index (PI), hypotension, spinal anaesthesia and Lower Segment Cesarean Section (LSCS)

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INTRODUCTION

Spinal anaesthesia is the anesthetic of choice for parturient undergoing elective LCSC. Hypotension is common after spinal anaesthesia. It is imperative that this hypotension is promptly treated to prevent decrease in placental perfusion and adverse effects on the fetus. Fluid loading, administration of vasopressor as a bolus or an infusion and other techniques have been used to treat the hypotension.[1,2] Prevention of hypotension would be desirable. But to prevent it one has to predict which patients are likely to develop such hypotension. We need a monitor to predict it. Our primary goal was to evaluate the baseline PI as a monitor that can predict such hypotension in parturient undergoing elective LSCS with spinal anaesthesia. Our

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secondary aim was to determine the cut off value of baseline PI that could predict such hypotension in these patients. Our hypothesis was that patients with higher baseline PI will have higher incidence of hypotension. Pulse oximeter was developed by Takuo Aoyagiand and Michio in 1992. Pulse oximeter has two wavelengths of 660 nm and 940 nm. Absorbance of light in both wavelengths has a pulsatile and non pulsatile component. Pulsatile component represents the fluctuation in the volume of arterial blood between the source and the detector in the pulse oximeter. The non-pulsatile component is from the venous flow, bone and connective tissue. Perfusion Index (PI) is the ratio of pulsatile to non-pulsatile component reaching the detector. The PI is influenced by body position, vasodilation and vasoconstriction at the monitoring site. Parturient has a low systemic vascular resistance and higher baseline PI. Spinal anaesthesia causes vasodilation. Combination of these two factors can increase the PI.[3,4] Our primary aim was to determine if such an increase in baseline PI could possibly predict the development of hypotension.

METHOD

This prospective study was conducted over a period of 6 months at a tertiary care center after the approval by the Institutional Ethics Committee. Sample size of the study was calculated using open EPI software 4 with a confidence interval of 95% and power of 90% upon advice of the statistician. Fifty two ASA Class II patients between the ages of 20 -35 years scheduled for elective LSCS were recruited for the study. Informed consent was obtained from each patient. Patients with high risk pregnancy, coagulopathy, allergy to local anesthetics, previous back surgery, and obesity (BMI>35) were excluded from the study. On the day of surgery patients were brought to the recovery room and spinal anaesthesia and associated risks were explained, a large bore intravenous catheter was placed in the left arm for infusion of fluids and administration of medications, Patient was placed in a supine position. Multi-parameter monitor placed. PI was measured with the pulse oximeter (Phillips Intellivue MX 450) placed on the left index finger. Non invasive blood pressure cuff was placed on the right arm and ECG leads were placed. Blood pressure, heart rate, oxygen saturation and baseline PI was measured and documented by the anaesthesiologist not involved in the anaesthetic care of the patient. Toyama recommended a baseline PI of 3.5. Duggappa ‘s study states that Indian parturient have a higher PI so we elected to use a baseline PI of 4.0 for this study.[3,5] In the operating room pulse oximeter, electrocardiogram, and non invasive blood pressure cuff monitor were attached. Patients were given 0.2 mg of glycopyrrolate and 4.0 mg of ondansetron IV as per the institutional protocol. Patient was placed in a sitting position. The Lumbar area was prepped and draped in a sterile fashion. Under all aseptic conditions spinal anaesthesia was administered using 25G Quincke point needle. On entering the subarachnoid space clear flow of cerebrospinal fluid (CSF) was observed after removal of the stylet. There was no pain or paresthesia on placement of the needle. 12.5 mg of 0.5% bupivacaine was injected in the subarachnoid space after aspiration of CSF. Patient was then placed in a supine position with a 15 degree left lateral tilt by putting the wedge under the right hip. Blood pressure was monitored and sensation was tested every two minutes using pin prick method till the sensory level of T6 was achieved. Ringer’s Lactate was used for intravenous infusion. 40% oxygen was delivered using facemask. Hypotension occurring during the first 30 minutes was attributed to spinal anesthesia. Decrease in mean arterial pressure (MAP) of more than 20% was defined as hypotension. This was treated with administration of 100 ml bolus of Ringer’s Lactate over 5 minutes and 6 mg of IV mephentermine. 20% drop in the heart rate from baseline was defined as bradycardia and was treated with 0.6 mg IV atropine if needed. Incidence if hypotension, number of fluid boluses and dose of mephentermine administered during surgery were recorded. Oxytocin 5 IU was given IV after delivery of the baby. Apgar scores in the newborn were recorded at 1 and 5 mins. Discrete and continuous data were analysed for normal distribution using Shapiro–Wilk test. Chi-square test was applied to assess statistical significance for discrete and categorical data. Independent sample *t*-test and Mann–Whitney U-test were applied for continuous data which showed normal and skewed distribution, respectively. Regression analysis with Spearman’s rank correlation coefficient was done to assess the correlation between baseline PI with other parameters. A Receiver Operating Characteristic (ROC) curve was obtained for baseline PI compared with the hypotension episodes of 52 parturient. Data were analysed using SPSS (Statistical Package for Social Sciences) version 20. (IBM SPSS Statistics for Windows, version 20.0, IBM Corp., Armonk, NY, USA) $P < 0.05$ was considered statistically significant. $P < 0.001$ was considered as statistically highly significant. $P > 0.05$ considered as statistically not significant.

RESULTS

There were 24 evaluable patients in each group. One patient in each group did not attain a sensory level of T6, and one patient in each group needed additional Oxytocin so these 4 patients were excluded from the study. Both groups were comparable in demographics and surgery times (Table 1). The results were analyzed using various statistical tests. Receiver Operating Characteristic (ROC)

is a characteristic curve. The PI values of both groups were combined and assessed for normal distribution. The median PI in Group I was 3.15 (IQR 2.3-4.4) but in Group II it was 5.2 (IQR 4.2-8.1). The ROC yielded the cut off value of 4.05 with 85% sensitivity and specificity (figure 1) and area under the ROC curve was 0.903.(table 4) During the first 30 minutes the MAP in group II was lower compared to Group I and remained so at 2, 4, 6, 8, 20 25 and 30 minutes. Twenty two patients developed hypotension in Group II (91.6%) compared to 4 patients in Group I (16.6%) (P<0.001)(table 2). Baseline PI and hypotension showed a statistically significant correlation as evaluated by Spearman's rank correlation. Patients with a higher baseline PI had increased incidence of hypotension and required more fluid boluses and doses of mephentermine. Post hoc power analysis while comparing hypotension and the vasopressor use demonstrated a power of more than 90% with confidence interval of 95%. There was no difference in the Apgar score in the newborn in the two groups.

Table 1: Demographic parameter

Demographic Parameter	Group 1 PI < 4.0 n=24	Group 2 PI ≥ 4.0 n=24
AGE (years)	25± 2.02	24± 3.02
BMI (kg/sqm)	24.3 ± 1.02	25.2 ± 2.3
Height(cm)	154± 2.18	155± 3.26
Weight(kg)	60± 1.32	59± 2.18
SURGICAL TIME (min)	55 ± 3.2	54 min ± 2.9

Table 2: Episodes of hypotension

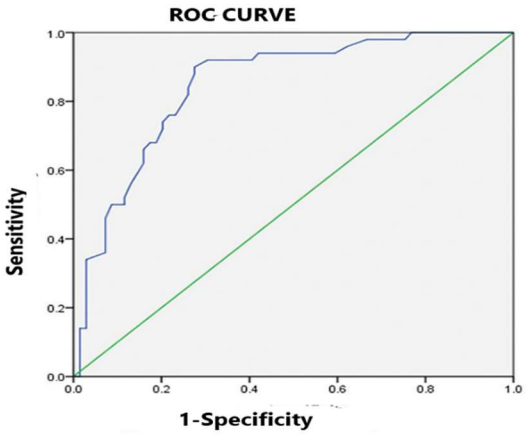
	Group 1 PI<4.0	Group 2 PI >= 4.0	p value
Number of patients	4/24 16.6%	22/24 91.6%	P<0.01

Table 3: Vassopressor and fluid requirement

PARAMETER	GROUP 1 PI < 4.0 (n=24) IQR(LL-UL)	GROUP 2 PI ≥ 4.0 (n=24) IQR(LL-UL)	P value
Dose of Inj.Mephentermine in mg	0.00(0-12)	6.0(0-18)	0.0002814
Fluid bolus in ml	200(100-300)	400(300-500)	0.0001706

Table 4: Area under curve

Area under curve				
PI Baseline				
Area	SEM	P value	95% confidence interval	
			Lower Bound	Upper Bound
0.903	0.036	<0.001	0.812	0.994



DISCUSSION

In this prospective study we were able to show that parturient with a baseline PI >4.0 undergoing elective LSCS had higher incidence of hypotension. They also required more fluid boluses and higher dose of mephentermine to treat this hypotension. Peripheral vascular tone affects the baseline PI.[1] There is a decrease in systemic vascular resistance, increase in blood volume and cardiac output after 30 weeks of gestation and can increase the baseline PI. Spinal anaesthesia causes hypotension because of sympathectomy and this can also increase the PI so, it is possible that the combined effects of these vasodilatory factors can increase the PI and can potentially result in higher incidence of hypotension. This study was designed to answer this very question so that baseline PI potentially can be used as a non-invasive useful monitor to detect the hypotension and treat it promptly to avoid undesirable effects on the fetus. Our results have shown that our patients with higher PI had increased incidence of hypotension. We were also able to determine the cut off value as 4.0. Various studies have been done to evaluate the usefulness of Perfusion Index. Prasad et. al and Toyama have used PI as an early predictor of hypotension in LSCS under spinal anaesthesia.[6,5.] Chu and colleagues have studied PI as a discharge criteria from the post anaesthesia care unit[7]. Mehandale evaluated PI as a predictor of hypotension following propofol induction[8].Mowafi demonstrated that PI is a reliable indicator compared to the hemodynamic parameter for detection of intravascular injection of epidural test done containing epinephrine[9] Uemura and his colleagues have indicated that PI is a useful objective and non-invasive method for evaluation of epidural block in pediatric patients[10] An increasing PI over time after an epidural placement is an indicator of successful block whereas flat PI signifies a failed block. Our study though has several limitations. We used the left index finger to measure baseline PI, despite being aware that motion could affect the PI. Pregnant patients are not given sedative

premedication, so anxiety and stress could cause activation of sympathetic stimulation and vasoconstriction leading to an effect on baseline PI. We measured our baseline PI in supine position. Supine position in term pregnant patients can lead to aortocaval compression and that can decrease in cardiac output and blood pressure. This could affect the baseline PI and we cannot rule that out. Future studies should compare the baseline PI in pregnant and nonpregnant patients. There is paucity of literature about baseline PI in normal pregnancy and those with pregnancy induced hypertension (PIH). In conclusion, despite the limitations for our study we were able to demonstrate that hypotension is more likely to develop after spinal anesthesia for LSCS in patients with higher baseline PI and it can be used as a non-invasive monitor to predict it. We also concluded that the cut off value for PI was 4.0 in this population.

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