



ORIGINAL RESEARCH PAPER

Anaesthesiology

PERFUSION INDEX AS PREDICTOR OF HYPOTENSION FOLLOWING SPINAL ANAESTHESIA FOR CAESAREAN SECTION

KEY WORDS: spinal anesthesia, hypotension, perfusion index, pulse oximeter.

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ABSTRACT

Introduction: Most common complication associated with spinal anaesthesia for lower segment caesarean section(LSCS) is hypotension. Non invasive blood pressure measurement is the most common method used for monitoring intraoperative hemodynamics. However, beat to beat variation in perfusion dynamics cannot be measured by this method since it is intermittent in nature and fails to detect hypotension in a timely manner. **Methods:** In this prospective observational study, noninvasive Perfusion Index (PI) and blood pressure were measured in 110 healthy parturients undergoing elective caesarean section under spinal anesthesia. The correlation between baseline Perfusion Index and the degree of spinal anesthesia induced hypotension during caesarean delivery by PI were investigated using Spearman's rho correlation coefficient. **Aim:** To predict hypotension by perfusion index before changes in Non invasive blood pressure (NIBP) values. **Objective:** To find the effect of intravenous Oxytocin and Mephentermine bolus on Perfusion Index. **Results:** PI appeared to increase more quickly and significantly in parturients with significant hypotension. Mephentermine showed significant decrease in PI. Effect of Oxytocin is significant with 5 International Unit (IU) bolus, though it does not cause a significant bloodpressure drop. **Conclusion:** Perfusion index can be a useful tool to predict hypotension following spinal anesthesia for caesarean section. Response to mephentermine can be quickly assessed by the change in the PI which helps to decide the further boluses of mephentermine.

Introduction.

With advances in the field of obstetrics the incidence of caesarean section is increasing exponentially. Central neuraxial anaesthesia is considered as the gold standard technique for obstetric anaesthesia as it avoids problems with general anaesthesia. The ability to identify hypotension early would help anaesthetist to start appropriate treatment with intravenous fluids or drugs. Beat to beat variation in perfusion dynamics cannot be measured by non- invasive blood pressure monitoring since it is intermittent in nature and fails to detect hypotension in a timely manner.

Perfusion index using pulse oximeter has recently come into focus as an early predictor of hypotension which effectively assesses peripheral perfusion dynamics and vascular tone. The degree of hypotension is due to decrease in vascular tone, PI can be used to assess the peripheral perfusion which can be altered due to peripheral vascular tone[1].

PI is a non-invasive method of assessing peripheral perfusion determined by the percentage of pulsatile to non-pulsatile blood flow in the extremities. It is also purposed to be an indicator of systemic vascular resistance. It is derived from the plethysmographic waveform obtained from pulse oximeter probe. It is defined as the ratio of the pulsatile blood flow to the non -pulsatile static blood flow in a patient's peripheral tissue such as fingertip, toe or earlobe and can be measured non-invasively using pulse oximeter. PI is a numeric value that indicates the strength of the IR (infrared) signal returning from the monitoring site [1].It is calculated by the following formula [2].

Perfusion Index =AC/DC x100

AC represents the pulsating component of infrared signal, the light which is absorbed by the pulsating arterial inflow, it also represents the amplitude of pulse oximeter waveform. DC represents the non-pulsatile component of infrared signal that is absorbed by the skin, other tissues and non-pulsatile amount of blood at the vascular site. It is expressed as

percentage.It predicts the chance of development of hypotension following spinal anaesthesia.PI has been used earlier for assessing hemodynamic parameters [3].But there are limited data regarding its use for prediction of the incidence of hypotension occurring as a result of the central neuraxial blockade. Hence, this prospective observational study is designed to demonstrate whether changes in Perfusion Index correlates with the development of hypotension during spinal anaesthesia and to find if Perfusion Index can be used as a tool for early prediction of hypotension following spinal anaesthesia.

Methods

After obtaining approval of the Ethical Committee of Government Medical College, Jammu, this prospective observational study was conducted in the Department of Anaesthesiology and Intensive Care, Government Medical College, Jammu. This study included 110 ASA grade 1&2 patients ranging from age 18-40 years with singleton pregnancy posted for caesarean section. In total, 110 pregnant mothers undergoing LSCS with an ASA status of 1 or 2 with a singleton foetus were included in the study.After securing Intravenous line, each woman was given a rapid intravenous infusion of Ringer's lactate at the rate of 15 ml/kg started as co-loading during the spinal block. In supine position and 15 degree table tilt position, baseline systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, oxygen saturation and perfusion index were recorded. Spinal anaesthesia was performed in the sitting position at L4- L5 or L3- L4 interspace via midline approach using 25 gauge Quinckes spinal needle. Following regime (145 cm -149 cm: 2ml, 150 cm -154 cm: 2.3 ml, 155 cm -160 cm: 2.4 ml, 160 cm and above: 2.5 ml) was used to decide the dose of 0.5 % hyperbaric bupivacaine over 20 seconds. After injection of the spinal drug patients were placed in supine position. Supplemental oxygen was given through a facemask at a flow rate of 5 L/min. Sensory level assessment was done with pinprick in the midline. A sensory block upto T5 was achieved. Motor assessment was done with modified

bromage scale. After delivery of the baby 5 U oxytocin was given i/v directly and 10U in 500 ml of ringer lactate was infused slowly over 1 hour. Maternal SBP, DBP, MAP (Mean Arterial Pressure), heart rate, and perfusion index were recorded every 2 minutes (mins) until the delivery of the baby and then at 3 mins interval until the end of surgery.

Results

The following parameters were recorded. Complications like hypotension and bradycardia were assessed. A decrease in mean arterial pressure of > 20 % of the baseline or systolic blood pressure < 100 mm Hg was treated with incremental doses of intravenous mephenteramine (6mg). A decrease in heart rate of <60 beats per minute was treated with Inj. Atropine (0.6 mg) intravenously.

Table 1

Correlations			AVERAGE SBP	AVERAGE PI
Spearman's rho	AVERAGE SBP	Correlation Coefficient	1.000	-.973**
		Sig. (2-tailed)		.000
		N	16	16
	AVERAGE PI	Correlation Coefficient	-.973**	1.000
		Sig. (2-tailed)	.000	
		N	16	16

** . Correlation is significant at the 0.01 level (2-tailed).

The above table shows the relationship of perfusion index with the hypotension analysed using the Spearman's rho correlation coefficient. Correlation revealed that the PI correlated with the changes in systolic arterial pressure. Correlation is significant at 0.01 level (2-tailed).

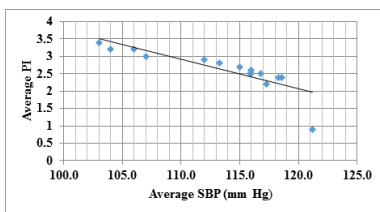


Figure 1

The above figure shows the correlation between PI and the systolic blood pressure during spinal anesthesia for LSCS. PI values rose more rapidly for the patients who experienced hypotension.

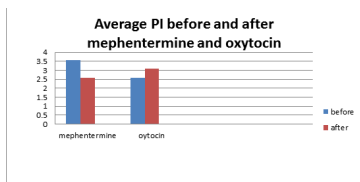


Figure 2. This figure shows significant correlation between values of PI before and after giving mephentermine and oxytocin using Pearson's correlation coefficient.

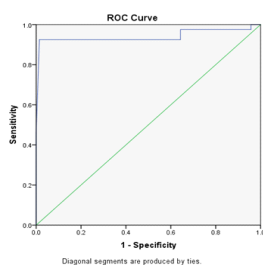


Figure 3

If cut off is taken as 3.5, then the sensitivity of PI to detect hypotension is 92.5% and specificity is 98%.

Discussion:

Many attempts have been made to look for predictors of hypotension in spinal anaesthesia. One novel predictor which has shown promise is the use of perfusion index derived from a pulse oximeter. Perfusion index has been used in the study by Ginosar Y et al., (2009) who demonstrated that increase in PI following epidural anaesthesia is a clear and reliable indicator of sympathectomy[2]. In contrast, a study performed by Yokose M et al., (2015) demonstrated that PI had no predictive value for hypotension in parturients undergoing LSCS following spinal anaesthesia[4]. This discrepancy was attributable to methodological differences, such as the definition of hypotension, co loading with colloids and method of calculation of baseline PI. The mean duration of surgery was 40 minutes. Our results were in accordance with Mallawaarachchi RP et al., (2020) who concluded that Perfusion Index increased significantly and more quickly in parturients with significant hypotension[5]. They used ephedrine bolus intravenously to treat hypotension and found a significant difference (p<0.001) between PI before and after giving ephedrine which is in accordance with our study. They also found that a significant (p<0.001) increase in PI following 5IU bolus of oxytocin which is also a finding in our study. The result of our study was not in tandem with Yokose M et al., (2015) who demonstrated that perfusion index had no predictive value for hypotension in LSCS[4].

In our study, we also found that the incidence and severity of hypotension and mephentermine requirement was higher in parturients whose baseline PI values were greater than 3.5. The Receiver Operating Curve (ROC) revealed that PI discriminated well between patients who developed hypotension versus those who did not. It yielded a new baseline PI value of 3.5 as the cut off point for predicting hypotension in parturients undergoing caesarean section under sub arachnoid block with a sensitivity of 92.5% and specificity of 98%. Our results were in accordance with Toyama S et al., (2013) who did regression analysis and ROC curve analysis, concluded that a baseline perfusion index cut off point of 3.5 could be used to identify parturients at risk for such hypotension [6]. In Toyama's study, only the baseline value was considered for analysis, because they did not try to explore the correlation between changes in serial PI values with the incidence of hypotension. Dugappa DR et al., (2017) also found the incidence and severity of hypotension, vasopressor requirement was higher in parturients whose baseline PI values were greater than 3.5 which again was in accordance with our study[7]. Patel N et al., (2021) concluded that there was a significant correlation between the baseline PI, incidence of hypotension, fluid boluses and dose of mephentermine[8].

A healthy pregnancy is characterised by a decrease in systemic vascular resistance, increased total blood volume, and cardiac output [9]. This decrease in tone will correspond to higher perfusion index values due to an increase in pulsatile component due to vasodilatation. Induction of sympathectomy by spinal anaesthesia will cause a further decrease in peripheral vascular tone and increasing pooling and hypotension.

Ginosar Y et al., (2009) demonstrated that an increase in PI following epidural anaesthesia is a clear and reliable indicator of sympathectomy[2]. Uemura and colleagues (2006) have indicated that PI is a useful objective and non-invasive method for evaluation of sympathetic blockade due to epidural block in paediatric patients [10]. An increasing PI over time after an epidural placement is an indicator of successful block whereas flat PI signifies a failed PI.

In our patients, the raised PI post spinal anaesthesia was likely due to vasodilatation from sympathetic blockade. On Spearman's correlation, a highly significant correlation was found between increase in perfusion index and the hypotension. In our study, PI appeared to increase higher and more quickly in women with significant hypotension suggesting that spinal anaesthesia may have developed more quickly in these cases. The thoracic sympathetic blockade is known to increase PI in the fingers demonstrated by Huang B et al., (2013). [11]. Brachial plexus block has been shown to increase PI in blocked arm. Mehandale SG et al., (2017) evaluated PI as a predictor of hypotension following propofol induction [12]. Mowafi et al., (2009) demonstrated that PI is a reliable indicator compared to the hemodynamic parameter for detection of intravascular injection of epidural test dose containing epinephrine [13].

The limitations in our study included the patient movement and any stimulus increasing sympathetic activity like anxiety that could easily change the PI values. In this study, we recorded baseline PI values with utmost care to avoid patient movement and all patients were counselled before taking them up for surgery to allay anxiety. We measured baseline PI values in left lateral position to avoid the effect due to aortocaval compression in the supine position while recording.

Conclusion

The present study concluded that baseline PI value of 3.5 can be taken as cut off to detect hypotension in obstetric patients undergoing caesarean section under spinal anaesthesia. There is a significant rise in PI following oxytocin bolus. Patients who were given iv mephentermine bolus (6mg) to treat hypotension showed significant decrease in PI. PI can be an effective tool to predict hypotension in healthy parturients are done in spinal anaesthesia. This can help anaesthetists to start appropriate treatment with intravenous fluids or drugs in a timely manner to prevent complications of hypotension and improve maternal and fetal outcomes.

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