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Ability of Finger Perfusion Index to Predict the Incidence of Hypotension during Spinal Anaesthesia in Parturient undergoing Elective Caesarean Section

Moumita Roy [1],Sankar Roy [2],Nabanita Roy [3],Arunava Biswas [4],Dipasri Bhattacharya [5]

[1] Senior Resident, Naihati State General Hospital, Naihati, West Bengal, India

[2]Associate Professor, Department of Anaesthesiology, Jalpaiguri Government Medical College & Hospital,Jalpaiguri, West Bengal, India

[3]Senior Resident, Dinhata Sub-Divisional Hospital, CoochBehar, West Bengal, India

[4]Associate Professor, Department of Pharmacology, Barasat Government Medical College & Hospital, Barasat, West Bengal, India

[5]Professor, Department of Anaesthesiology, Santiniketan Medical College, Bolpur, Birbhum,West Bengal, India

Institution to which the work is attributed: R. G. Kar Medical College & Hospital, Kolkata-700004

Corresponding Author:

Dr. Arunava Biswas(MD, DM)

Associate Professor, Department of Pharmacology

Barasat Government College & Hospital, Barasat

West Bengal, India

Email: **drabiswas@gmail.com,** Mob: **+91 9674328329**

Abstract:

Background: Spinal route of approach is the standard mode of regional anesthesia for conducting caesarean section is considered the standard mode of anaesthesia in caesarean section and it is considered safe, low cost with patient compliance. Spinal anesthesia induced sympathetic blockade, supine hypotension syndrome and low baseline vascular tone cause post spinal hypotension in the mothers. Perfusion index is a real time non-invasive parameter for early detection of this post spinal hypotension. Therefore the aim of this study was early prediction of anypost spinal hypotension and its degree of correlation withperfusion index.

Materialsand Methods:A prospective observation study was conduct on200parturient, based on inclusion exclusion criteria devoid of any co-morbidities undergoing elective caesarean section subjected to spinal anesthesia. After routine investigations parturient were posted for elective caesarean section maintaining proper fasting guidelines. The perfusion index was measured with pulse oximeter at fixed time interval along with other vital parameters. The final data were analyzed with appropriate statistical software.

Results: The parturient whose baseline finger perfusion index (P.I) is >3.5 have more chance of post spinal hypotension with a significance of p< 0.0001. Finger P.I with degree of decrease of SBP has positive correlation with highly significant value (r=0.7,p value<0.0001) whereas for MAP, it is highly significant but notpositively correlated(r=0.4, p value<0.0001).

Conclusion: Finger perfusion index is an effective non- invasive predictor for the post spinal hypotension undergoing elective caesarean section. Additionally, the finger perfusion index is a reliable indicator of the extent to which systolic and mean arterial pressure decreases.

Key words: Assessment, Finger Perfusion Technology, Parturient hypotension

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Running Title: Finger perfusion technique to estimate the risk of hypotension during spinal anaesthesia

Introduction

The common anaesthetic method applied to caesarean deliveries is spinal anaesthesia (SA) [1]but incidence ofhypotensionafterspinalanesthesia for caesarean section is reported to be as high as 71%, despite fluid co-loading, lateral uterine displacement and use of vasopressors.[1]Advantages of spinal anaesthesia are lower risk for gastric aspiration , avoiding airway manipulation by endotracheal tube etc. In case of caesarean delivery it also helps in lesser use of drugs which have cardio- respiratory depressant effect.Post spinal hypotension for caesarean section is a common and important problem, with significant maternal and foetal complications (nausea, vomiting, foetal hypoxia and acidosis etc.). Hypotension after spinal anaesthesia is primarily due to a decrease in systemic vascular resistance secondary to vasodilation with the blockade of sympathetic fibre up to T4 level.[2, 3]This hypotension, if severe can adversely affect mother and foetus. In a study by Neepa et al on 2021, concluded that higher baseline perfusion index predict the higher incidence of hypotension after spinal anaesthesia in elective caesarean section with a cut off value of 4.05.[4]However, a study conducted by Mehandale SG et al concluded perfusion index could predict hypotension following propofol induction. However, it has a very high negative predictive value in predicting hypotension following induction of anaesthesia with propofol, especially before endotracheal intubation.[5] Nonetheless, this study was conducted on patients on whom general anaesthesia was administered instead of spinal anaesthesia.. Now a days, along with management, early detection of this post spinal hypotension can be possible by a number of non-invasive methods like: thoracic electrical bio impedance, heart rate variability and perfusion index (P.I). But the drawback of these methods is they cannot measure aorto-caval compression by gravid uterus.[6,7]Among these non-invasive methods, finger perfusion indexmeasured by pulse oximeter, reflects the real time changes in peripheral blood flow.It is inversely proportional to the vascular tone, in anonlinear fashion. [8]This finger perfusion index is measured from pulse oximeter. Perfusion indexis a ratio between pulsatile(arterial) and non-pulsatile(venous and capillary blood and other tissue) component of light, reaching photo diode (PD) of pulse oximeter.Peripheral vasoconstriction can be detected by low finger perfusion indexwith or without severe hypovolemia and vice versa. [9, 10]

Therefore this study was conducted primarily to assesswhether baseline finger perfusion indexcould predict this post spinal hypotensionderived from pulse oximeter during elective caesarean section and secondarily whether the baseline finger perfusion indexcould correlate with the degree of post spinal hypotension.

Methodology

After obtaining the Institutional Ethics Committee approval (RKC no.84. dated 20.01.20) a prospective, observationalstudywas conducted in the Department of Obstetrics and Gynecology at a tertiary care hospital from January 2020-June 2021 on pregnant women aged 18-40 years, belonging to ASA-2 with gestational age between 36-40weeks who had no co-morbidities, needed elective caesarean section under spinal anesthesia.Parturient with placenta previa, cardiovascular disease, cerebrovascular disease, diabetes mellitus, known

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anxiety disorder, autonomic neuropathy, pre-eclampsia and eclampsia,BMI>40, contraindication to spinal anesthesia were excluded from the study.

It wasestimatedthatthesamplesize of 184 were required to calculate a moderate correlation coefficient (0.45 in the sample *vis a vis* 0.6 in the population) with 80% power and 5% probability of type1 error, rounding off to n=200 subjects, calculated by nmaster2.0 (Department of biostatistics, CMC Vellore; 2011) software.

After proper selection of the study participants, they werefasted according to ASA fasting guideline27a.All the parturient were co-loaded with IVF Ringer Lactate @10-20ml/kg/hour intra-operatively. Initiallybaseline SBP, DBP, H.R and finger P.I of the parturient were recorded in IntelliVue MP30 monitor by another anesthesiologist who has not taken part in further intra-operative monitoring or any intervention to prevent interviewer's bias. During spinal anesthesia, pulse oximeter of IntelliVueMP30 monitor was disconnected and the Spo2was monitored by another pulse oximeter to prevent observer bias. Spinal anesthesia was given by the researcher anesthesiologist.

For spinal anesthesia, parturient were turned to sitting position. 26 G Quinckes spinal needle was used for spinal anesthesiaat L3-L4 intervertebral space with 0.5% heavy bupivacaine 10mg and fentanyl 20 microgram. After giving subarachnoid block, parturient wereplaced immediately in supine position.Height of sensory block was measured by alcohol swab and height of motor block was measured by modified Bromage Score after 5minutes of spinal anesthesia. Serial monitoring and recording of vitalswas done every 3minutes interval till the end of surgery.The values of P.I were comparedwith hemodynamicvariability (systolic and diastolic blood pressure, mean arterial blood pressure, heart rate) and correlated with the change inparameters to assess any adverse effects.More than20% reduction from baseline systolic blood pressure or <90 mm of Hg 4,5or complaining of fainting, dizziness, nausea, vomiting without systolic blood pressure <90mm of Hg 28 or MAP <65 mm of Hg was defined as post-spinal hypotension.50microgramIV phenylephrine was given to the parturient in post spinal hypotension with heart rate >60/minutes as rescue medication.

Statistical Analysis:

Datawere summarized byroutinedescriptivestatistic, mainly mean and standard deviation for normally distributed numerical variables, median and interquartile range for skewed numerical variable, counts and percentage for categorical variables. Association between finger P.I and individual haemodynamic parameters were quantified over the period of observation by calculating Pearson's correlation coefficient (r). Every effort was made to conduct reservoir operating curve (ROC) analysis in order to identify any finger P.I value that could be considered as appropriate cut-off for detecting post spinal hypotension.

Results:

All the participants (n=200) completed the study with majority of them were found between age group 26-30 years, 86(4%) followed by 21-25 years, 69(34.6%). The pregnant mothers had a mean height of 163.6 (± 6.3)centimeters and weight in kilogram 59.91 (± 8.0) with a median (IQR) and range of gestational age 38(2); 36 – 40, gravida3 (1); 2 – 6 and parity2 (1); 1 – 4 respectively. Table 1 and the scatter plots in Figure 1 & 2 depicts the correlation among baseline PI and different parameters assessed and it shows a very significant p< o.ooo1 outcomeagainst decrease in SBP and MAP.

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Table 1: Correlation between baseline PI and degree different parameters assessed during SA for caesarean delivery

Parameters	% SBP decrease		% MAP decrease	
	R	*P* value	R	*P* value
Baseline PI	0.7	**<0.0001**	0.4	**<0.0001**
Age (yr.)	- 0.037	0.598	- 0.104	0.144
Height (cm)	0.020	0.776	0.015	0.829
Weight (Kg)	0.069	0.332	- 0.010	0.885
Gestational age (weeks)	- 0.076	0.284	- 0.063	0.374
Gravida	0.025	0.721	0.172	**0.015**
Parity	0.041	0.560	0.146	**0.039**

* r = Correlation coefficient

Figure1: Scatter plot showing correlation between baseline PI and degree of decrease of SBP during SA for caesarean delivery

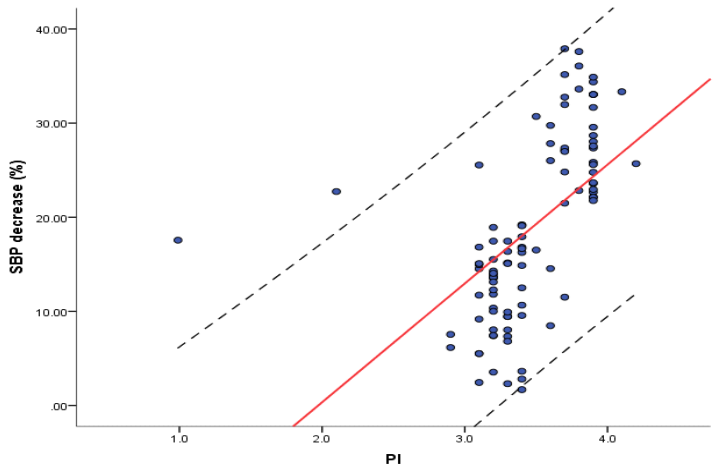
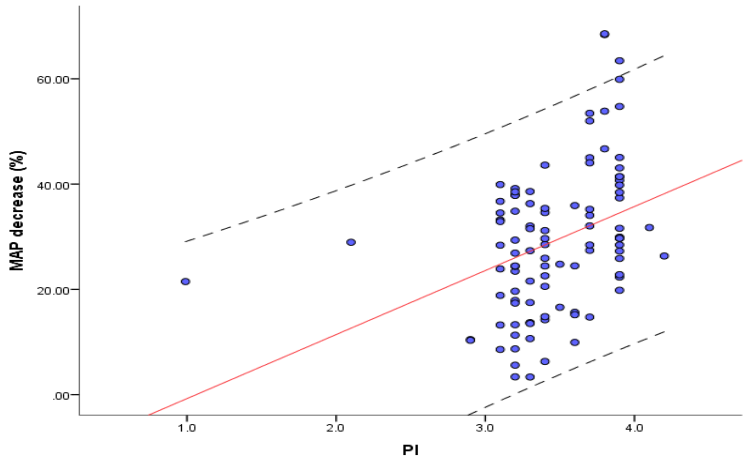


Figure2: Scatter plot showing correlation between baseline PI and degree of decrease of MAP during SA for caesarean delivery



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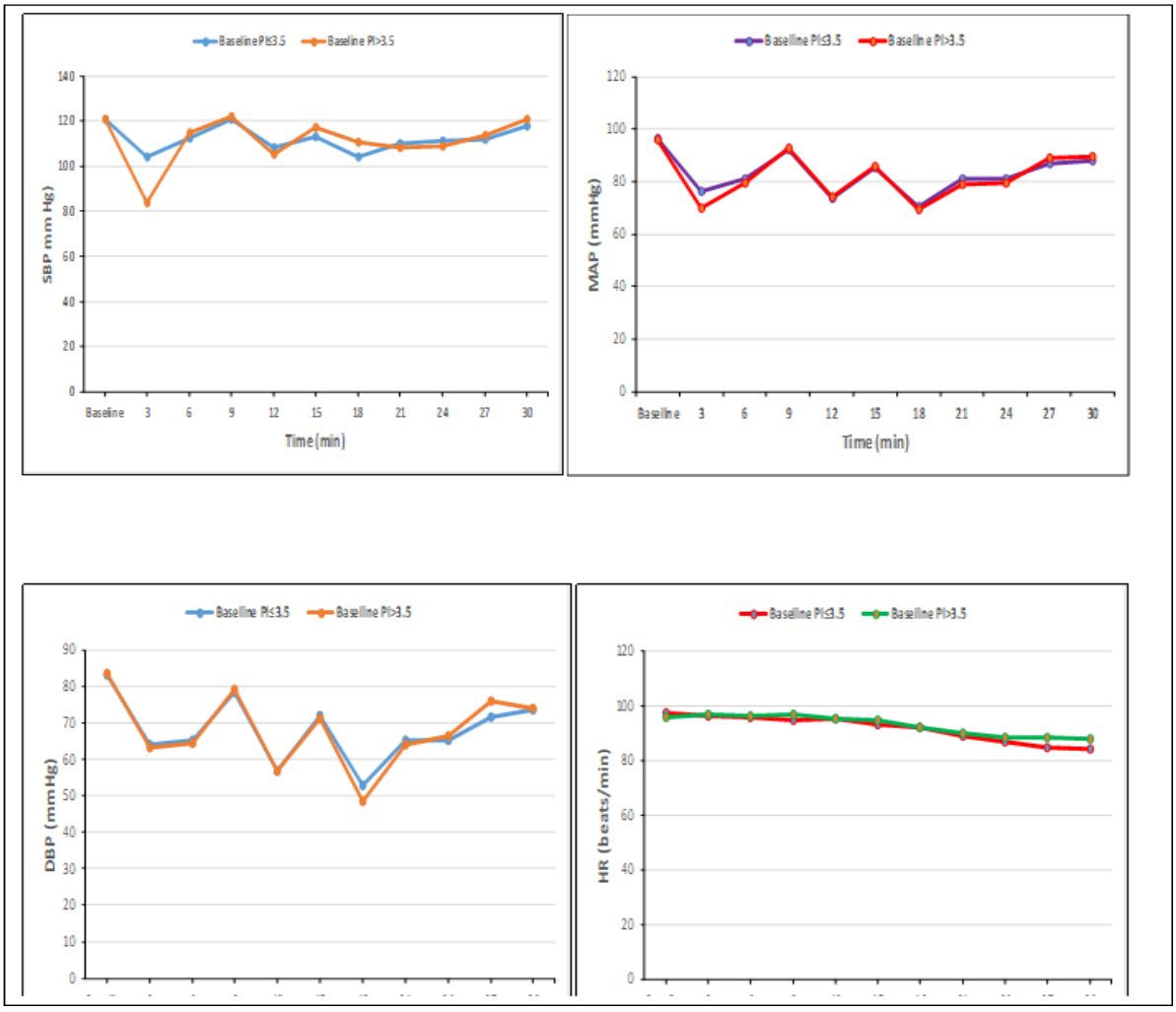
Based on the value of PI observed, the study population was divided into Group A with PI ≤ 3.5 and Group B with PI>3.5for the comparative assessment. The mean change in PI at different time interval assessed is shown in Table 2.

Table 2: Changes in PI Mean (±SD) from baseline to 30 minutes after the induction of spinal anaesthesia among the two groups of study population

	PI values Mean (±SD)										
Time (minutes)	Base	3	6	9	12	15	18	21	24	27	30
Group A (PI≤3.5)	3.2 (±0.3)	7 (±3.0)	4.9 (±1.6)	3.8 (±0.9)	5.1 (±1.4)	4.6 (±1.4)	5.7 (±2.3)	5.1 (±1.7)	4.8 (±1.3)	4.5 (±1.2)	3.8 (±0.7)
Group B (PI>3.5)	3.8 (±0.1)	8.1 (±3.1)	5.3 (±2.0)	4.8 (±1.4)	6.6 (±2.0)	4.6 (±1.1)	5.6 (±1.9)	5.5 (±1.8)	5.4 (±1.7)	4.7 (±1.0)	4.1 (±0.9)

The comparison of changes in SBP, DBP, MAP and HR from baseline to 30 minutes after the induction of spinal anaesthesia among the study groups based on PI value is depicted in the line diagrams in Figure 3.

Fig. 3: Line diagrams showing the changes in SBP, DBP, MAP and HR at different time interval after the induction of spinal anaesthesia among the PI based two study groups



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Discussion:

The present study was conducted on 200 parturient in a single study centre. All the recruited would be mothers were followed up and there was no drop out. The changes in Mean (±SD) of PI from baseline to 30 minutes after the induction of spinal anaesthesia among the PI based two groups of study population was found to be very significant with p<0.0001.Neepa et al on 2021, concluded that higher baseline P.I predict the higher incidence of hypotension after SA in elective caesarean section with a cut off value of 4.05.[4]In this study it was alsoobserved that higher the baseline PI, higher the chance of post spinal hypotension in elective caesarean section with a cut off value of 3.5.

V Yathish et al on 2020, concluded that there was significant correlation of P.I with hypotensive episodes (r=0.57, p value < 0.001) [11]. In the present study it was found that the baseline P.I with degree of decrease of SBP is highly correlate and significant (r=0.7,pvalue<0.0001) whereas for MAP, it is highly significant(r=0.4, p value<0.0001).Joseph George et alon 2019 concluded that the degree of correlation between baseline P.I and baseline SBP was significant(r=0.368, p<0.05) with a baseline cut off value of P.I was 3.6 (sensitivity 80%, specificity60%) [12].The current study also showed a positive correlation and highly significance between P.I and SBP (r=0.7, p value<0.0001) with cut off value of PI was 3.5(sensitivity and specificity of 95% and 93% respectively.

Varghese et al on 2018, divided 60 parturient into two groups. Group 1 included PI > 3.5 and group 2with PI ≤ 3.5. Spinal anaesthesia was given with 2ml of 0.5% bupivacaine (hyperbaric) in L3-L4 or L2-L3 inter space. MAP < 65mm of Hg was defined as hypotension. The correlation between baseline PI>3.5 and the number of episodes of hypotension was significant. The sensitivity and specificity of baseline PI of 3.5 to predict hypotension was 86.67% and93.33% respectively [13]. In this study >20% reduction of SBP from baseline or MAP < 65 mm of Hg were considered for hypotension and showed similar result. Duggappa et al conducted a comparative study with 126 parturient in 2017 one had baseline P.I<3.5 and another had >3.5 and concluded that baseline P.I >3.5 were more likely associated with post spinal hypotension [14].Our study also showed similar result among 200 parturient.

In the study conducted by Inoue. S et al with 9 patients who underwent orthopaedic surgery with SA on 2016 and measured the changes of mean arterial pressure, H.R and toe P.I after SA and concluded that there was increased P.I 2minutes after administration of 0.5% hyperbaric bupivacaine (2.9+/-0.3) ml (sensitivity 0.8 and specificity 0.99) [15]. Our study was conducted among parturient undergoing elective caesarean section with SA after administration of 0.5% heavy bupivacaine and 20 microgram fentanyl and concluded the similar result. Genderen van E Michel et al conducted a study with 24 healthy volunteers on 2013and concluded that P.I reflected early clinically significant central hypovolemia before changing the cardiovascular components (baseline SBP, stroke volume and H.R) [16]. Our study also reflect that P.I is an early predictor for post spinal hypotension.Toyama et al [6] conducted a study with 66 parturient in 2010 which showed that baseline P.I could predict the degree of post-spinal hypotension in term of decreased SBP(r-0.664, p=<0.0001) and MAP (r=0.491, p=0.0029) and the cut-off value of baseline P.I was 3.5(sensitivity 81%, specificity

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86%, p<0.001). The baseline P.I>3.5 show marked decreased in blood pressure similar to our study.

Limitations: The present study had certain limitations. Firstly, hypertensive parturient were not included in the above study. Secondly, only measured finger perfusion index which could not predict aorto-caval compression by gravid uterus directly. Thirdly, sympathetic hormonal response, anxiety, stress response may affect blood pressure and heart rate and influence post spinal hypotension in parturient.

Conclusion:

The study concludes that finger perfusion index was an effective non- invasive predictor for the post spinal hypotension undergoing elective caesarean section. The parturient whose baseline finger perfusion index was >3.5 had more chance of post spinal hypotension. Finger perfusion indexcan also effectively predict the degree of decrease of systolicand mean arterial pressure in such parturient undergoing spinal anaesthesia for caesarean section.

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Conflicts of interest: Authors declare no conflicts of interest.

References:

1. Loubert C. Fluid and vasopressor management for Caesarean delivery under spinal anesthesia: continuing professional development. Canadian Journal of Anesthesia/Journalcanadiend'anesthésie. 2012; 59(6):604-19.
2. Hanss R, Bein B, Ledowski T, Lehmkuhl M, Ohnesorge H, Scherkl W et al. Heart rate variability predicts severe hypotension after spinal anesthesia for elective caesarean delivery. The Journal of the American Society of Anesthesiologists. 2005:1; 102(6):1086-93.
3. Jeon YT, Hwang JW, Kim MH, Oh AY, Park KH, Park HP et al. Positional blood pressure change and the risk of hypotension during spinal anesthesia for caesarean delivery: an observational study. Anesthesia & Analgesia. 2010:1; 111(3):712-5.
4. Patel N, Joshi NK, Shah D. Higher baseline perfusion index can predict hypotension in parturient undergoing elective lower segment caesarean section under spinal anaesthesia. MedPulse International Journal of Anesthesiology.2021; 17(3): 99-102.
5. Mehandale SG, Rajasekhar P. Perfusion index as a predictor of hypotension following propofol induction - A prospective observational study. Indian J Anaesth. 2017; 61(12):990-5.
6. Toyama S, Kakumoto M, Morioka M, Matsuoka K, Omatsu H, Tagaito Y et al. Perfusion index derived from a pulse oximeter can predict the incidence of hypotension during spinal anaesthesia for Caesarean delivery. British Journal of Anaesthesia. 2013: 1; 111(2):235-41.
7. Berlac PA, Rasmussen YH. Per-operative cerebral near-infrared spectroscopy (NIRS) predicts maternal hypotension during elective caesarean delivery in spinal anaesthesia. International journal of obstetric anesthesia. 2005:1; 14(1):26-31.

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8. Mehandale SG, Rajasekhar P. Perfusion index as a predictor of hypotension following propofol induction-A prospective observational study. Indian journal of anaesthesia. 2017:61(12):990.
9. Mowafi HA, Ismail SA, Shafi MA, Al-Ghamdi AA. The efficacyof perfusion index as an indicator for intravascular injection of epinephrine-containing epidural test dose in propofol-anesthetized adults. AnesthAnalg. 2009; 108:549–53.
10. Goldman JM, Petterson MT, Kopotic RJ, Barker SJ. Masimo signal extraction pulse oximetry. Journal of clinical monitoring and computing. 2000:16(7):475-83.
11. Yathish V. Perfusion Index derived from Pulse Oximeter as a Predictor of Hypotension following Spinal Anaesthesia in Elective Caesarean Delivery (Doctoral dissertation, Tirunelveli Medical College, Tirunelveli.
12. George J, Valiaveedan SS, Thomas MK. Role of Perfusion Index as a Predictor of Hypotension during Spinal Anaesthesia for Caesarean Section-A Prospective Study. JMSCR. 2019; 7:1208-6.
13. Varghese RV. Perfusion Index Assessed from a Pulse Oximeter as a Predictor of Hypotension during Spinal Anaesthesia for Caesarean Section. JMSCR. 2018; 6:427-31.
14. Duggappa DR, Lokesh MP, Dixit A, Paul R, Rao RR, Prabha P. Perfusion index as a predictor of hypotension following spinal anaesthesia in lower segment caesarean section. Indian journal of anaesthesia. 2017; 61(8):649.
15. Inoue S, Asamto M, Orii R, Yamada Y. Abstract PR025: Detection of Spinal Anesthesia Effect By Measuring A Pulse Oximeter Based Toes Perfusion Index. Anesthesia & Analgesia. 2016; 123(3S):39-40.
16. Van Genderen ME, Bartels SA, Lima A, Bezemer R, Ince C, Bakker J, van Bommel J. Peripheral perfusion index as an early predictor for central hypovolemia in awake healthy volunteers. Anesthesia & Analgesia. 2013; 116(2):351-6.