## ORIGINAL RESEARCH

# Prediction Of Hypotension Following Spinal Anaesthesia For Caesarean Delivery Using Perfusion Index

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**ABSTRACT**
**Aim:** To evaluate use of baseline perfusion index for prediction of hypotension following spinal anaesthesia for caesarean section. **Objectives: Primary Objective-** To find out whether baseline perfusion index has any relation in the occurrence of postspinal hypotension in parturients undergoing LSCS. **Secondary Objective**

- To observe the intraoperative systolic blood pressure, diastolic blood pressure, mean arterial pressure, perfusion index, heart rate.
- Estimate the required dose of vasopressor used.

**Methodology-** We divided all patients into 2 groups anticipating equal distribution of baseline PI on either side of cutoff point of 3.5 as suggested by a study by Toyama et al. Group I - Those with baseline PI≥3.5 Group II – Those with baseline PI <3.5 Spinal anaesthesia was given with the parturient in left lateral decubitus position using Quincke's 23-gauge spinal needle with 11mg of injection bupivacaine 0.5% (hyperbaric) at the L3-L4 intervertebral space.Maternal HR, NIBP and PI were recorded at 2 min intervals after subarachnoid block upto 20 minutes and then at 5 minutes intervals till the end of surgery. Hypotension was defined as a decrease in MAP>20% from baseline based on a previous study. **Result:** The ROC analysis revealed that baseline PI was suitable for detecting part urients at risk for hypotension. The baseline PI cut-off point that predicted hypotension as detected by ROC analysis was 3.75 with a sensitivity 89% and specificity 84%.



## INTRODUCTION

Caesarean sections are the most commonly performed surgeries in the world. Spinal anaesthesia has emerged as he most preferred choice of anaesthetic techniques for caesarean delivery. Neuraxial local anes the tics have ifferent potencies on motor, sensory, and sympathetic nerves. This differential block is largely related to the size f different nerves. Large motor nerves are most resistant to local anesthetic block. Sensory nerves have ntermediate sensitivity. Preganglionic sympathetic fibers are the smallest and most sensitive to local anesthetics. These differences occur with both subarachnoid and epidural anesthesia. Analgesia (loss of sensation of harpness to pinprick) extends two or more segments more cephalad than anesthesia (loss of sensation to touch). mpathetic block (as measured by increase skin temperature) may extend as many as six spinal segments higher than the upper limit of sensory block 1.Cardiovascular changes seen with spinal anes the sia are caused by blockade of the sympathetic efferent fibers and thus generally are related to block height2.Both arterial and venous relaxations contribute to hypotension, resulting fromdecreases in systemic vascular resistance (SVR) and cardiac output. Venodilation causes increased pooling of blood in the capacitance vessels, thusreducing central blood volume. Although heart rate is typically maintained, bradycardia can occur with spinal anesthesia in 10% to 15% of cases, andunexpected circulatory collapse remains a dreaded complication with apotentially grave outcome3-5. the incidence of bradycardia increases with increased block height, with 75% of ccurrences associated with sensory block above T5. Cardioacceleratorfibers originate from T1 to T5, and thus sympathetic blockade above T5 is thought to allow parasympathetic predominance over heart rate, mediated via the vagus nerve6.Hemodynamic changes following spinal anaesthesia like hypotension, bradycardia etc. are aggravated in parturients at term since they already have areduced peripheral vascular tone19-22. Moreover pregnant women are moresensitive to local anaesthesia and less responsive to vasopressors. This canhave serious adverse effect on maternal& neonatal outcome23. So many studieshave been conducted to look for predictors of hypotension in pinalanaes the sia, like heart rate variability, body mass index24, advanced age, preoperative anxiety, baseline heart rate25. Photo-electric plethysmography can be used during anaesthesia tomonitor the pulsations associated with changes in blood volume in a peripheralvascular bed, and may be useful as a detector of iminent aemodynamic disturbance. The device is non-invasive, and can be applied easily and rapidly26. Perfusion index is the numerical value of the amplitude of the plethysmographic pulse wave which is displayed on pulse oximeters27.

## AIM

I. To evaluate use of baseline perfusion index for prediction of hypotension following spinal anaesthesia for caesarean section.

## OBJECTIVES

### Primary Objective

II. To find out whether baseline perfusion index has any relation in the occurrence of postspinal hypotension in parturients undergoing LSCS.

### Secondary Objective

III. To observe the intraoperative systolic blood pressure, diastolic blood pressure, mean arterial pressure, perfusion index, heart rate.

I. Estimate the required dose of vasopressor used.

## METHODOLOGY

All parturients will be explained in detail about the anaesthetic procedure and written informed consent will be obtained. All parturients on arrival to the operation room, standard monitoring equipments as electrocardiography, automated noninvasive blood pressure and pulse oximetry will be attached. Cuff of automated NIBP device will be applied to right arm and systolic(SBP) and diastolic arterial pressure(DBP) will

be noted. Pulse oximeter probe will be applied to the left index finger. Based on the hypothesis that parturients with higher baseline perfusion index would have higher incidence of hypotension, we will divide all patients

into 2 groups anticipating equal distribution of baseline PI on either side of cutoff point of 3.5 as suggested by a study by Toyama et al. Group I - Those with baseline PI≥3.5 Group II – Those with baseline PI <3.5 Precautions will be taken throughout intraoperative period to prevent hypothermia. Intravenous access will be established in the left forearm using 18G intravenous cannula and each parturient will be prehydrated with 500 ml of Ringer lactate over 20 minutes. Parturients' baseline haemodynamic variables and PI will be recorded in supine position after prehydration. Spinal anaesthesia will be given with the parturient in left lateral decubitus position using Quincke's 23-gauge spinal needle with 11mg of injection bupivacaine 0.5% (hyperbaric) at the L3-L4 intervertebral space. Immediately the parturient will be returned to the supine position with a left lateral tilt of 150. Oxygen will be given via face mask @ 4L/min. The upper sensory block level will be checked after 5 minutes of spinal injection by assessing loss of cold sensation with alcohol swabs. It will be ensured that a T6

sensory block level is achieved. Maternal HR, NIBP and PI will be recorded at 2 min intervals after subarachnoid block upto 20 minutes and then at 5 minutes intervals till the end of surgery. Hypotension was defined as a decrease in MAP>20% from baseline based on a previous study. If SBP decreases to this level, a bolus of inj. mephentramine 3mg IV and 100ml of Ringer lactate will be given as a rescue medication keeping the decrease within ≤20% from baseline MAP. Rescue mephentramine will be given in the same manner if patient complaints of faintness, dizziness, nausea or vomiting even if the decrease in MAP from baseline is ≤20%. The amount of mephentrmine administered within 60 min after spinal anaesthesia will be used to calculate vasopressor requirements. A bolus of 0.2mg inj. atropine will be given if hypotension occurs in combination with bradycardia (HR<55 beats/min). Inj. Oxytocin 20 U will be given as uterotonic agent after baby extraction and cord clamping. Those who require additional uterotonic agents or additional surgical interventions are excluded from the study. Patients with intraoperative blood loss more than 1000 ml are also excluded from the study. The first 1 hour following spinal anaesthesia will be considered for anaesthesia induced hypotension.

**OBSERVATION**

**Tableno.-1 Parturient demographic characteristics**

| | Group | Age | Weight | Height |
|---|---|---|---|---|
| **N** | P.I<3.5 | 50 | 50 | 50 |
| | P.I≥3.5 | 50 | 50 | 50 |
| **Mean** | P.I<3.5 | 25.02 | 60.54 | 154.82 |
| | P.I≥3.5 | 25.52 | 60.36 | 154.64 |
| **Median** | P.I<3.5 | 24 | 60 | 155 |
| | P.I≥3.5 | 25.5 | 60 | 154.5 |
| **Std.Deviation** | P.I<3.5 | 3.89 | 7.59 | 5.49 |
| | P.I≥3.5 | 3.13 | 7.44 | 5.45 |
| **Minimum** | P.I<3.5 | 19 | 48 | 142 |
| | P.I≥3.5 | 20 | 47 | 142 |
| **Maximum** | P.I<3.5 | 35 | 74 | 165 |
| | P.I≥3.5 | 32 | 73 | 166 |

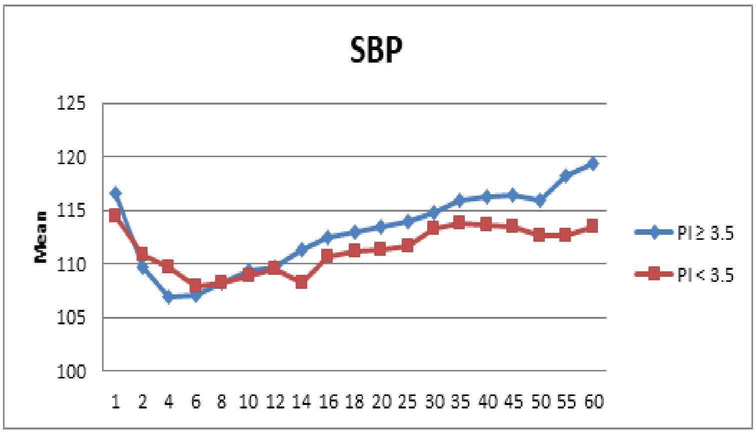
1. The demographic parameters such as age weight and height were comparable between the two groups(P>0.05)

**Tableno.-2: Comparison of baselinesbp, Dbp & Mapbetween two Groups**

| Baseline | PI<3.5 | | PI≥3.5 | | PValue |
|---|---|---|---|---|---|
| | Mean | Std.Deviation | Mean | Std.Deviation | |
| SBP | 116.4 | 8.46 | 125.26 | 7.51 | 0.093742 |
| DBP | 71.14 | 7.52 | 77.04 | 6.36 | 0.560617 |
| MAP | 86.36 | 7.5 | 92.95 | 5.57 | 0.198685 |

2. The table shows that the basel in e SBP, DBP & MAP values in both egrou psare comparable(p>0.05).

**Fig1.Changesinsbpafterspinalanaesthesiain Both Groups**




**Tableno.-3: Comparison of sbp values after sab in both groups**

| **Systolic BPafterinduction** | | | | | |
|---|---|---|---|---|---|
| **Time(min )** | **PI<3.5** | | **PI≥3.5** | | **PValu e** |
| | **Mean** | **Std.Deviation** | **Mean** | **Std.Deviation** | |
| 1 | 114.5 | 12.77 | 116.54 | 10.79 | 0.374052 |
| 2 | 110.88 | 12.31 | 109.7 | 11.56 | 0.963593 |
| 4 | 109.68 | 13.22 | 106.94 | 11.81 | **0.02641** |
| 6 | 107.96 | 12.56 | 107.02 | 12.02 | 0.045842 |
| 8 | 108.28 | 11.25 | 108.14 | 12.5 | **0.00105** |
| 10 | 108.82 | 10.88 | 109.28 | 10.86 | 0.416404 |
| 12 | 109.52 | 10.06 | 109.7 | 9.58 | 0.463587 |
| 14 | 108.22 | 16.09 | 111.28 | 8.3 | 0.118006 |
| 16 | 110.72 | 7.79 | 112.54 | 9.06 | 0.142091 |

| | | | | | |
|---|---|---|---|---|---|
| 18 | 111.22 | 8.02 | 112.92 | 8.51 | 0.153208 |
| 20 | 111.34 | 8.67 | 113.4 | 9.77 | 0.133724 |
| 25 | 111.68 | 8.45 | 113.92 | 10.68 | 0.123926 |
| 30 | 113.22 | 7.29 | 114.74 | 9.84 | 0.191163 |
| 35 | 113.76 | 8.21 | 116 | 10.08 | 0.11309 |
| 40 | 113.68 | 7.95 | 116.26 | 9.69 | 0.074359 |
| 45 | 113.44 | 8.8 | 116.36 | 10.21 | 0.06442 |
| 50 | 112.7 | 8.55 | 115.94 | 8.61 | **0.03097** |
| 55 | 112.66 | 8.39 | 118.26 | 7.74 | **0.00039** |
| 60 | 113.52 | 8.63 | 119.36 | 8.01 | **0.00034** |

3. The above table shows SBP values after SAB for 1hour in both the groups. There is statistically significant difference in SBP values among thesegroupsat**4**th,**6**th,**8**th,**50**th,**55**thand**60**thminute.

**Fig2.Changesindbpafterspinalanaesthesiainbothgroups**

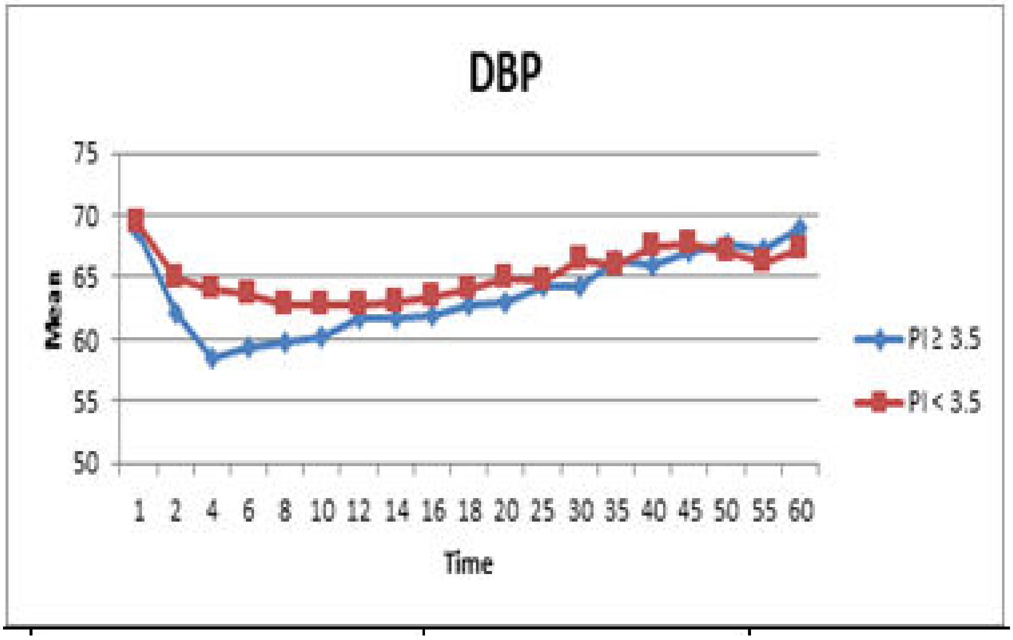



**Fig3.Changesinmapafterspinalanaesthesiainboth Groups**

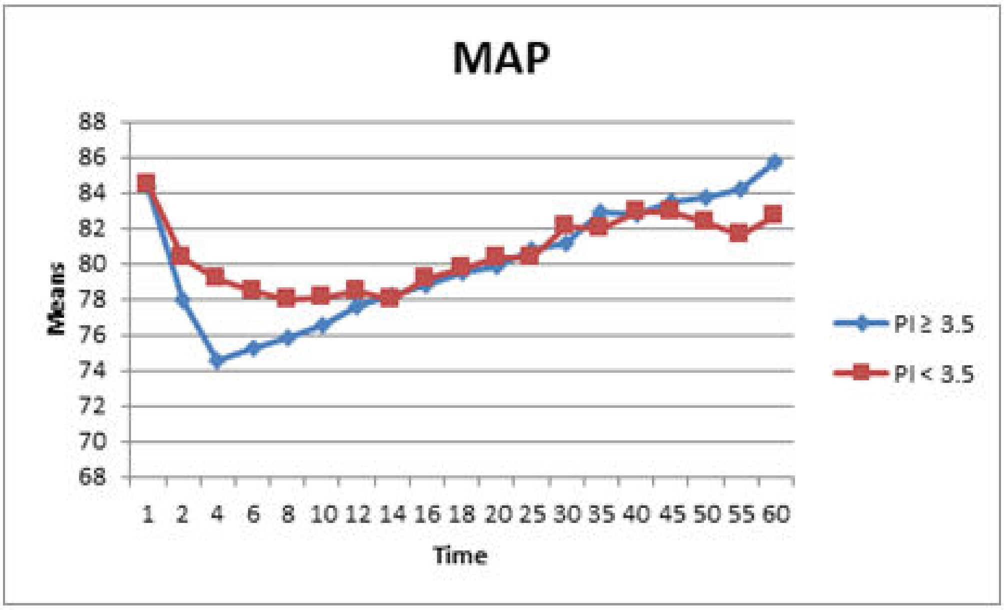


**Fig4.Comparison of incidences of hypotension between the two groups**

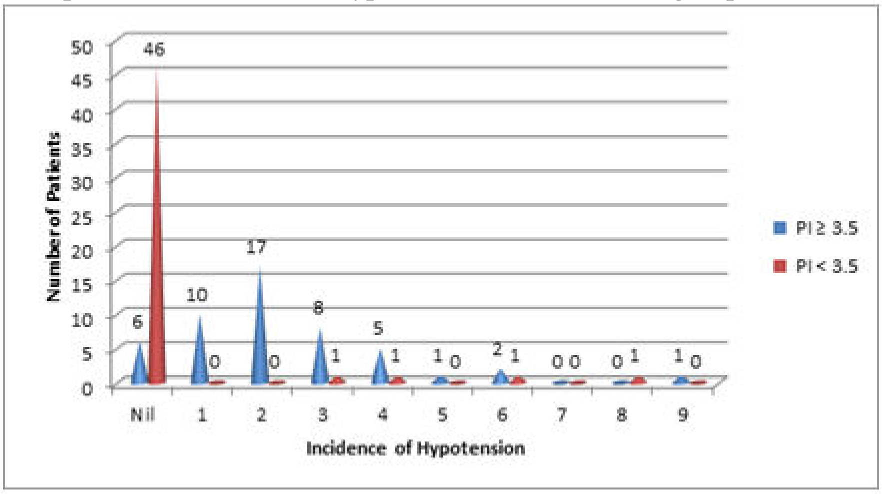
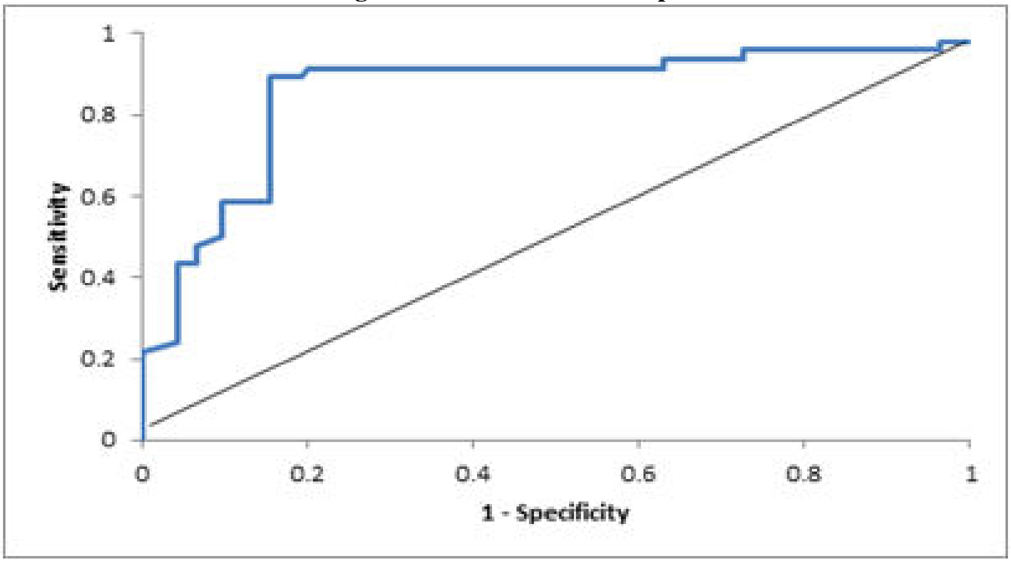



**Fig5.Comparison Of Usage Of Mephenteramine In Both Groups**
**Fig5.Roccurveforthebaselinepi**




Above figure is the ROC curve depicting baseline PI against incidence of hypotension during spinal anaesthesia. The ROC analysisrevealedthatbaseline PI was suitablefor detecting parturients at risk for hypotension. The baseline PIcut –off point that predictedhy potension as detected by ROC analysis was 3.75withasensitivity89%andspecificity84%.

## DISCUSSION

Subarachnoid block is the most common method of administering anaesthesia in lower segment caesarean section. Hypotension is the most common complication of spinal anaesthesia. Our study was to find out the correlation between the baseline perfusion index and the incidence of hypotension after spinal anesthesia in parturients undergoing caesarean delivery. Many hemodynamic parameters have been studied for the prediction of hypotension following spinal anaesthesia. Perfusion Index is a relative assessment of the pulse strength at the monitoring site. Parturients with high baseline perfusion index are expected to have lower peripheral vascular tone and hence are at higher risk of developing hypotension following spinal anaesthesia. Demographic parameters like age, weight and height of all patients were comparable in both groups. Baseline parameters like Systolic BP, Diastolic BP and Mean arterial BP were all comparable in parturients of both groups. SBP, DBP and MAP values of all parturients were measured serially every 2 minutes after performing spinal anaesthesia for 20 minutes and then every 5 minutes till one hour. These values were tabulated and statistical analysis was done. Hypotension following spinal anaesthesia was defined as a fall of MAP by more than 20% from baseline value50 and was treated with iv mephentramine 3mg and 100 ml ringer lactate. Mean Arterial Pressure values after SAB for 1 hour in both the groups showed statistically significant difference in MAP values for the whole period. The incidence of

hypotension in parturients with baseline PI≥3.5 was 88 % (44/50) compared to 8% (4/50) in parturients with baseline PI<3.5. This was clinically and statistically significant (P < 0.05). The usage of mephentramine was more in parturients with baseline PI≥ 3.5 when compared to those with PI < 3.5. The mean mephentramine usage for parturients with baseline PI≥ 3.5 was 6.84±5.22mg. The same for those with PI<3.5 was 1.26±4.62mg. The difference between the two groups were The baseline perfusion index cut off value for prediction of hypotension following spinal anaesthesia was chosen as 3.5 based on a study conducted by ***Toyama et al***. In that study the ROC analysis revealed that baseline PI was suitable for detecting parturients at risk for hypotension. The baseline PI cut-off point that predicted hypotension as determined by the ROC analyses was 3.5 with a sensitivity of 81%, a specificity of 86%, a positive predictive value of 89% and a negative predictive value of 75%. ROC analysis in our study yielded a new baseline PI cut-off of **3.75** with a sensitivity of 89% and specificity of 84% slightly different from the study by Toyama *et al.* The slight difference in findings may be attributed to thefollowing reasons 1. Toyama *et al.* studied on Japanese population while our study was on Indian population. 2. The definition of hypotension was taken as a decrease in SAP>25% from baseline in the study done by Toyama *et al*. In our study hypotension was defined as a fall in MAP>20%. 3. Toyama *et al.* used phenylephrine 50μg as a rescue medication for hypotension while mephentramine 3mg was used in our study statistically highly significant (P<0.01) In 2014, a prospective observational study was done by determine whether a baseline PI>3.5 predicted the development of hypotension after spinal anaesthesia in parturients. 126 parturients were put into 2 groups based on baseline PI cut-off point of 3.5. The incidence of hypotension in Group I (PI<3.5) was 10.5% (6/57) compared to Group II (PI>3.5) where incidence was 71.42% (45/63). The ROC curve yielded 3.85 as a more appropiate cut-off with a well balanced 76 % sensitivity and specificity. Findings of our study was similar to the findings of the above study by Duggappa*et al*. The slight difference in the baseline PI cut off point, sensitivity and specificity may be attributed to a different definition of hypotension(MAP<65mmHg) and use of Ephedrine 6mg as treatment oh hypotension instead of mephentramine in their study. **P Sridhar, Nirmal, *et al***. conducted a similar study dividing 70 parturients undergoing LSCS under subarachnoid block based on baseline perfusion index into 2 groups. Group 1 with a PI<3.5 and group 2 with a PI >3.5. The incidence of hypotension in group I was less compared to group II , this was clinically and statistically highly significant. The ROC curve yielded 3.45 as the most appropiate cut off point in baseline PI with a sensitivity of 81% and a specificity of 47.9%. This finding was almost similar to our study and the difference in numbers could be because of difference in definition of hypotension (MAP<65mmHg) and use of ephedrine as rescue medication in their study. Perfusion index had been used in the study by **Mowafi*et al*** . to detect intravascular injection of the epinephrine containing epidural test dose, where its reliability to detect vasoconstriction was demonstrated successfully. **Ginosar *etl***. in a study demonstrated that increase in PI following epidural anaesthesia is a clear and reliable indicator of sympathectomy. In contrast, a recent study conducted by **Yokose*et al*** 51. demonstrated that PI had no predictive value for hypotension in parturients undergoing LSCS following spinal anaesthesia. This discrepancy can be attributed to methodological differences, such as the definition of hypotension, co- loading with colloids and method of calculation of baseline PI There are many limitations in this study. Patient movement or any stimulus increasing sympathetic activity like anxiety can influence the PI values. Here, we recorded baseline PI values with care to avoid patient
movement and all parturients were counselled before taking them up for surgery to reduce anxiety. Systemic vascular resistance and invasive arterial blood pressure were not measured, but it would been invasive and unnecessary for the uncomplicated caesarean section. The baseline value of PI could have been affected because of aortocaval compression in supine position while recording.

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