PREDICTION OF POST SPINAL ANESTHESIA HYPOTENSION IN PATIENTS UNDERGOING CESAREAN SECTION USING PERFUSION INDEX

Pyakurel K[1], Rajbanshi LK[2], Bhattarai R[3], Dahal S[4]*

Affiliation

1. *Lecturer, Department of Anesthesiology and Critical Care, Birat Medical College and Teaching Hospital, Nepal*
2. *Associate Professor, Department of Anesthesiology and Critical Care, Birat Medical College and Teaching Hospital, Nepal*
3. *Assistant Professor, Department of Anesthesiology and Critical Care, Karnali Academy of Health Sciences, Nepal*
4. *Lecturer, Department of Pediatrics, Birat Medical College and Teaching Hospital, Nepal*

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**** Corresponding Author***

Dr. Kumud Pyakurel
Lecturer
Department of Anesthesiology and Critical Care
Birat Medical College and Teaching Hospital, Biratnagar, Nepal
Email ID: kumudpyakurel.kp@gmail.com
ORCID ID: https://orcid.org/0000-0002-0888-3691

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ABSTRACT

Introduction

Spinal anesthesia induced hypotension frequently complicates Cesarean delivery. Measurement of perfusion index derived from pulse oximeter predicting hypotension during the intraoperative course could provide new dynamism in prevention of hypotension, improving safe execution of anesthesia.

Objectives

The primary objective of this study was to compare incidence of hypotension following spinal anesthesia for LSCS in patients with baseline PI ≤ 3.5 to those with PI > 3.5. The secondary objectives were to compare PI, HR, SBP, MAP and adverse effects between the two groups.

Methodology

This prospective observational study was conducted at Nobel Medical College Teaching Hospital from to July 2019 to October 2019. 73 Term parturients presenting for elective cesarean delivery were included for the study. Spinal Anesthesia with 10 mg of 0.5% heavy Bupivacaine and 20 mcg Fentanyl (total 2.4ml) was given. Patients with baseline PI ≤ 3.5 and those with PI > 3.5 were compared for HR, SBP, MAP, PI and adverse events.

Results

The incidence of hypotension in Group I was 18.8% compared to 81.3% in Group II. This was highly significant (P = 0.000, odds ratio 0.11). On Spearman's rank correlation highly significant correlation between baseline PI >3.5 and number of episodes of hypotension (rs 0.482, P = 0.000) was found. The sensitivity and specificity of baseline PI with cut-off 3.5 for predicting hypotension were 81.3% and 66.7% respectively. ROC curve analysis showed 3.53 as appropriate cut–off for our findings. The area under the ROC curve (AUC) was 0.734.

Conclusion

This study demonstrates that baseline PI of > 3.5 correlates with incidence of hypotension after spinal anesthesia for cesarean delivery in healthy parturients compared to a baseline PI of < 3.5.

KEYWORDS

Perfusion index, hypotension, spinal anesthesia, cesarean delivery

INTRODUCTION

Spinal anesthesia induced hypotension frequently complicates Cesarean delivery. Spinal anesthesia induced hypotension is usually attributed to sudden sympatholysis due to local anesthetics acting on spinal nerve roots leading to splanchnic vasodilatation and peripheral pooling of blood causing decreased venous return.[1-4] This can be aggravated by physiological changes of pregnancy leading to change in baseline peripheral vascular tone.

Strategies to prevent hypotensive episodes should be the primary aim of anesthetic management. In most of the patients it is often difficult to predict hypotension despite assessment of risk factors. The perfusion index (PI) derived from a pulse oximeter has been used for assessing peripheral perfusion dynamics due to changes in peripheral vascular tone.[5,6] PI is a non-invasive method of assessing the relative vascular tone with the use of pulse oximeter which calculates the ratio of pulsatile versus the non-pulsatile component of the blood flow.[7] Thus, PI is a continuous and noninvasive measure of peripheral perfusion obtained from a pulse oximeter.

So, a simple noninvasive measurement of perfusion index derived from pulse oximeter predicting hypotension during the routine intraoperative course could provide a new dynamism to the management of anesthesia, improving the safe execution of anesthesia. Thus, this study aimed to observe whether baseline preanesthetic PI could predict hypotension after spinal anesthesia for cesarean delivery.

METHODOLOGY

This prospective observational study was conducted after ethical approval at Nobel Medical College Teaching Hospital from to July 2019 to October 2019. Term parturients presenting for elective cesarean delivery were included for the study. A pilot study was conducted in 20 parturients using a baseline PI of 3.5 as cut-off point as suggested in a study by Toyama *et al*.[8] and a difference in the incidence of hypotension of 41.41% was found when those 20 patients were divided into two groups based on cut-off point of 3.5 (PI ≤3.5 [nine patients] and PI >3.5 [eleven patients]). Keeping the confidence interval at 95%, a minimum of 30 parturients were required in each group, to achieve a power of 90%. Parturients involved in the pilot study were not considered for the final analysis.

A written informed consent for the study was obtained from all patients. Exclusion criteria included patient refusal, emergency indication, known contraindications to spinal anesthesia, patients with BMI > 40, preeclampsia, placenta previa or with comorbidities like cerebrovascular or cardiovascular disease and gestational diabetes. Patients with more than two attempts to lumbar puncture were also excluded from the study.

Thorough preanesthetic evaluation was done a day before surgery. The patients were kept nil per oral for eight hours and standard premedication with Ranitidine 50mg and Metoclopramide 10mg IV were administered 30 minutes prior to anesthesia. Upon arrival in the operation room, standard monitors were attached and baseline HR, SBP, DBP, MAP, PI and SPO2 were recorded in supine position. All values of PI were taken from Mindray uMEC 12 monitor. The patients with baseline PI ≤ 3.5 were enrolled into Group I and those with a PI > 3.5 were enrolled into Group II. A different monitor was used for monitoring SPO2 while giving spinal anesthesia and the original monitor was attached as soon as the patient was returned to the supine position. The managing anesthesiologist was blinded to the value of baseline PI. Spinal Anesthesia with 10mg of 0.5% heavy Bupivacaine and 20mcg Fentanyl (total 2.4ml) was given at L3-L4 interspace in sitting position using midline approach. Patient was then returned to supine position with left lateral tilt of 15 degrees to facilitate left uterine displacement. Upper sensory level was checked at 5 minutes using alcohol swab. Once T-6 level was reached, surgery was started. Maternal SBP, DBP, MAP, HR and PI were recorded at 1 minute intervals between spinal injection and delivery and then 3 minutes until end of surgery.

Clinically relevant hypotension was defined as the decrease in MAP by 20% or more from baseline value. It was initially treated with 200 ml Ringer's lactate solution, if ineffective, 5 mg Mephenteramine was given intravenously. Clinically relevant bradycardia was defined as a heart rate decrease to < 50 beats/minutes and was treated with 0.01 mg/kg atropine intravenously.

RESULT

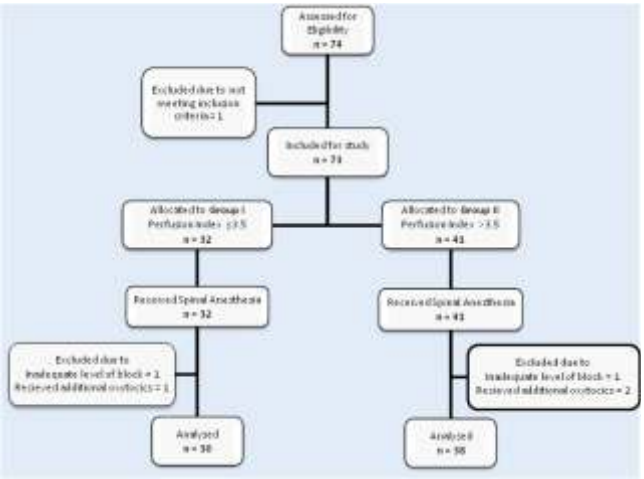

Figure 1: CONSORT flow chart

In total, 73 patients were enrolled in the study. Five patients were excluded from the study due to inadequate level of spinal anesthesia or requirement of additional oxytocics. Hence, 68 patients were taken for the final analysis (Figure 1). The patient characteristics like the demographics, obstetrics and other patient data were comparable in both the groups (Table 1).

Table 1: Patient Characteristics (Values are expressed in Mean±SD and Median (IQR)*)

Patient Characteristics	Group I Mean ± SD	Group II Mean ± SD	P- value
Age (years)	23.67 ± 4.13	25.95 ± 5.52	0.064
Height (cm)	148.97 ± 5.55	149.74 ± 5.82	0.582
Weight (Kg)	70.47 ± 8.68	67.71 ± 8.15	0.183
Gravidity (n)*	2 (1-4)	2 (1-4)	0.672
Parity (n)*	1 (1-3)	1 (1-3)	0.837
Period of Gestation (wks)	39.00 ± 1.46	38.74 ± 1.62	0.490
Volume of Spinal (ml)	2.29 ± 0.1	2.31 ± 0.1	0.454
Hemoglobin (gm/dl)	11.42 ± 0.86	11.87 ± 1.02	0.059
Blood loss (ml)	680.00 ± 123.6	646.05 ± 137.73	0.295
IVF (ml)	1945.00 ± 331.75	2096.05 ± 334.58	0.068
Baby weight (grams)	3086.67 ± 398.91	2982.89 ± 453.26	0.327
Duration of Surgery (min)	41.00 ± 11.06	38.34 ± 8.67	0.270
Duration of Anesthesia (min)	46.43 ± 11.4	43.74 ± 8.62	0.271

The baseline HR, SBP and MAP in both the groups were comparable. HR was comparable throughout the course [Figure 2]. SBP was comparable in both the groups except for 5 to 8 minutes after spinal anesthesia where it was significantly different [Figure 3]. MAP values showed significant difference at 5-7 minutes of spinal anesthesia and 3 and 6 minutes after delivery [Figure 4].

The baseline PI in Group I and Group II were 1.93 and 4.95 respectively. There was decrease in PI in both the groups after spinal anesthesia and delivery. In Group I, there was a significant decrease in PI compared to the baseline at 2 minutes to 6 minutes of spinal anesthesia. Whereas in Group II compared to the baseline, the value of PI was significantly decreased from 2 minutes of spinal anesthesia to 45 minutes after delivery [Figure 5].

Figure 2: HR changes over time

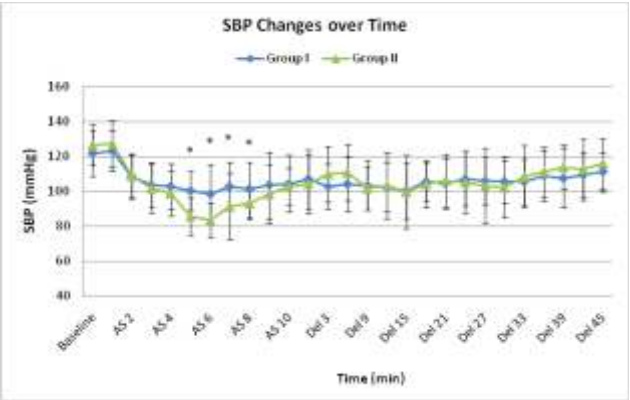

Figure3: SBP changes over time, * P value < 0.05 in between the groups

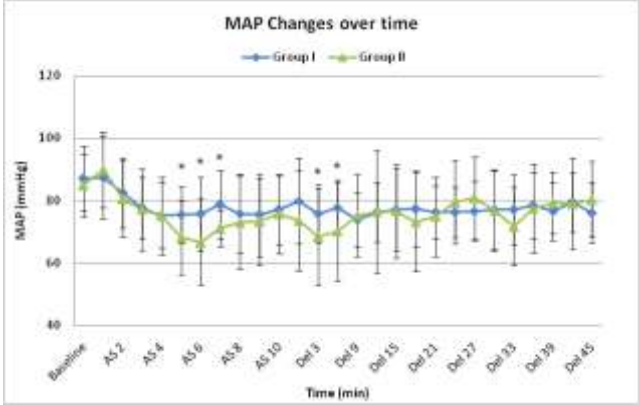

Figure4: MAP changes over time, *P value < 0.05 in between the groups

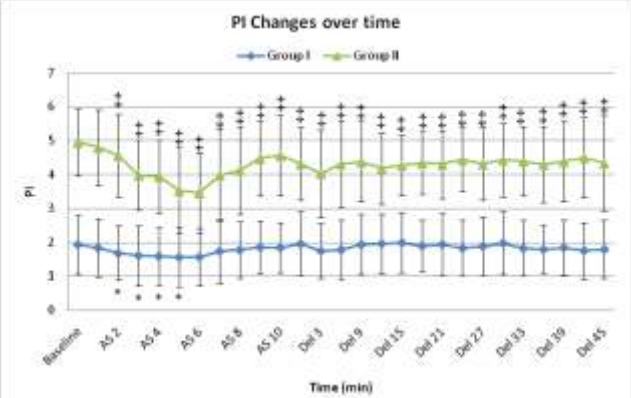

Figure5: PI changes over time, ‡ P value < 0.05 compared to baseline in Group I, * P value < 0.05 compared to baseline in Group II

The ROC curve analysis showed 3.53 as appropriate cut–off for our findings. The area under the ROC curve (AUC) was 0.734 [Figure 6] [Lower bound 0.608 and upper bound 0.861, P=0.001]

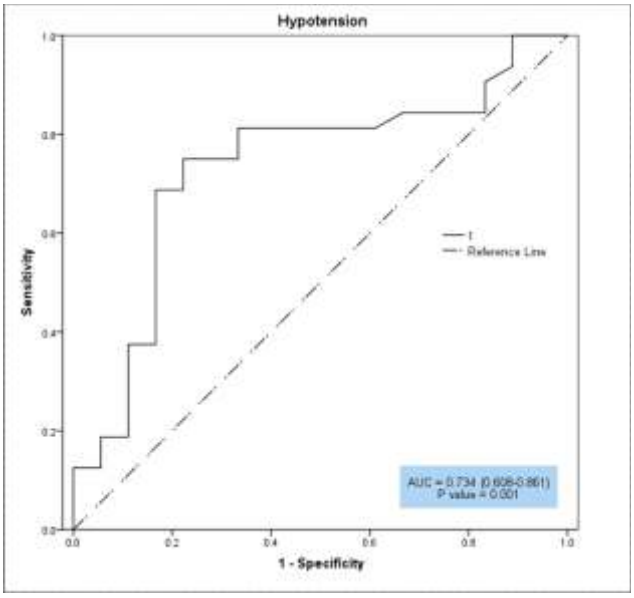

Figure 6: ROC curves for the baseline PI and the incidence of hypotension

The incidence of hypotension in Group I was 18.8% (6/30) compared to 81.3% (26/38). This was clinically and statistically highly significant (P = 0.000, odds ratio 0.11). On Spearman's rank correlation we found highly significant correlation between baseline PI >3.5 and number of episodes of hypotension (rs 0.482, P = 0.000). The sensitivity and specificity of baseline PI with cut-off 3.5 for predicting hypotension were 81.3% and 66.7% respectively. The RR and SpO2 were comparable between the two groups throughout the study period. There was no significant difference in APGAR scores between the groups at 1st and 5th min.

Adverse events

Adverse events such as hypotension and nausea and vomiting were seen in both groups. Significantly high incidence of hypotension was observed in Group II (P=0.000). Both the groups had Nausea and vomiting but with no significant difference.

Table 2 - Adverse events

Adverse events	Group I n (%)	Group II n (%)	OR (95% CI)	P value (Fisher test)
Hypotension	6 (20)	26 (68.42)	0.115	0.000
Nausea / Vomiting	2 (6.67)	4 (10.53)	1.647	0.687

DISCUSSION

This study has demonstrated that a higher PI of > 3.5 is significantly associated with hypotension following spinal anesthesia for cesarean section. Our study reports the sensitivity and specificity of 81.3 % and 66.7 % for baseline PI of 3.5 for predicting post spinal anesthesia hypotension. The AUC was 0.734 and baseline PI value of 3.53 as appropriate cut-off for our findings.

PI has been previously used as a marker for sympathectomy after epidural anesthesia and also to predict fluid responsiveness in critically ill patients.[5,6,9] Few studies have been carried out for PI to predict hypotension after spinal anesthesia for cesarean section. The idea of PI being associated with hypotension after spinal anesthesia is related to peripheral vascular tone or the degree of vasodilatation.[5,6] By definition, PI is the ratio of pulsatile to non-pulsatile fraction of blood volume. So, an increase in pulsatile fraction as in vasodilatation or a lower peripheral vascular tone corresponds to a higher PI. Spinal anesthesia causing sympathectomy in this scenario leads to further decrease in peripheral vascular tone resulting into peripheral pooling of blood thereby hypotension. So, the patients with a higher PI have a lower peripheral vascular tone and thus have a higher risk of developing hypotension after spinal anesthesia.

The findings of our study are in line with previous studies by Toyoma et al[8] and Duggapa et al.[10] In both these studies a baseline PI of > 3.5 significantly predicted hypotension after spinal anesthesia. Toyoma et al[8] recorded sensitivity and specificity for PI 3.5 at 81 % and 86 % whereas Dugappa et al[15] reported 69.84 % and 89.29 %. This discrepancy could be due to the fact that all the studies including ours have methodological differences such as the definition of hypotension, preloading or co-loading of IV fluid and the definition of baseline PI.

The incidence of hypotension had a significant difference in the two groups when PI of 3.5 was used as a cut off in both studies by Duggapa et al[15] and ours. The reported incidence of hypotension by Dugappa et al[15] was 10.5% vs 71.42% compared to 18.8% vs 81.3% in our study. This difference in the incidence of hypotension was notably different probably because of the definition of hypotension. They took a MAP < 65 mmHg as hypotension whereas we took MAP decrease by more than 20% from the baseline as hypotension. The other notable difference in methodology was Duggapa et al[15] had preloaded their patients with RL 500 ml whereas we co-loaded our patients.

Contrasting the above findings, the results form Yokose et al[11] suggests PI not to be a reliable indicator for post spinal anesthesia hypotension during cesarean delivery. They have made argument highlighting several methodological factors that may have influenced the discrepancies such as definition of hypotension, preloading or co-loading of IV fluid and method of calculation of baseline PI.

Thus it seems hard to come to a conclusion, with all studies having important methodological differences. Nonetheless with us using more practical methods for defining hypotension and co-loading of IV fluids, we believe we provide a valid conclusion to this argument.

LIMITATIONS OF THE STUDY

1. Specific patient monitors showing PI values are required.
2. PI value is sensitive to patient movement, anxiety and stress that can induce sympathetic activation, which in turn induces peripheral vasoconstriction, thus altering PI values.
3. Parturients may have significant aortocaval compression in supine position which can alter the values of PI.
4. Furthermore, calculation of cardiac output or systemic vascular resistance which was not done in this study could be more direct evidence of cardiovascular function than blood pressure measurement.

CONCLUSION

This study demonstrates that baseline PI of > 3.5 correlates with incidence of hypotension after spinal anesthesia for cesarean delivery in healthy parturients compared to a baseline PI of < 3.5. Thus, a simple noninvasive everyday monitor in PI can be used to predict healthy parturients at risk of developing hypotension after spinal anesthesia for cesarean delivery.

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CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

REFERENCES

1. Hanns R, Bein B, Ledowski T, et al. Heart rate variability predicts severe hypotension after spinal anesthesia for elective cesarean delivery. Anesthesiology 2005; 102: 1086–93. DOI: 10.1097/00000542-200506000-00005
2. Aya AG, Mangin R, Vialles N, et al. Patients with severe preeclampsia experience less hypotension during spinal anesthesia for elective cesarean delivery than healthy parturients: a prospective cohort comparison. Anesth Analg 2003; 97: 867–72. DOI: 10.1213/01.ane.0000073610.23885.f2
3. Ueyama H, He YL, Tanigami H, Mashimo T, Yoshiya I. Effects of crystalloid and colloid preload on blood volume in parturient undergoing spinal anesthesia for elective cesarean section. Anesthesiology 1999; 91: 1571–6. DOI: 10.1097/00000542-199912000-00006
4. Berlac PA, Rasmussen YH. Per-operative cerebral near-infrared spectroscopy (NIRS) predicts maternal hypotension during elective caesarean delivery in spinal anaesthesia. Int J Obstet Anesth 2005; 14: 26–31. DOI: 10.1016/j.ijoa.2004.06.003
5. Ginosar Y, Weiniger CF, Meroz Y, et al. Pulse oximeter perfusion index as an early indicator of sympathectomy after epidural anesthesia. Acta Anaesthesiol Scand 2009; 53: 1018–26. DOI: 10.1111/j.1399-6576.2009.01968.x
6. Lima AP, Beelen P, Bakker J. Use of a peripheral perfusion index derived from the pulse oximetry signal as a noninvasive indicator of perfusion. Crit Care Med 2002; 30: 1210–3. DOI: 10.1097/00003246-200206000-00006
7. Hales JR, Stephens FR, Fawcett AA, et al. Observations on a new non-invasive monitor of skin blood flow. Clin Exp Pharmacol Physiol 1989; 16: 403–15. DOI: 10.1111/j.1440-1681.1989.tb01578.x
8. 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. Br J Anaesth 2013;111:235-41. DOI: 10.1093/bja/aet058
9. Mowafi HA, Ismail SA, Shafi MA, Al-Ghamdi AA. The efficacy of perfusion index as an indicator for intravascular injection of epinephrine-containing epidural test dose in propofol anesthetized adults. Anesth Analg 2009; 108: 549–53. DOI: 10.1213/ ane.0b013e31818fc35b
10. Duggappa DR, Lokesh M, Dixit A, Paul R, Raghavendra Rao RS, Prabha P. Perfusion index as a predictor of hypotension following spinal anaesthesia in lower segment caesarean section. Indian J Anaesth 2017;61:649-54. DOI: 10.4103/ija.IJA_429_16
11. Yokose M, Mihara T, Sugawara Y, Goto T. The predictive ability of non-invasive haemodynamic parameters for hypotension during caesarean section: A prospective observational study. Anaesthesia 2015;70:555-62. DOI: 10.1111/anae.12992