



COMPARISON OF HEART RATE VERSUS PI IN PREDICTING HYPOTENSION DURING SPINAL ANAESTHESIA FOR CAESAREAN DELIVERY

Dr Madhusudanan E.S.	MBBS MD, Assistant professor Department of Anaesthesiology, Government Medical College, Thrissur
Jamsheena M P*	Department of Anaesthesiology, Government Medical College, Thrissur *Corresponding Author
Dr. Amminikutty C.M.	Additional professor, Department of Anaesthesiology, Government Medical College, Thrissur

KEYWORDS :

INTRODUCTION

Caesarean section is a common surgical procedure with an estimated rate of 17.2% in India (Desai et al., 2017). Spinal anaesthesia is the current standard of care during caesarean section, but is associated with intraoperative hypotension and severe adverse effects in mothers. The reduction in blood pressure is attributed to decreased vascular resistance due to sympathetic blockade and decreased cardiac output due to blood pooling in blocked areas of the body (Hans et al., 2005; Aya et al., 2003; Ueyamma et al., 1999; Berlac et al., 2005). Peripheral vascular tone, a factor that is known to affect the degree of hypotension, is reported to be decreased in parturients at term, particularly in multiparous pregnancy (Barwin et al., 1976; Sakai et al., 1994; Bowyer et al., 2003; Ajne et al., 2005). Decreased peripheral vascular tone results in blood volume being trapped in the extremities even before spinal anaesthesia, and the sympathetic blockade with spinal anaesthesia would further increase the blood pooling (Adsumelli et al., 2003). Therefore, parturients with low baseline vascular tone may be at an increased risk of developing hypotension after spinal anaesthesia.

Perfusion index (PI), defined as the ratio of pulsatile blood flow to non-pulsatile blood flow in the peripheral vascular tissue, is used to assess the hemodynamic parameters and is often considered as a non-invasive method for detecting the probability of developing hypotension (Ginosar et al., 2009). Risk of haemodynamic impairment following spinal anaesthesia can also be assessed by determination of autonomic tone (Joshi et al., 2018). Analysis of heart rate is the most convenient and non-invasive method for assessing the autonomic tone. This study aimed to compare the effect of baseline PI and baseline heart rate in predicting spinal anaesthesia-induced hypotension during caesarean section.

METHODOLOGY

This prospective, observational study was conducted on 60 parturients for a period of one year (Jan 2017 to Jan 2018) at the department of anaesthesiology, Government Medical College, Thrissur. Parturients belonging to American Society of Anaesthesiologists physical status II posted for elective caesarean section in the age group of 20-30 years were included in the study. Exclusion criteria included gestational age < 36 weeks or < 41 weeks, BMI \geq 40, height < 150 cm or > 160 cm, and prenatal complications like cardiovascular disease, pre-eclampsia, placenta previa, and cerebrovascular disease. Incidence of hypotension and phenylephrine requirement following spinal anaesthesia were noted for each participant. The association between baseline PI and HR, degree of hypotension during spinal anaesthesia, and also predictability of spinal anaesthesia-induced hypotension during Caesarean delivery by PI and HR were investigated.

The results obtained from both the groups of patients (Those who did not develop hypotension were included in group A while those who developed hypotension included in group B) were coded and entered in Excel. Normally distributed data were analyzed using t test and categorical data were analyzed using the Chi square test. Continuous data are presented as mean and standard deviation, whereas categorical data are presented as number of patients. Data were analyzed using IBM SPSS statistics 20.0 software. P value less than 0.05 was considered statistically significant.

RESULTS

Demographic data of the two groups (group A and group B) of participants were comparable (Table 1). There was no statistically significant difference between the two groups with respect to age and BMI, thus excluding the chance of confounding in terms of the two factors.

Table 1: Demographic data of the participants

Variables	Group	Mean	Std Deviation	p Value
Age	A	24.53	2.837	0.861
	B	24.4	3.013	
BMI	A	28.079	1.9513	0.121
	B	27.3	1.8861	

(Group A- Participants who did not develop hypotension, Group B – Participants who developed hypotension)

There was no statistically significant difference between the mean heart rate of the two groups (85.40 \pm 12.89bpm and 95.70 \pm 15.47bpm, respectively) Table 2. Out of the 30 participants in Group B, about 93% (n=28) had a high baseline HR (>73 bpm), and a total of 77% (n=23) had a high baseline PI (> 3.5).

Table 2: Comparison of heart rate and PI in Group A and Group B

Variables	Group	Mean	Std Deviation	p Value
Heart rate	Group A	85.4	12.899	0.007
	Group B	95.7	15.479	
PI	Group A	3.718	3.8173	0.031
	Group B	5.693	3.0646	

(Group A- Participants who did not develop hypotension, Group B – Participants who developed hypotension)

Statistically significant association was found between the heart rates at baseline for both the groups (p<0.05). Association between PIs in the two groups (mean \pm SD; Group A - 3.718 \pm 3.81 and group B - 5.69 \pm 3.06) was also found to be statistically significant (p<0.05). Regression analysis shows that the odds of a parturient with high HR to develop hypotension was 1.224 times more than that of a participant with lower heart rate at baseline (95% CI 1.007 - 1.480; p<0.05). Similarly, the odds of a parturient with high PI to develop hypotension was 1.0573 times more than that of a participant with lower PI (95% CI, 1.013 - 1.103; p<0.05).

DISCUSSION

Spinal anaesthesia is a simple, fast, reliable and cost-effective technique which has emerged as the technique of choice for routine, scheduled caesarean delivery, unless contraindicated, as it avoids the unacceptable risks associated with general anaesthesia. But the risk of hypotension following subarachnoid block for caesarean delivery remains high with an incidence of 70-80% (Mercier et al., 2013). One of the problem with evidence on predicting hypotension is the definition of the condition in different studies (Bishop 2014). Most of the studies were on large number of patients with maximum variability. In this study, hypotension is defined as reduction of systolic blood

pressure to less than 25% of baseline pressure and is applicable to a population of an otherwise healthy group of patients for elective or emergency C-section. This is important as the incidence of hypotension could have a large variation, just by changing the inclusion criteria with respect to the definition of hypotension.

Because of the higher incidence, hypotension under spinal anaesthesia has been a subject of study and debate in different parts of world. There is no standard predictive monitoring system to know the risk of developing hypotension that will help in taking adequate precautions during C-section. Given the high maternal mortality rate in India, identifying women at particular risk of hypotension during spinal anaesthesia is a worthwhile effort.

Studies have tried to evaluate the usefulness of many predictors including maternal body mass index, caval compression, PI and heart rate in predicting hypotension following spinal anaesthesia during a Cesarean section (Nani et al., 2011; Ginosar et al., 2009; Toyama et al., 2011; Ghabach et al., 2011; Dahlgren et al., 2007; Kinsella et al., 1996). But the current evidence does not have a consensus on the predictive abilities of many of the factors studied. Further, most of the studies focused on individual factors or different factors in a mutually exclusive way. The forte of this study is that it tries to compare the effectiveness of two different predictors of hypotension in a group of healthy women meeting the inclusion criteria.

In the present study, the two different groups had comparable demographic data, so that confounding factors like age and BMI are excluded in the analysis. Our study shows that participants who developed hypotension had a high base PI. This statistically significant rate was obtained at a PI cut off value of 3.5 (Toyoma et al., 2013). About 93% of the participants who developed hypotension had a high baseline heart rate. The odds of developing hypotension was 1.224 times more in group with a high baseline heart rate. Similarly, in women with high baseline PI, the odds of developing hypotension was 1.0573 times more than that of those with a low PI measure. Studies on both PI and heart rate has produced conflicting results (Bishop 2014). Our study clearly shows that both these parameters to be equally effective in predicting hypotension with spinal anaesthesia.

CONCLUSION

This study shows that both PI and HR are equally effective in predicting hypotension during spinal anaesthesia for Cesarean delivery.

REFERENCES

- Desai G, Anand A, Modi D, Shah S, Shah K, Shah A, et al. (2017) Rates, indications, and outcomes of caesarean section deliveries: A comparison of tribal and non-tribal women in Gujarat, India. *PLoS ONE* 12(12): e0189260. <https://doi.org/10.1371/journal.pone.0189260>.
- 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.
- Aya AG, Mangin R, Vialles N, et al. Parturients 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.
- 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 caesarean section. *Anesthesiology* 1999; 91: 1571–6.
- 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.
- Barwin BN, Roddie IC. Venous distensibility during pregnancy determined by graded venous congestion. *Am J Obstet Gynecol* 1976; 125: 921–3.
- Sakai K, Imaizumi T, Maeda H, et al. Venous distensibility during pregnancy. Comparisons between normal pregnancy and preeclampsia. *Hypertension* 1994; 24: 461–6.
- Bowyer L, Brown MA, Jones M. Forearm blood flow in preeclampsia. *BJOG* 2003; 110: 383–91.
- Ajne G, Ahlborg G, Wolff K, Nisell H. Contribution of endogenous endothelin-1 to basal vascular tone during normal pregnancy and preeclampsia. *Am J Obstet Gynecol* 2005; 193: 234–40.
- Adsumelli RS, Steinberg ES, Schabel JE, Saunders TA, Poppers PJ. Sequential compression device with thigh-high sleeves supports mean arterial pressure during Caesarean section under spinal anaesthesia. *Br J Anaesth* 2003; 91: 695–8.
- Ginosar Y, Weiniger CF, Meroy Y, Kurz V, Bdelah-Abram T, Babchenko A, et al. Pulse oximeter PI as an early indicator of sympathectomy after epidural anesthesia. *Acta Anaesthesiol Scand* 2009; 53: 1018–26.
- Joshi MC, Raghu K, Rajaram G, Nikhil N, Kumar S, Singh A. Baseline heart rate as a predictor of post-spinal hypotension in patients undergoing a caesarean section: An observational study. *Journal of Obstetric Anaesthesia and critical care*. 2018; 8(1):20-23.
- Mercier FJ, Augé M, Hoffmann C, Fischer C, Le Gouez A. Maternal hypotension during spinal anesthesia for caesarean delivery. *Minerva Anestesiologica* 2013; 79: 62–73.
- Toyama S, Kakumoto M, Morioka M, Matsuoka K, Omatsu H, Tagaito Y, et al. PI derived from a pulse oximeter can predict the incidence of hypotension during spinal anaesthesia for caesarean delivery. *Br J Anaesth*. 2013; 111: 235–41.
- Bishop DG. Predicting spinal hypotension during Caesarean section. *South African Journal of anaesthesia and analgesia*. 2014; 20 (4): 170-173.
- Nani FS, Torres MLA. Correlation between the body mass index (BMI) of pregnant

women and the development of hypotension after spinal anesthesia for cesarean section. *Rev Bras Anestesiol*. 2011; 61: 21–30. [10.1016/S0034-7094\(11\)70003-4](https://doi.org/10.1016/S0034-7094(11)70003-4).

- Ghabach MB, El-Khatib MF, Zreik TG, et al. Effect of weight gain during pregnancy on heart rate variability and hypotension during caesarean section under spinal anaesthesia. *Anaesthesia*. 2011; 66: 1106–11. [10.1111/anae.2011.66.issue-12](https://doi.org/10.1111/anae.2011.66.issue-12)
- Dahlgren G, Granath F, Wessel H, et al. Prediction of hypotension during spinal anesthesia for cesarean section and its relation to the effect of crystalloid or colloid preload. *Int J Obstet Anesth*. 2007; 16: 128–34. [10.1016/j.ijoa.2006.10.006](https://doi.org/10.1016/j.ijoa.2006.10.006)
- Kinsella SM, Norris MC. Advance prediction of hypotension at cesarean delivery under spinal anesthesia. *Int J Obstet Anesth*. 1996; 5: 3–7. [10.1016/S0959-289X\(96\)80067-7](https://doi.org/10.1016/S0959-289X(96)80067-7).
- Frölich MA, Caton D. Baseline heart rate may predict hypotension after spinal anesthesia in prehydrated obstetrical patients. *Can J Anesth* 2002; 49: 185–189.