



PRE-OPERATIVE HEART RATE MONITORING AS A PREDICTOR OF POST SPINAL HYPOTENSION IN PATIENTS UNDERGOING LOWER SEGMENT CAESAREAN SECTION: AN OBSERVATIONAL STUDY

Anaesthesiology

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ABSTRACT

Background and Aims: Subarachnoid block (SAB) is widely used regional anaesthesia technique for the patients undergoing lower segment caesarean section (LSCS). It is associated with sympathetic autonomic nervous system blockade, as it blocks lumbosacral segment of the spinal cord. Haemodynamics is mainly controlled by autonomic nervous system, so this study was conducted to assess correlation between baseline heart rate and incidence of hypotension following subarachnoid block in parturients. **Materials and Methods:** After obtaining written and informed consent, 150 parturients aged >18 years, with gestational age >32 weeks were included in this prospective observational study. Parturients were randomly divided in two groups according to their baseline heart rate. Group I (n=75): parturients with HR $\geq$ 91 bpm and Group II (n=75): parturients with HR $\leq$ 90 bpm. All parturients were given inj. bupivacaine 0.5% Heavy 2 ml (10 mg) in SAB. Incidence of hypotension and other parameters, requirement of rescue drug were recorded. **Results:** In Group I (HR $\geq$ 91 bpm) incidence of hypotension (34 vs 21, P=0.0279), duration of hypotensive episode per parturient (2.15 ± 3.16 vs 1.02 ± 2.01 , P=0.009) and requirement of rescue drug (mephentermine) per parturient (4.24 ± 5.47 mg vs 2.56 ± 4.54 mg, p=0.042) were significantly higher as compared to Group II (HR $\leq$ 90 bpm). (p<0.05) **Conclusion:** Parturients with HR $\geq$ 91 are at higher risk of developing hypotension after subarachnoid block and requirement of vasopressors is more as compared to those parturients with HR $\leq$ 90.

KEYWORDS

Baseline heart rate, Subarachnoid block, Hypotension, Mephentermine.

INTRODUCTION

Subarachnoid block (SAB) or spinal anaesthesia is the technique of choice for routine scheduled caesarean delivery (LSCS). However, SAB has its own bag of adverse effects. The most common adverse effect is hypotension (75-85% cases)⁽¹⁾, and it is primarily because of chemical sympathectomy associated with the blockade of lumbosacral segment of spinal cord. Factors associated with hypotensive episodes are anaesthetic technique, history of hypertension, basal heart rate and obesity.^(2,3) Hypotensive response might be exaggerated in pregnant patients due to physiological changes associated with pregnancy and also due to gravid uterus. Although baseline volume status affects the degree of hypotension,⁽⁴⁾ baseline peripheral vascular tone may also have influence. Peripheral vascular tone is decreased in parturients at term, especially in those who are multiparous.⁽⁵⁻⁸⁾ Decreased peripheral vascular tone results in blood volume being trapped in the extremities even before SAB, and the sympathetic blockade with SAB would further increase the venous pooling.⁽⁹⁾

Hypotension due to any cause may have serious effects on mother and neonate. So, hypotension as a result of anaesthesia can be prevented to some extent with prophylactic ephedrine or mephentermine, pelvic tilt and intravascular volume expansion.

Systemic haemodynamic is mainly modulated by autonomic nervous system.⁽¹⁰⁾ Preoperative determination of the autonomic tone might provide an opportunity to detect parturient at risk of developing severe haemodynamic impairment following SAB. Most convenient method to determine autonomic tone is heart rate (HR), as it is easy to record, very handy and non-invasive method. Therefore, preoperative analysis of HR may predict hypotension following spinal anaesthesia and identify at risk parturients. So, we chose this study to observe pre-operative (baseline) heart rate monitoring as a predictor of post spinal hypotension in patients undergoing lower segment caesarean section under spinal anaesthesia. The objective of present study was to see no. of cases with hypotension and assess requirement of vasopressors to manage hypotension.

Materials and Methods:

After obtaining approval from institutional ethical committee (IEC) and informed and written consent from parturient, a prospective

observational study was conducted at our tertiary care institute during august 2020 to november 2020 which is registered under CTRI (CTRI/2020/08/027252).

Sample size: Sample size was calculated on the basis of a previous study by Joshi Mc et al in which 50.9% of patients having HR $\geq$ 91 and 25.5% of the patients having HR $\leq$ 90 developed postspinal hypotension. A minimum of 69 cases and 69 controls were required to study a minimum difference of 25.5% in population of postspinal hypotension in two groups (HR $\geq$ 91 and HR $\leq$ 90) with type I error of <5% and power of 80%. Therefore, we enrolled 75 cases in each group to compensate for the dropouts.

This study was carried out in 150 parturient, aged >18 yrs with ASA Gr II and gestational age >32 weeks, taken up for both elective and semi elective caesarean section under subarachnoid block.

Parturient having emergency indication of caesarean section like antepartum haemorrhage, placenta previa, abruptio placentae, foetal distress, obstructed labour, umbilical cord prolapse, hand prolapse, patient in labour pain, patients having coagulation abnormalities or on anticoagulants, patients on beta blockers, with associated systemic illness (hypo/ hyperthyroidism, diabetic, neuromuscular diseases, ischaemic/ valvular/ congenital heart diseases, psychiatric illness, haematological disorder), history of seizures, coma, neurological signs or symptoms (Eclampsia), Obesity (weight > 100 Kg), short stature (height<150cm), with spinal deformity, those having contraindications for subarachnoid block or allergic to local anaesthetic or refusing to participate in study were excluded from the study.

As the study period started, all consecutive parturient posted for caesarean section were assessed for inclusion criteria, if they fulfil it, they were enrolled for the study till 150 patients (75 in each group) completed.

The parturient were randomly allocated into two groups based on baseline heart rate:

- Group I (n=75): Parturient with HR $\geq$ 91 bpm and

- Group II (n=75): Parturient with HR ≤ 90 bpm

Blinding Two anaesthesiologists were involved in the study. The baseline heart rate and other parameter were recorded by an anaesthesiologist who was not involved in the further intra-operative monitoring of the patient. The another anaesthesiologist, who is conducting the study and performed all subarachnoid blocks and recorded all data, Patient, surgeon, and postoperative ward nurse were not aware of group allocation.

Preoperative evaluation, preparation and monitoring applied as per institutional protocol which includes non-invasive blood pressure (NIBP), electrocardiogram (ECG) and pulse oximetry. Baseline heart rate (HR) was determined with ECG by taking average of five independent recordings, every minute in sequence. Baseline haemodynamic parameters (SBP, DBP, MBP) and peripheral oxygen saturation on room air (SpO₂) were also recorded. Baseline MBP was taken as average of five reading taken 2 minutes apart on table. After securing peripheral IV access with 20 G cannula, preloading with 500 ml ringer's lactate was done in all the parturient. Subarachnoid block was given using 25 G Quincke's spinal needle in L2-L3 or L3-L4 space via midline approach in left lateral position and 2 ml 0.5% bupivacaine (Heavy) was injected in subarachnoid space with full aseptic precautions. Patient was turned supine, and a wedge under right hip was placed to provide left lateral tilt to prevent aortocaval compression. End of spinal injection was taken as time zero for all further data recording. Oxygen at a rate of 5L /min was administered via oxygen face-mask.

Surgery was allowed to start when sensory block of T6 level and maximum bromage score of 2 or 3 was achieved. Parturient with Partially and completely failed block were excluded from study.

Hypotension was defined as fall in MBP of $>25\%$ from baseline value and treated with mephentermine 6 mg I.V. and bolus of 100 ml ringer's lactate was given to maintain MBP $>75\%$ of baseline. The grading of severity of hypotension was done according to duration of hypotension: Mild (1-5 min), Moderate (5-10 min) and Severe (>10 min). Inj. dopamine, adrenaline, noradrenaline as IV infusion was considered to treat severe hypotension if needed. If HR < 60 per min, then atropine 0.4 mg IV was given to treat bradycardia.

The demographic characteristics, type and duration of surgery, haemodynamic profile (i.e. HR, SBP, DBP and MBP) were recorded every 2 min till 20 min and thereafter every 5 min till the end of surgery. Sensory block characteristics (Time to achieve T6 dermatomal level, peak sensory level), motor block characteristics (maximum bromage score (MBS), time to achieve Maximum Bromage Score), No. of episodes of hypotension, and its duration and vasopressor requirement (number of doses and amount) were recorded in each parturient intraoperatively. Other complications like nausea, vomiting were recorded and treated with Ondansetron 4 mg slow IV.

Statistical Analysis: Data was entered in MS excel and analysed using SPSS version 20. Categorical (qualitative) data were presented as number (proportion), and compared with chi-square test. Continuous variables (quantitative) were presented as Mean $\pm$ SD and compared using unpaired student t-test. $P < 0.05$ was considered statistically significant.

RESULTS:

No statistical difference was found between two groups in terms of mean age, weight, height, and gestational age (Table 1) ($p > 0.05$). Mean Time of sensory and motor block, duration of surgery, time of baby delivery after SAB and APGAR score at 1 min and 5 min were comparable and no statistically significant difference was found in both the groups ($P > 0.05$).

Table 1 Demographic profile

DEMOGRAPHIC PARAMETERS	GROUP I (n=75)	GROUP II (n=75)	P value
AGE(YRS.)	27.14 $\pm$ 2.57	27.84 $\pm$ 1.78	0.241
HEIGHT(CM.)	157.05 $\pm$ 2.72	157.08 $\pm$ 3.34	0.957
WEIGHT(KG.)	62.48 $\pm$ 5.42	62.25 $\pm$ 5.17	0.794
GESTATIONAL AGE (WK.)	37.37 $\pm$ 0.76	37.55 $\pm$ 0.81	0.181

Test used – 't' test, Data are expressed in Mean $\pm$ SD.

Two groups were statistically comparable in mean SBP, DBP and MAP at all time interval except at 12 min after SAB, where fall in DBP in group I was more as compared to group II and it was significant ($P=0.044$). Incidence of side effects like bradycardia, nausea/vomiting and shivering were minimal and statistically comparable between two groups ($P > 0.05$).

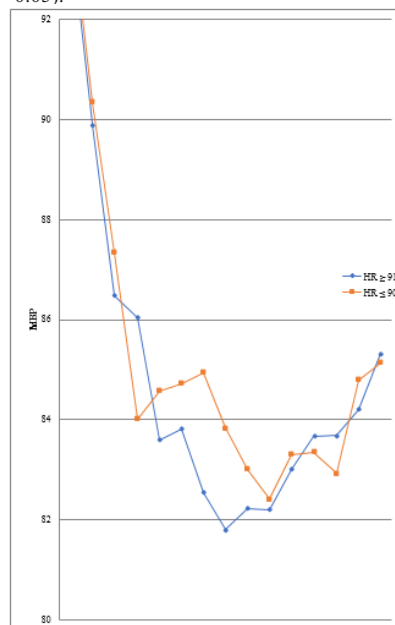


Fig.1: Comparison of Mean Blood Pressure In Two Groups

Out of total 150 parturient 55 parturient developed hypotension (36%), of whom 34(61%) parturient were in Group I and 21 (39%) were in Group II. Incidence of hypotension was significantly higher in Group I as compared to Group II (34 vs 21), ($P=0.027$).

The episodes of hypotension (2.15 ± 3.16 vs 1.02 ± 2.01), ($P=0.009$) and requirement of rescue drug mephentermine (in mg) per parturient (4.24 ± 5.47 vs 2.56 ± 4.54), ($P=0.042$) was also greater in Group I than Group II and that was found statistically significant between two groups.

Table 2. Comparison of incidence of hypotension, hypotensive episode per parturient and requirement of rescue drug (in mg) per parturient.

VARIABLES		Group I (n=75)	Group II (n=75)	P VALUE
HYPOTENSION	PRESENT	34(45.33%)	21(28.0%)	0.276*
	ABSENT	41(54.67%)	54(72.0%)	
HYPOTENSIVE EPISODE PER PARTURIENT (MIN.)		2.15 $\pm$ 3.16	1.02 $\pm$ 2.01	0.009 #
USE OF MEPHENTERMINE PER PARTURIENT (mg)		4.24 $\pm$ 5.47	2.56 $\pm$ 4.54	0.042 #

- *P value calculated using chi square test
- # P value calculated using 't' test
- P value < 0.05 statistically significant

DISCUSSION:

Physiological changes in healthy pregnant women characterized by a decreased in systemic vascular resistance and increases in total blood volume, heart rate and cardiac output.⁽¹¹⁾ Parturient >30 weeks of gestation have decrease in vascular tone which causes pooling of blood in extremities^(5,6) and consequently, the sympathectomy as a result of subarachnoid block in healthy pregnant women will further causes pooling of blood in extremities due to decrease peripheral vascular tone, resulting in more blood trapped in the extremities compared with nonpregnant women.⁽⁹⁾

Systemic haemodynamic are modulated by autonomic nervous system.⁽¹²⁾ Preoperative determination of the autonomic tone might be a useful tool to detect parturient at risk of developing severe haemodynamic impairment following spinal anaesthesia. One of the

easiest, a convenient, handy and noninvasive method of measuring activity of autonomic nervous system is analysis of HR. Therefore, preoperative analysis of HR may predict hypotension following spinal anaesthesia and identify at risk parturient. This can be beneficial in initiating measures to prevent hypotension in at risk parturient.

So we hypothesised that hypotension following SAB in pregnant women posted for LSCS could be assessed by using baseline heart rate values derived from ECG. In our study, we have taken cut off value of baseline heart rate for prediction of hypotension was 90/min, which was taken from study conducted by Joshi MC et al.⁽¹³⁾

In our study, we compared group I (HR ≥ 91) with group II (HR ≤ 90) on basis of baseline heart rate in parturient undergoing LSCS under sub arachnoid block using 10 mg (2ml) inj. bupivacaine 0.5% (Heavy) and compared haemodynamic changes (MBP, SBP, DBP) and vasopressors requirement.

In our study demographic, sensory and motor block characteristic and baby outcome in both the groups were comparable and similar to previous studies.

Haemodynamic in regards to heart rate, blood pressure and SPO2 were comparable between two groups.

In present study, the incidence of hypotension was significantly higher in Group I [34/75 (45.33%)] as compared to Group II [21/75 (28%)]. Our results were comparable with study done by Joshi MC et al⁽¹³⁾ in which incidence of hypotension in parturient with baseline heart rate (HR > 91) was 27/53 (50.9%), whereas in parturients with baseline heart rate (HR < 90) was 12/47 (25.5%), ($P < 0.05$). Similarly, another study done by Bagle Aparna et al⁽¹⁴⁾ found incidence of hypotension in Group I (HR > 90) was 24/50 (48%) compared to 10/50 (20%) in Group II (HR < 90). In both the study MAP fall below 20% was considered hypotension whereas in our study it was 25%.

In our study, total 53 episodes of hypotension occurred in Group I as compared to 32 episodes in Group II, which was statistically significant ($P < 0.05$).

The no. of hypotensive episodes per parturient in Group I was (0.71 ± 0.91) as compared to Group II (0.43 ± 0.76), which was also significantly higher in Group I ($P < 0.05$).

Mean duration of hypotensive episode per parturient in Group I was (2.15 ± 3.16) as compared to Group II (1.02 ± 2.01) ($P = 0.009$).

Total duration of hypotension in Group I was 161 min and 77 min in Group II.

In present study total vasopressor drug (mephentermine) required to treat hypotensive episodes in Group I was 318 mg which was significantly higher as compared to Group II where total 192 mg mephentermine was required. Mephentermine required to treat hypotensive episode per parturient in Group I was (4.24 ± 5.47 mg), as compared to Group II (2.56 ± 4.54 mg) which is significantly lesser in Group II. ($P = 0.042$). Similar results were observed with previous study done by Bagle Aparna et al⁽¹⁴⁾ where requirement of rescue drug in Group I (HR > 91) was 4.38 ± 1.53 mg as compared to Group II (HR < 90) 3.0 ± 0.0 mg ($P = 0.008$) and also in a study by Joshi MC et al⁽¹³⁾ requirement of rescue vasopressor drug in Group I (HR > 91) was 4.34 ± 0.45 mg as compared to Group II (HR < 90) 3.9 ± 0.45 ($P = 0.0148$).

In present study severity of hypotension was mild in (Group I-24/75, Group II-17/75), moderate in (Group I-9/75, Group II-4/75), and severe in (Group I-1/75, Group II-0/75) two groups, these are minimal and statistically comparable ($P > 0.05$).

In present study incidence of side effects like bradycardia (Group I-1/75, Group II-1/75), nausea/vomiting (Group I-8/75, Group II-6/75), and shivering (Group I-9/75, Group II-7/75) was similar in two groups, these are minimal and statistically comparable ($P > 0.05$).

CONCLUSION:

We conclude that parturient with baseline HR ≤ 90 have lower risk of developing hypotension and requirement of vasopressors as compared to those parturient with HR ≥ 91 undergoing lower segment caesarean section under subarachnoid block.

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