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PREDICTION OF POSTSPINAL HYPOTENSION IN ELECTIVE CAESAREAN SECTION: AN OBSERVATIONAL STUDY

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ABSTRACT
Objectives: Spinal anaesthesia is the most preferred method of anaesthesia for a caesarean section. The frequent complication of the subarachnoid block is hypotension. This study aimed to find out the association of pre-operative heart rate with post-spinal hypotension. Materials and Methods: A total of 100 pregnant patients, ASA physical status I and II, aged between 20-35 years, undergoing elective caesarean section, under spinal anaesthesia. The patient's baseline heart rate, Systolic blood pressure, Diastolic blood pressure, Mean arterial pressure, and SPO_2 were noted. Incidence of hypotension and mephentermine requirement following spinal anaesthesia noted. Results: Fifty-seven out of 100 patients developed hypotension (57.0%) of whom 48 were in the subgroup with HR >90bpm (67.0%) and 09 patients were in the group with HR < 90bpm (31.0%). The baseline heart rate was statistically significant with a p-value of 0.001. The average dose of mephentermine required to correct hypotension was 9.47±4.8 mg. Conclusion: Baseline heart rate is a promising predictor of postspinal hypotension in obstetric patients undergoing elective caesarean section.

INTRODUCTION

Spinal anaesthesia is the most preferred method of anaesthesia for a caesarean section. It has many advantages over general anaesthesia like decreased risk of failed intubation, decreased risk of pulmonary aspiration of gastric contents and avoidance of the depressant effects of general anaesthetics on the neonate. The most frequent complication of spinal anaesthesia in pregnant patients is hypotension [1]. Physiological changes in full term pregnant women and dehydration lead to the high incidence of hypotension after spinal anaesthesia. Hypotension during spinal anaesthesia is mainly due to decreased systemic vascular resistance and blockade of preganglionic sympathetic fibres associated with the lumbosacral block [2]. Hypotension due to any cause may have serious effects on mother and neonate like reduced uteroplacental blood flow and foetal acidosis in neonate or nausea, vomiting and decreased consciousness in parturient [3]. Specifically, hypotension as a result of anaesthesia can be interrupted to some extent by preloading with fluids, pelvic tilt, prophylactic vasopressors like ephedrine, phenylephrine, nor-adrenaline & mephentermine [4]. However,

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none of the presently available strategies are effective in preventing hypotension caused by spinal anaesthesia [5]. Therefore, prediction and prevention of maternal hypotension is very important. The ability to predict patients at risk of severe hypotension would enable Anaesthesiologists to prepare appropriately and also to potentially individualize treatment. The ability to predict which patients will develop severe hypotension would also enable adequate preparation in the perioperative phase and could potentially result in altered treatment regimes, such as the early initiation of vasopressors in high-risk patients.

There are many predictors of post-spinal hypotension which can be classified as non- modifiable and modifiable factors. Non-modifiable risk factors include over anxious patient, increased maternal age (>35years), increased maternal BMI (>25Kg/m^2), increased baseline line heart rate (>100bpm). Modifiable risk factors include – technique of giving spinal anaesthesia, amount of spinal drug given and the level of anaesthesia achieved.

Pre-operative determination of the autonomic tone might help to detect risk of developing severe haemodynamic impairment following spinal anaesthesia. There are many methods to determine autonomic tone like Heart rate, Heart rate variability, Baroreflex sensitivity, Microneurography, Norepinephrine levels, Scintigraphic Imaging. Of these, a convenient and non-invasive method of measuring activity of ANS is analysis of heart rate (HR) [6].

With this background we conducted the present study to find out the association of pre-operative heart rate with post spinal hypotension in patients posted for elective lower segment caesarean section under spinal anaesthesia.

MATERIALS AND METHODS

This observational study was conducted during - February 2021 to November 2021, after obtaining approval from institutional ethics committee (Ref.No.112/MC/EC/2020 dated February 01, 2021) and registered with the Clinical Trial Registry-India (CTRI/2021/04/032924). The written informed consent was obtained from all the participants of the study.

A total 100 pregnant patients of American Society of Anesthesiologist (ASA) physical status I and II and aged between 20 to 35 years, who were scheduled for elective lower segment caesarean section under spinal anesthesia were included in this study. The patients refusing spinal anaesthesia known allergy to LA agent, emergency surgery, significant cardiovascular, renal, hepatic and thyroid diseases, any contraindication to spinal anaesthesia, and such patients were excluded from this study. The consort diagram indicating patient selection and progress is shown in figure.1

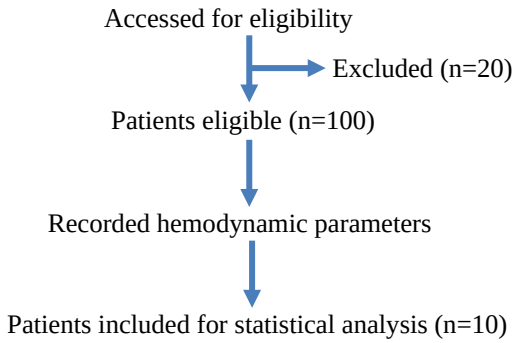

Fig 1: Consort flow chart

A pre-anesthetic checkup was done one day before the surgery. Patient was counselled during preoperative examination. After receiving the patient in the operating room, documents were checked. After taking informed written consent and confirming overnight fasting, patient was taken on the operation table, standard monitors were attached and baseline vitals like baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were recorded. After establishing IV access with an 18G cannula, ringer lactate was started. No anticholinergic was given as premedication. Basal heart rate was determined with pulse oximeter by taking average of five independent recordings, every minute in sequence. Baseline blood pressure was recorded by taking average of 5 independent recordings, every minute in sequence with the help of non –invasive blood pressure monitor. The patient was placed in sitting position and dual puncture was performed in L3-L4 interspace taking all aseptic measures. Hyperbaric Bupivacaine (0.5%) 2ml was injected intra-thecally and patient was made to lie down with wedge under the right buttock.

Blood pressure was recorded immediately after subarachnoid block and repeated every 3 minutes in first 30 minutes and cycled to 5 minutes till the end of surgery. Patients developing more than 20% drop in their mean arterial pressure (MAP) were noted and treated with parenteral mephentermine 6 mg IV bolus. Mephentermine treatment was repeated as indicated up to maximum of 30mg throughout the surgery. The amount of

mephentermine administered within 30 minutes after spinal anaesthesia was used to calculate mephentermine requirement.

The primary objective was to predict post spinal hypotension on the basis of baseline heart rate and other independent factors like age, gravida, weight, baseline SBP and baseline DBP. Secondary objective was to determine mean dose of mephentermine required to correct hypotension and to assess, describe the change in haemodynamic parameters. Sample size estimation was based on previously published data evaluating heart rate and maternal hypotension during caesarean section under spinal anaesthesia [10]. Sample size was estimated with 95% confidence to predict postspinal hypotension on the basis of six independent factors. Statistical analysis was done by summarizing continuous data in the form of Mean ± SD. Difference in means of two subgroups was analyzed using students 't' test. Allowing dropouts total sample size was 100. Logistic regression was done to predict post spinal hypotension on the basis of independent factors including baseline heart rate.

RESULTS

A total of 100 patients were enrolled in this study and underwent elective caesarean section under spinal anaesthesia. Out of 100 patients 57(57%) developed hypotension (Table 1)

Table 1: Number of patients developing hypotension after SAB

S. No.	Post spinal hypotension	No. of patients	%
1.	Present	57	57.0
2.	Absent	43	43.0
	Total	100	100

Baseline heart rate was an independent factor for prediction of postspinal hypotension as it was statistically significant (p value 0.001) (Table.2)

Table 2: Logistic regression analysis performed for prediction of post spinal hypotension on the basis of independent factors including baseline heart rate

Variables Step 1 a	B	S.E	Wald	Df	Significance (p-value)	Exp (B)	95% CI for Exp (B)	
							Lower	Upper
Age	-0.087	0.064	1.809	1	0.179	0.917	0.808	1.040
Weight	-0.029	0.031	0.862	1	0.353	0.971	0.913	1.033
Gravida	0.427	0.290	2.172	1	0.141	1.532	0.869	2.704
HR baseline	0.062	0.019	10.892	1	0.001	1.064	1.026	1.105
SBP baseline	0.029	0.042	0.477	1	0.490	1.029	0.949	1.117
DBP baseline	-0.074	0.065	1.283	1	0.257	0.929	0.817	1.056
MAP baseline	0.036	0.080	0.204	1	0.652	1.037	0.887	1.212
Constant	-3.466	3.488	0.987	1	0.320	0.031		

Table 3: Relation between baseline heart rate and incidence of hypotension

S No	Heart rate (bpm) at baseline	No. of patients	No. of patients developing hypotension	% of patients developing hypotension
1.	>91	71	48	67.6%
2.	<90	29	09	31.0%
	Total	100	57	57.0%

The Wald criterion demonstrated that only baseline heart rate ($p<0.05$) made a significant contribution to prediction and other predictors were not significant. For baseline heart rate, the Odd's ratio is 1.064 times as large and therefore chance of post spinal hypotension is 1.064 times more likely. Incidence of hypotension was greater in the subgroup having baseline heart rate more than 90bpm (67.6%) compared to subgroup with baseline heart rate < 90 bpm (31%) (Table 3)

Other independent factors like age, weight, gravida status, baseline SBP, baseline DBP do not help in prediction of postspinal hypotension as their association were statistically insignificant (p value>0.05) (Table 2). Average dose of mephentermine required to correct hypotension was 9.47 ± 4.80 mg (Table 4).

Table 4: Distribution of patients according to dose of mephentermine required (in mg)

S No	Dose of mephentermine (in mg)	No. of patients	%
1.	6	33	33.0
2.	12	17	17.0
3.	18	05	05.0
4.	24	02	02.0
		100	100
	Mean ± SD	9.47 ± 4.80	

DISCUSSION

Pregnancy is marked by many anatomic and physiologic changes that allow the woman to adapt to the developing fetus and its metabolic demands. Successful anaesthetic management of the pregnant woman demands recognition of these anatomic and physiologic changes and appropriate adaptation of the anaesthetic techniques to account for them. Spinal anaesthesia is the preferred mode of anaesthesia in pregnant females undergoing caesarean section since it was first used in 1902 by Hopkins.

The advantages of spinal anaesthesia for cesarean delivery are simplicity of technique, speed of induction (in contrast to an epidural block), reliability and minimal exposure of the fetus to the drugs, an awake parturient along with minimization of aspiration. Disadvantages of spinal anaesthesia for caesarean delivery include high incidence of hypotension, intrapartum nausea and vomiting, possibility of headache after dural puncture and limited duration of effect.

Hypotension after spinal anaesthesia for caesarean section remains as a common and potential serious complication, despite the use of left uterine displacement, prophylactic ephedrine, phenylephrine, mephentermine, noradrenaline and fluid loading. Hypotension also leads to maternal morbidity due to severe nausea and vomiting and fetal complications due to fetal acidemia[7]. The ability to predict which patient will develop severe hypotension would enable adequate preparation in the perioperative phase. The predictors of post-spinal hypotension include over-anxious patient, increased maternal age (>35 years), increased maternal BMI (>25 Kg/m2), increased base line heart rate (>90bpm), technique of giving spinal anaesthesia, amount of spinal drug given and the level of anaesthesia achieved. Hypotension under spinal anaesthesia can be prevented by preloading with fluids, pelvic tilt, and use of many drugs like ephedrine, phenylephrine, noradrenaline and mephentermine.

Our study aimed to determine predictors of postspinal hypotension. In our study, out of 100 parturients, 57 patients developed postspinal hypotension (57%) and required mephentermine to correct hypotension. Hypotension was defined as 20% drop in the mean arterial pressure from baseline. David M Kahoro [8] in 2009 performed a study to determine the incidence and risk factors for hypotension during spinal anaesthesia for caesarean section at Kenyatta National hospital in 112 full term pregnant women. They defined Hypotension as systolic blood pressure equal to or below 90mmHg. He found that the incidence of hypotension was 64% after spinal anaesthesia. In our study, the mean age of parturients undergoing caesarean section was 26 ± 3.84 years. Majority of females were in the age group 25 to 30 years. By logistic regression association of age was not statistically significant in prediction of postspinal hypotension. (P value=0.179, table 2)

In our study mean weight of females undergoing caesarean section was 62.85 ± 7.335 kg. Majority of females were in the group 56 to 66 kg. By Logistic regression weight factor did not contribute to prediction of hypotension after spinal anaesthesia. (p =0.353, table 2).

Majority of females in our study were gravida 2(40%), followed by primigravida (36%). By logistic regression gravida status was not statistically significant predictor of postspinal hypotension with p value of 0.141. Table (2).

Fakherpour et al [9] in 2018 conducted a study, to evaluate a wide range of variables (related to parturient and anaesthesia techniques) associated with the incidence of different degrees of spinal anaesthesia-induced hypotension during elective CS. They concluded that, age, body mass index, weight gain, gravidity, history of hypotension, baseline SBP and heart rate, fluid preloading, adding sufentanil to bupivacaine and sensory block height were the main risk factors identified in the study for SA-induced hypotension during CS.

In our study, 71 females had baseline heart rate > 91bpm. Maximum heart rate recorded was 140bpm which was seen at 0 minute of administration of SAB. Only one patient had an episode of bradycardia at 12 minutes after SAB. The bradycardia was associated with drop in blood pressure to 72/48 mmHg with mean arterial blood pressure of 56mmHg.The bradycardia was corrected with inj. Atropine 0.6 mg IV and hypotension was treated with inj, mephentermine 6 mg IV. Thus, the incidence of bradycardia in our study was 1%. Incidence of hypotension was greater in the subgroup having baseline heart rate more than 90bpm (67.6%) compared to subgroup with baseline heart rate < 90bpm (31%). (table 3). Baseline heart rate was statistically significant predictor by logistic regression with p value of 0.001 in Our study. Our results are consistent with findings of a similar

study by MC Joshi et al [10] in 2018 on prediction of post spinal hypotension. In our study baseline SBP, baseline DBP and Baseline mean arterial pressure were not significant predictors. Mean baseline SBP was 114.83 ± 7.40mmHg. Lowest recorded systolic blood pressure was 72mmHg which was seen 12 minutes after SAB. Highest recorded blood pressure was 138mmHg at 6 minutes after SAB. By logistic regression, baseline systolic blood pressure was not a statistically significant predictor for postspinal hypotension in parturients undergoing caesarean section under spinal anaesthesia. (P value=0.490 table 2). Mean baseline diastolic blood pressure was 77.32±7.5 mmHg. Lowest recorded diastolic blood pressure was 36mmHg at 6 minutes after SAB. Highest recorded diastolic blood pressure was 97mmHg which was seen after 6 minutes of SAB. In our study, baseline diastolic blood pressure was also not an independent predictor for postspinal hypotension according to logistic regression (p value 0.257 Table 2).

Mean of baseline arterial pressure was 90.67 ± 7.6mmHg. Lowest recorded mean arterial pressure was 50mmHg and highest recorded was 111mmHg.By logistic regression baseline mean arterial pressure was not statistically significant predictor of postspinal hypotension (p value=0.652 table 2). Out of 100 parturients, 57 patients required mephentermine to correct hypotension. Minimum dose used to treat hypotension was 6 mg in 33 parturients. Maximum dose used was 24mg in 2 parturients. Mean dose of mephentermine required to treat hypotension was found to be 9.47 ± 4.80mg.

The main limitation of our study was small sample size. Further studies are required to establish the relationship between preoperative heart rate and postspinal hypotension. Differences in patient population can alter both incidence and mechanism of hypotension. For the study population to be comparable in all aspects, it was needed that the time taken for completion of surgery should be almost same and the surgery should be performed by the same surgeon. But it was not possible in our institute due to rotation of surgical units. So, it was not possible to have uniform duration of surgery because of difference in surgical skill.

CONCLUSION

We conclude that baseline heart rate is a promising predictor of postspinal hypotension in obstetric patients undergoing elective caesarean section. Other independent factors like age, gravida status, weight, baseline systolic blood pressure, baseline diastolic blood pressure does not have significant association in prediction of postspinal hypotension.

FINANCIAL ASSISTANCE

Nil

CONFLICT OF INTEREST

The authors declare no conflict of interest

AUTHOR CONTRIBUTION

Kanchan Chauhan contributed in conception of work and study design, Poornima and Anupama Nagar performed experimental work and collected data. Kshama Rao and Poornima performed statistical analysis and interpreted the data. Poornima and Anupama Nagar drafted the manuscript and interpreted the collected data. All authors read and approved the final manuscript.

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