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### RESEARCH ARTICLE

#### PREDICTION OF POSTSPINAL HYPOTENSION BASED ON PREOPERATIVE HEART RATE IN PATIENTS UNDERGOING CAESAREAN SECTION: AN OBSERVATIONAL STUDY

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##### Manuscript History

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#### Abstract

**Background:** Hypotension is most common side effect of spinal anaesthesia in obstetrics patients undergoing caesarean section. It has chances of affecting both mother and fetal well-being. Systemic hemodynamics are modulated by autonomic nervous system (ANS). Evaluation of ANS may be helpful in predicting hypotension. The present study is designed to identify the subset of pregnant patients at higher risk of developing post-spinal hypotension based on baseline heart rate (HR) prior to administration of spinal anaesthesia.

**Materials and Method:** This was a prospective study conducted on 100 patients aged 20–30 years, of American Society of Anaesthesiologists (ASA) grade I or II, posted for elective caesarean section under spinal anaesthesia. Patients were divided into two groups based on their preoperative HR. Incidence of hypotension and mephentermine requirement following spinal anaesthesia were noted.

**Results:** 39% patients out of 100 developed hypotension, of whom 27 were in the group with HR  $\geq 91$  beats per minute (bpm) (50.9%) and 12 patients were in the group with HR  $\leq 91$  bpm than group with HR.

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#### Introduction:-

Spinal anaesthesia for caesarean section is advantageous due to simplicity of technique, rapid administration and onset of anaesthesia, reduced risk of systemic toxicity and increased density of spinal anaesthetic block.<sup>1</sup> The most common complication of spinal anaesthesia in pregnant patients is hypotension, with incidence of up to 71%.<sup>2</sup> Hypotension during central neuraxial block is mainly a result of decreased systemic vascular resistance after blockade of preganglionic sympathetic fibers.<sup>3</sup>

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.<sup>4</sup> 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.<sup>5</sup> However, none of the currently available strategies is entirely effective in preventing hypotension caused by spinal anaesthesia.<sup>6</sup> Therefore, prediction and prevention of maternal hypotension are potentially important.

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Systemic haemodynamic are modulated by the autonomic nervous system.<sup>7</sup> Preoperative determination of the autonomic nervous system control might provide an opportunity to detect patients at risk of severe hemodynamic impairment. A non-invasive method of measuring the activity of the autonomic nervous system is the analysis of heart rate (HR).<sup>3</sup>

The preoperative heart rate may vary between patients in relation to the severity of hypotension after subarachnoid block.

Therefore preoperative heart rate may predict post-spinal. This can prove beneficial in initiating measures to prevent this drop in blood pressure(BP).

In the backdrop of this information, this study was conducted to determine the association of preoperative heart rate with post spinal hypotension in patients presenting for caesarean section. This study can help us in prevention of post spinal hypotension in patients with higher pre operative heart rate. Thus this study can be a step forward in developing new and beneficial treatment protocols best suited for our patients.

### **Materials and Methods:-**

A prospective study carried out after obtaining institutional ethical committee clearance and the study was conducted between may 2023 to may 2024. The study included total of 100 patients belonging to ASA physical status I and II with age between 20-30 years posted for elective caesarean section under spinal anaesthesia. Patients with significant cardiovascular, renal, hepatic diseases, thyroid disease and patients who refused to give consent were excluded from the study. All patients were explained in detail about the anaesthetic procedure and written informed consent was obtained.

All the patients were preloaded with 500 ml of lactated Ringer's solution 15 min prior to spinal anaesthesia. No anticholinergics were given as pre-medication. Baseline HR was determined with pulse oximeter by taking average of three independent recordings, every minute in sequence. Baseline blood pressure was recorded by taking average three independent recordings, every minute in sequence with the help of non-invasive blood pressure monitor. Patient's peripheral oxygen saturation, surface temperature, and electrocardiogram were monitored. Basal values were recorded.

Subjects were divided into two groups based on their baseline HR. The patients having a HR of 90 beats per minute or less were included in group A, while those having HR of 91 bpm or more were included in group B. The patients were placed in lateral position and dural puncture was performed at L3-L4 inter space. Hyperbaric bupivacaine (0.5%) 2.2 ml was injected intrathecally and patient made to lie in supine position with wedge under right buttock. Blood pressure was recorded immediately after subarachnoid block and repeated every 3 min in first 30 min and repeated every 5 min till end of surgery. Patients developing more than 20% drop in their mean arterial pressure (MAP) were noted and treated with intravenous mephentermine 6mg bolus. Mephentermine repeated as indicated up to maximum of 30mg throughout the surgery. The amount of mephentermine administered within 30 min after spinal anaesthesia was used to calculate mephentermine requirements.

Sample size estimation was based on previously published data evaluating maternal hypotension during caesarean section under spinal anaesthesia. (8,9)

We included 100 patients in the study to increase statistical power. Fisher's exact test was used to compare incidence of hypotension and Student's t-test was used to compare ephedrine requirements.  $P < 0.05$  was considered statistically significant.

### **Results:-**

One hundred patients belonging to age group of 20–30 years, of ASA grade I or II, posted for caesarean section under spinal anaesthesia were enrolled for this study (Table 1). Patients were divided into two groups based on their baseline HR [Figure 1]. The patients having a HR 90 bpm were included in group A; 47 patients were included in group A and 53 patients in group B. There was no statistical difference between the two groups in age, weight, height, and duration of surgery. Incidence of hypotension and mephentermine requirement following spinal anaesthesia were noted. Thirty-nine patients out of 100 developed hypotension (39%), of whom 27 were in the

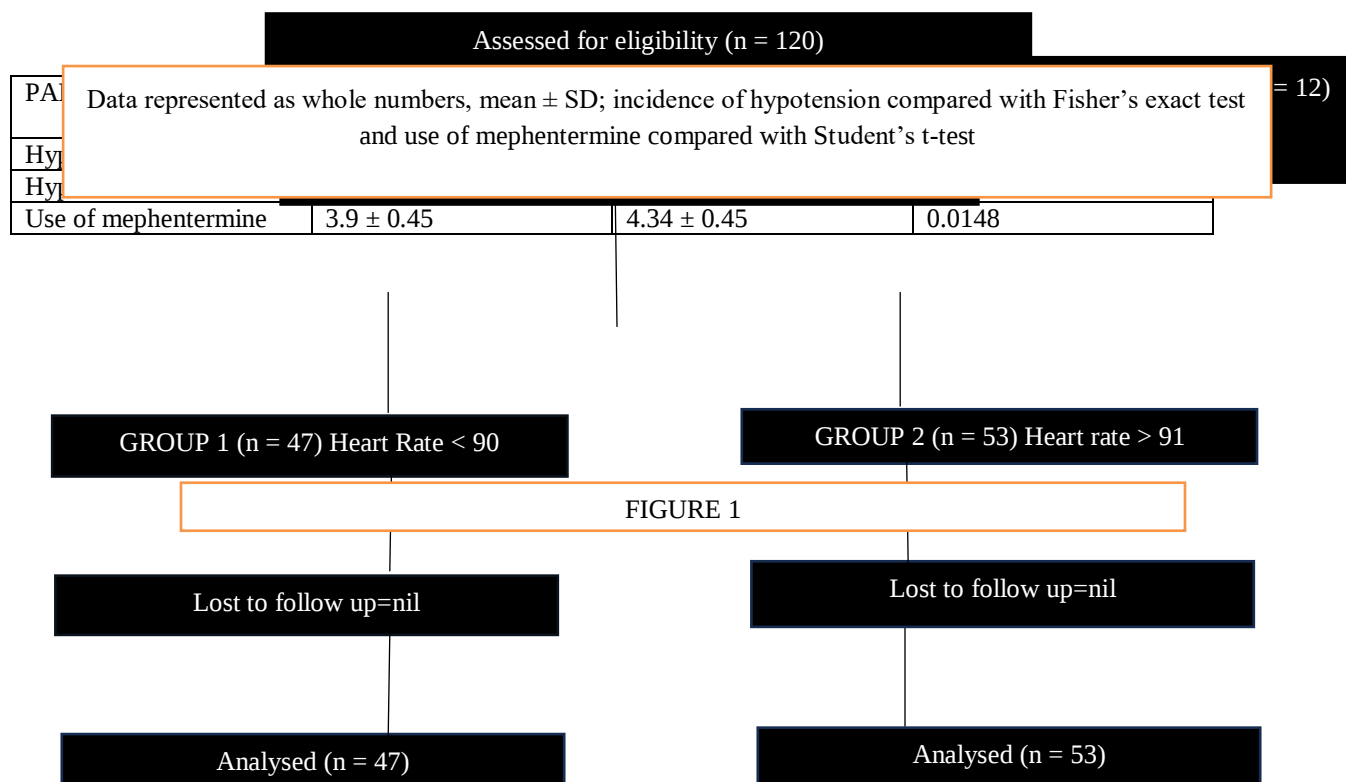
group B (50.9%) and 12 patients were in the group A (25.5%). The incidence of hypotension was statistically significant between two groups ( $P = 0.0260$ ) [Table 2]. The use of ephedrine was greater in group B than group B (mean  $3.9 \pm 0.45$  vs  $4.34 \pm 0.45$ ,  $P = 0.0148$ ).

**Table 1:- Patient Parameters.**

| PARAMETER            | GROUP A (n = 47)  | GROUP B (n = 53)  | P-VALUE |
|----------------------|-------------------|-------------------|---------|
| AGE (YEARS)          | $24.08 \pm 2.75$  | $24.67 \pm 3.14$  | 0.223   |
| WEIGHT (KGS)         | $66.37 \pm 6.21$  | $65.52 \pm 5.95$  | 0.445   |
| HEIGHT (CMS)         | $162.30 \pm 6.44$ | $163.37 \pm 5.80$ | 0.342   |
| SURGICAL TIME (MINS) | $86 \pm 24$       | $79 \pm 30$       | 0.483   |

Data represented as mean  $\pm$  SD; unpaired t-test; n, number of patients

**TABLE 2 : HAEMODYNAMIC DATA**



### Discussion:-

Spinal anaesthesia is the preferred technique for caesarean section in obstetric patients.<sup>10</sup> It has certain advantages over general anaesthesia<sup>11</sup> as well as over epidural anaesthesia<sup>12</sup> for obstetric cases. However it has certain disadvantages as well. The most common and most dreaded disadvantage is development of post-spinal hypotension.<sup>13, 14</sup>

Hypotension following spinal anaesthesia may have serious adverse effects for both mother and foetus. There are many methods to prevent hypotension following spinal anaesthesia, which include pre-loading, pelvic tilt, prophylactic mephentermine, but no single method is entirely satisfactory and applicable to all patients.

Therefore there is a need for a predictor which can predict patients at risk of developing post spinal hypotension.

Predictive factors of maternal hypotension during caesarean section under spinal anaesthesia that have been reported previously include HR >90 bpm, complaints of dysphoria following postural change from left lateral to supine position, high Pleth Variability Index (PVI) before anaesthesia.<sup>8,15</sup>

Systemic hemodynamics are modulated by ANS.<sup>7</sup> Pre-operative determination of the autonomic tone might provide an opportunity to detect patients at risk of developing severe hemodynamics impairment following spinal anaesthesia. There are several methods to determine autonomic tone. Of these, a convenient, handy and non-invasive method of measuring activity of ANS is analysis of heart rate (HR). Therefore, pre-operatively analysed HR may predict hypotension following spinal anaesthesia and identify at risk patients. This can prove beneficial in initiating measures to prevent hypotension in at risk patients.

Present study demonstrated that the higher the preoperative HR, higher is the risk of developing post-spinal hypotension. The cut-off value of HR >90 bpm was based on previous studies.<sup>16</sup>

Shahram khan et al.<sup>17</sup> conducted a study to evaluate effect of pre-operative HR on post-spinal hypotension in obstetric patients. They found out that incidence of hypotension was more in group with HR  $\geq$  91 bpm (31.82%) than patients with HR  $\leq$  90 bpm (11.86%) with P value of <0.001. The results of our study are comparable to this study in correlating higher preoperative heart rate and development of post spinal hypotension.

Hannas et al.<sup>3</sup> found that an LF/HF ratio (low frequency to high frequency) greater than 2.5 may indicate a high risk of hypotension after spinal anesthesia. The LF/HF ratio is ratio of heart rate variability. An LF/HF ratio of less than 2.5 may indicate a low risk of hypotension after spinal anaesthesia. The higher ratio indicates greater pre operative heart rate and hence greater sympathetic discharge. The results of this study are comparable to ours.

Sakata.K et al.<sup>18</sup> concluded that postural change test with heart rate variability analysis may be used to predict the risk of hypotension during spinal anaesthesia for caesarean section. Changes in maternal heart rate with postural changes or values of heart rate variability have been reported to predict hypotension. A total of 45 women scheduled to undergo caesarean section under spinal anaesthesia were enrolled. A postural change test was performed the day before caesarean section. The ratio of the power of low and high frequency components contributing to heart rate variability was assessed in the order of supine, left lateral, and supine. Patients who exhibited a  $\geq$ two-fold increase in the low-to-high frequency ratio when moving to supine from the lateral position were assigned to the postural change test-positive group. According to the findings of the postural change test, patients were assigned to the positive (n=22) and negative (n=23) groups, respectively. Hypotension occurred in 35/45 patients, of whom 21 (60%) were in the positive group and 14 (40%) were in the negative group. The incidence of hypotension was greater in the positive group ( $P < 0.01$ ). The total dose of ephedrine was greater in the positive group ( $15 \pm 11$  vs.  $7 \pm 7$  mg,  $P = 0.005$ ). The area under the receiver operating characteristic curve was 0.76 for the postural change test as a predictor of hypotension.

This study can be used as a stepping stone for future research to determine the relationship of pre operative heart rate and post spinal hypotension.

### Conclusion:-

There is a significant association between Pre operative heart rate and post spinal hypotension in patients undergoing caesarean section.

39% out of 100 developed hypotension, of whom 27 were in the group B (50.9%) and 12 patients were in the group A (25.5%). The incidence of hypotension was statistically significant between two groups ( $P = 0.0260$ ). The use of ephedrine was greater in group B than group A (mean  $3.9 \pm 0.45$  vs  $4.34 \pm 0.45$ ,  $P = 0.0148$ ).

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