

## UTILITY OF SUPINE STRESS TEST TO ANTICIPATE SPINAL ANAESTHESIA INDUCED HYPOTENSION IN PATIENTS UNDERGOING ELECTIVE CESAREAN SECTION

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### ABSTRACT

#### INTRODUCTION

Reduction in venous return caused by compression of the inferior vena cava by the gravid uterus, known as the supine hypotensive syndrome of pregnancy, is one of the reasons for particular susceptibility to hypotension at cesarean delivery. The hypotensive effect of spinal anaesthesia further exacerbates maternal hypotension in the supine position in term parturients. This study was conducted with the objective to evaluate the ability of supine stress test to predict spinal anaesthesia induced hypotension in patients undergoing elective cesarean section.

#### MATERIAL AND METHODS

A prospective observational study was done among 232 singleton parturients scheduled for elective cesarean delivery under spinal anaesthesia in Universal College of Medical Sciences Teaching Hospital. Patients were subjected preoperatively to supine stress test and divided into two groups of 116 patients each. SBP, DBP, MAP, HR were compared between two groups. Descriptive as well as inferential statistics were used to analyze the data.

#### RESULTS

Supine stress test was positive by heart rate criteria in 50% of positive patient. The incidence of hypotension in positive test group was 73.3%, while it was 11.2% in negative test group, which was statistically significant ( $p < 0.001$ ).

#### CONCLUSION

This study demonstrates that supine stress test can easily identify parturients in risk of developing hypotension during cesarean section under spinal anaesthesia.

#### KEYWORDS

Supine stress test, Supine hypotension syndrome

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## INTRODUCTION

Spinal anaesthesia is the preferred mode of anaesthesia for patients undergoing elective cesarean section.<sup>1</sup> The incidence of spinal anaesthesia induced hypotension occurs in up to 70% of cases,<sup>2,3</sup> which results from decrease in the systemic vascular resistance secondary to vasodilation with the blockade of preganglionic sympathetic fibers.<sup>4</sup>

Reduction in venous return caused by compression of the inferior vena cava by the gravid uterus, known as supine hypotensive syndrome of pregnancy, is one of the reasons for particular susceptibility to hypotension at cesarean delivery.<sup>5,6</sup> Supine hypotension syndrome occurs in approximately 8% of pregnant patient at term.<sup>6</sup>

The hypotensive effect of spinal anaesthesia further exacerbates maternal hypotension in the supine position in term parturients.<sup>7,8</sup> Thereby, resulting in maternal nausea, vomiting, dizziness, rarely loss of consciousness, cardiac arrest, death and fetal compromise.<sup>2,3,9</sup>

Supine stress test (SST) is a test done to study maternal cardiovascular responses to supine position.<sup>10</sup> It helps in predicting severe systolic hypotension in patients undergoing cesarean section under spinal anaesthesia.<sup>11</sup>

This study was conducted with the objective to evaluate the ability of supine stress test to predict spinal anaesthesia induced hypotension in patients undergoing elective cesarean section.

## MATERIAL AND METHODS

This prospective observational study was conducted at Universal College of Medical Sciences Teaching Hospital. After approval of research protocol by the institutional research committee (UCMS/IRC/210/22), written informed consent was taken from 232 parturients at term, who were planned to undergo elective cesarean section and fell under ASA classification II from December 7, 2022 to December 8, 2023. Exclusion criteria were hypertension, pre-existing history of cardiovascular disease, pre-eclampsia, eclampsia, and known contraindication for spinal anaesthesia.

Pre anaesthetic evaluation was done a day before surgery and informed written consent was taken. All participants received pre-medication as per Institutional protocol. Upon arrival in the operation theatre, standard ASA monitors were attached. Patients were allowed to rest in the sitting position for 10 minutes and baseline systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) were recorded. Then the patients were kept in supine position with a pillow under the head for 5 minutes and SBP, DBP, MAP and HR were recorded again.

SST was considered positive if one or more of the following criteria were fulfilled,<sup>7</sup>

1. Increase in maternal heart rate >10 beats/min
2. Decrease in systolic arterial blood pressure >15 mm Hg
3. Signs related to the supine position - hip flexion, crossing of legs
4. Symptoms related to the supine position requiring a change in position- nausea, vomiting, dizziness

Based on the SST result, patients were divided equally in two groups with Group A containing SST positive and Group B containing SST negative patients. Each group consisted of 116 patients.

Following the supine stress test, patients were co-loaded with 10 ml/kg of Ringer's Lactate and the patients were kept in sitting position to receive spinal anaesthesia. Subarachnoid block (SAB) was performed using 25G Quincke needle at L3-4 intervertebral space via midline approach and 2.2 ml of 0.5% Hyperbaric Inj. Bupivacaine was administered.

Patients were then kept supine with left uterine displacement. SBP, DBP, MAP, HR were recorded at an interval of every 3 minutes from the time of intrathecal injection until the clamping of umbilical cord.

Surgery was started after achieving the sensory blockade upto the level of T6 and with Modified Bromage scale of 3. Hypotension was defined as SBP<90 mm Hg or MAP <65 mm Hg and was treated with IV Phenylephrine 100 mcg IV or Inj. Mephentermine 6 mg IV bolus according to the heart rate while bradycardia was defined as HR<45/min and was treated with Inj. Atropine 0.6 mg IV bolus.

### Statistical Analysis

The sample size was calculated based on study conducted by Tyagi et al<sup>12</sup> using formula

$$n = \left( \frac{r+1}{r} \right) \frac{(\bar{p})(1-\bar{p})(Z_{\beta} + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

r = ratio of two group (r=1)

$Z_{\alpha}$  = level of significance at 5% = 1.96

$Z_{\beta}$  = power of test at 80% = 0.84

$p_1$  = proportion of hypotension in SST positive = 63.33 %

$p_2$  = proportion of hypotension in SST negative = 45%

$\bar{p}$  = Average of two proportion

$$= \frac{p_1 + p_2}{2} = 54.16$$

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So, a minimum of 116 parturients were required in each group of study.

Data were entered and analyzed into SPSS version 20. Descriptive as well as inferential statistics were used to analyze the data. In descriptive statistics, frequency, percentage, mean and standard deviation were used to analyze the data. In inferential statistics, Chi-Square test was used to find the association between different variables with dependent variables. Independent sample t test was used to compare the mean difference between two groups. P value less than 0.05 was considered as statistically significant.

## RESULTS

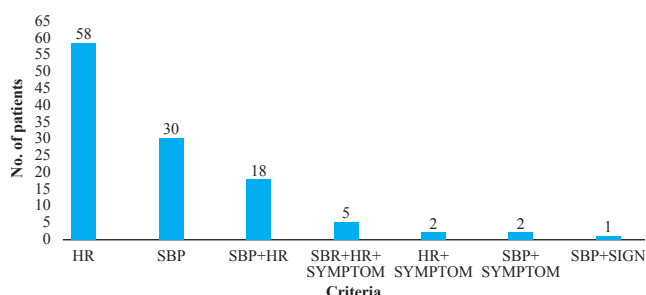
Out of 300 patients enrolled, 232 patients were included and 68 were excluded from the study due to emergency cesarean section, failed spinal anaesthesia, and patient refusal on the day of surgery.

Demographic profiles of the patients are shown in table 1, with no statistically significant difference in both groups.

**Table 1.** Demographic profile of two groups

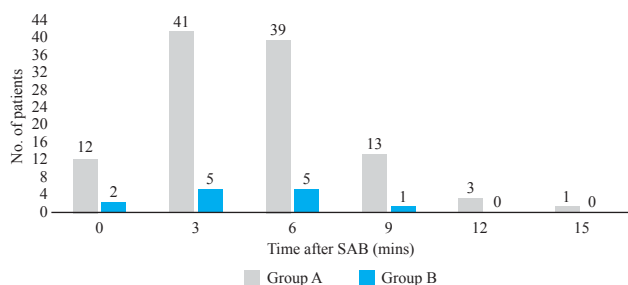
	Group A	Group B	p value
Age (years)	26.75 ± 4.52	27.33 ± 5.20	0.184
Height (cm)	155.75 ± 5.92	154.89 ± 5.25	0.121
Weight (kg)	64.55 ± 10.10	62.85 ± 9.13	0.178
BMI (kg/m <sup>2</sup> )	26.62 ± 4.05	26.48 ± 3.55	0.773

In group A, supine stress test was positive by heart rate criteria in 50% (58), systolic blood pressure criteria 25.86% (30) followed by combination of SBP and HR in 15.51% (18) as seen in figure 1.

**Figure 1.** Frequency distribution of criteria of positive supine stress test

Symptoms seen that fulfills the positive supine stress test criteria were nausea (6), nausea and dizziness (1) and nausea and vomiting (1) while only sign seen was crossing of legs (1).

The incidence of hypotension in Group A was 73.3% (85) while it was 11.2% (13) in Group B which was statistically significant ( $p < 0.001$ ). In Group A, 52 boluses of Inj Phenylephrine and 57 boluses of Inj Mephentermine were required for the management of hypotension. In Group B, only two boluses of Inj. Phenylephrine and eleven boluses of Inj. Mephentermine were administered for the management of hypotension. The maximum incidence of hypotension was seen at 3 and 6 minutes after spinal anaesthesia in both groups as shown in figure 2.

**Figure 2.** Frequency distribution of incidence of hypotension in both groups

Comparison of systolic blood pressure at baseline did not show any statistically significant difference between the two groups. But after supine stress test, statistically significant difference was seen ( $p < 0.001$ ) which was evident at 0, 3, 6, and 9 minutes after spinal anaesthesia (Table 2).

**Table 2.** Systolic blood pressure at different time period

SBP (mm Hg)	Group A	Group B	p value
Baseline	126.28 ± 9.78	124.47 ± 10.4	0.173
Supine stress test	117.36 ± 11.64	123.53 ± 10.56	<0.001
Time after SAB			
0 minutes	110.88 ± 13.31	118.92 ± 12.61	<0.001
3 minutes	101.97 ± 17.51	115.08 ± 14.13	<0.001
6 minutes	101.57 ± 16.26	113.99 ± 13.55	<0.001
9 minutes	107.51 ± 13.95	115.14 ± 10.46	<0.001
12 minutes	112.37 ± 13.08	115.59 ± 12.54	0.184
15 minutes	109.31 ± 14.45	116.21 ± 12.12	0.189

There was no significant difference in baseline diastolic pressure between two groups. Statistically significant difference was seen in both groups after supine stress test ( $p < 0.001$ ) and the difference was evident in further time interval of 0, 3, 6, and 9 minutes after spinal anaesthesia as seen in Table 3.

**Table 3.** Diastolic blood pressure at different time period

DBP (mm Hg)	Group A	Group B	p value
Baseline	75.61 ± 8.86	77.24 ± 9.35	0.175
Supine stress test	69.97 ± 10.6	76.42 ± 9.1	<0.001
Time after SAB			
0 minutes	64.47 ± 10.41	70.28 ± 9.61	<0.001
3 minutes	58.57 ± 10.28	67.8 ± 10.51	<0.001
6 minutes	58.55 ± 10.15	66.88 ± 10.78	<0.001
9 minutes	63.04 ± 9.56	67.69 ± 9.59	0.001
12 minutes	65.35 ± 8.47	79.89 ± 93.5	0.245
15 minutes	65.92 ± 10.68	69.29 ± 8.63	0.38

While comparing the mean arterial pressure, baseline value was comparable, but statistically significant difference was seen after supine stress test and differences were seen at 3, 6, and 9 minutes after spinal anaesthesia (Table 4).

**Table 4.** Mean arterial pressure at different time period

MAP (mm Hg)	Group A	Group B	p value
Baseline	92.97 ± 8.55	92.68 ± 8.85	0.804
Supine stress test	87.12 ± 8.79	92.9 ± 8.81	<0.001
Time after SAB			
0 minutes	86.81 ± 65.43	87.85 ± 10.12	0.865
3 minutes	73.49 ± 12.31	84.86 ± 10.79	<0.001
6 minutes	73.42 ± 12.09	90.21 ± 66.33	0.008
9 minutes	78.74 ± 10.87	84.87 ± 8.93	<0.001
12 minutes	81.79 ± 9.46	84.64 ± 9.41	0.111

No statistically significant difference was seen in both groups regarding heart rate at baseline. After supine stress test, statistically significant difference was seen ( $p < 0.001$ ) which was later seen at 3 and 6 minutes after spinal anaesthesia (Table 5).

**Table 5.** Mean heart rate at different time period

HR (beats/min)	Group A	Group B	p value
Baseline	89.9 ± 13.46	91.38 ± 0.19	0.173
Supine stress test	101.3 ± 12.61	93.08 ± 15.06	<0.001
Time after SAB			
0 minutes	98.23 ± 14.85	94.68 ± 16.54	0.087
3 minutes	99 ± 16.71	94.73 ± 14.19	0.037
6 minutes	97.16 ± 16.31	90.73 ± 15.78	0.003
9 minutes	93.47 ± 17.05	91.09 ± 15.55	0.307
12 minutes	95.91 ± 17.37	94.07 ± 14.85	0.546
15 minutes	93.15 ± 20.25	89 ± 14.71	0.545

## DISCUSSION

Result of our study suggests that preoperative supine stress test can predict intraoperative hypotension following spinal anaesthesia. It reflects various cardiovascular tolerance of parturients with aortocaval compression as reflected in changes in heart rate, blood pressure or maternal discomfort.<sup>8</sup> According to the criteria for supine stress test, heart rate more than 10 beats/minute criteria was seen in 50 % of the positive test parturients. Brebion et al,<sup>10</sup> Dahlgren et al,<sup>7</sup> Kinsella et al<sup>11</sup> also supported heart rate criteria as a predictor for positive supine stress test in most of the parturients.

The incidence of hypotension in positive group was 73.3 % which was comparable to 68% in positive group in the study by Dahlgren et al<sup>7</sup> while the incidence of hypotension in the negative group was 11.2 % which was lower than the findings of 29 % in the study of Dahlgren et al.<sup>7</sup>

In a study by Erango et al,<sup>13</sup> the group with the most prominent drop in blood pressure in supine position, also had the largest reduction in average blood pressure under spinal anaesthesia, and was still decreasing after 250 seconds. Similarly, in our study the incidence of hypotension was higher at 3 and 6 minutes after spinal anaesthesia in positive group. Incidence of hypotension was also evident in the negative group. While on the contrary, Erango et al<sup>13</sup> did not have fall in blood pressure in their negative group, which can be explained with the prophylactic use of Inj phenylephrine.

Higher incidence of hypotension results in increased use of vasopressors which can be seen by frequent administration of Inj. Phenylephrine and Inj. Mephentermine in our study. Similar results were found by Kinsella et al<sup>11</sup> where positive SST was associated with increased use of vasopressors and a higher hypotension- vasopressor score.

Erango et al<sup>13</sup> found that the mean systolic arterial pressure started to decline in both groups with a sharper drop in blood pressure in patient with positive test. This finding was also comparable in this study where the drop in blood pressure continued upto 9 minutes of spinal anaesthesia in positive group as compared to the negative group.

Change in diastolic pressure was evident in further time interval of 0, 3, 6, and 9 minutes after spinal anaesthesia which was also evident in the study by Tyagi et al<sup>12</sup> where fall in BP was statistically significant at 5 and 10 minutes in positive group as compared to the negative group.

## LIMITATION OF STUDY

Use of non-invasive blood pressure measurement could be the limitation of our study as invasive blood pressure measurement is considered more reliable and sensitive to detect early and subtle changes in intra operative blood pressure.

## CONCLUSION

This study demonstrates that a simple, non-invasive supine stress test preferably following heart rate criteria can easily identify parturients at risk of developing hypotension during cesarean section under spinal anaesthesia.

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