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RELATION OF SYMPHYSIOFUNDAL HEIGHT AND ABDOMINAL GIRTH WITH INCIDENCE OF HYPOTENSION IN PARTURIENTS UNDERGOING CESAREAN SECTION UNDER SPINAL ANAESTHESIA USING BUPIVACAINE WITH FENTANYL

Anaesthesiology

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ABSTRACT

Symphysiofundal height and Abdominal girth measurements give an indirect measure of the extent of inferior vena cava compression, which may influence the lumbosacral CSF volume. Hence, this clinical study was designed to see the effect of Symphysiofundal height and Abdominal girth on the incidence of hypotension. This prospective observational study was conducted under department of anaesthesia in a tertiary care hospital for a period of 2 years. Total 94 patients were enrolled in this study with mean age of patients was 26.57+4.13 years (20-35). The repeated measures ANOVA showed that there was a statistically significant differences in the heart rate, systolic blood pressure, diastolic blood pressure & mean arterial pressure at different time points of assessment. The maximum incidence of hypotension is seen at 10 min, 15 minute, 20 minute and 25 minute. There was a statistically significant differences in the systolic blood pressure at different time points of assessment. There was a positive moderate significant correlation between SFH and reduction in SBP (The Spearman's rho obtained was 0.4531 and $p< 0.0001$). There was a positive weak significant correlation between abdominal girth and reduction in SBP (The Spearman's rho obtained was 0.3981 and $p< 0.0001$.). From our study, we conclude that in parturients who are undergoing elective cesarean section under spinal anaesthesia, the Symphysiofundal height has a moderate significant positive correlation with the incidence of hypotension. Abdominal girth also was found to have a weak positive correlation with the incidence hypotension.

KEYWORDS

Symphysiofundal height, Abdominal Girth, Spinal anaesthesia, Bupivacaine with Fentanyl, Hypotension.

INTRODUCTION:

The type of anaesthesia for caesarean section is dependent on various factors such as maternal comorbidities, urgency of surgery and maternal preference. Numerous anatomical and physiological changes occur during gestation to meet the increased metabolic demands of pregnancy.[1] The knowledge of these changes is essential for successful anaesthetic management during cesarean section. Spinal anaesthesia is the most common method of anaesthesia for elective cesarean section.[2]

Spinal anaesthesia is preferred in parturients because of rapid onset and less complications. Also there is least absorption of local anaesthetic into maternal circulation , in turn resulting in least fetal exposure.[2,3] However, the effects of neuraxial blockade are often exaggerated by the physiological changes of pregnancy. Hypotension is the physiologic consequence of spinal anaesthesia and it can have a potentially deleterious effect on maternal and fetal well being.

The incidence of hypotension in parturients receiving spinal anaesthesia for Cesarean section is as much as 55%-90%. 3 It was suggested that the spinal anaesthesia resulted in venous pooling of blood in the lower legs, leading to decreased venous return and reduced cardiac output and thus hypotension.3 Partial or complete venacaval and aortic compression by gravid uterus is present in most of the parturients. The venacaval occlusion impedes venous return to heart and thus leads to hypotension. In most of the parturients, increased resting sympathetic tone compensates for the venacaval obstruction and thus blood pressure is maintained.[4] However, when sympathetic tone is decreased as occurs with spinal anaesthesia, there is marked decrease in blood pressure. It was postulated that "venous capacitance" due to sympathetic blockade plays rather important role than venous pressure in causing hypotension after spinal anaesthesia in obstetrics.[5] This intrinsic vascular tone is adversely impacted after spinal anaesthesia, leading to exaggerated fall in blood pressure.

The level of sympathetic block bears a direct effect on severity of hypotension. The extent of sympathetic block is determined by the spread of local anaesthetic in the subarachnoid space. Multiple factors have been studied that influence the spread of sensory blockade such as height, weight, body mass index of the patient, increased abdominal pressure, uterine size, abdominal girth etcetera.[6,7] The compression of the inferior vena cava caused by an enlarged uterus can lead to congestion and engorgement of the epidural venous plexus. This leads to decrease in the cerebrospinal fluid volume and narrowing the intrathecal space. [8,9] This results in more cephalad spreading of local anaesthetic agent and consequently hypotension as a result of the higher degree of sympathectomy.[10] Thus, the size of the enlarged uterus may have an effect on the local anaesthetic spread ,thereby influencing extent of sympathetic blockade. The size of the gravid uterus can be measured by Symphysiofundal height (SFH) and abdominal girth (AG) .These parameters are being used classically to assess the fetal growth during pregnancy since long. Symphysiofundal height and Abdominal girth measurements give an indirect measure of the extent of inferior vena cava compression, which may influence the lumbosacral CSF volume.[11]

Hence, this clinical study was designed to see the effect of Symphysiofundal height and Abdominal girth on the incidence of hypotension .

METHODOLOGY:

This prospective observational study was conducted under department of anaesthesia in a tertiary care hospital for a period of 2 years. Ethics committee clearance & written informed consent from patient posted for Cesarean section was obtained. In a similar study by Parthasarthy et al, the prevalence of hypotension was reported in 42% patients.[12] Using this data, sample size was calculated as follows, Using formula for sample size calculation for prevalence studies, Sample size = $z2\ p\ (1\text{-}p)\ /d2$ Where, z = 1.96 for 95% Confidence interval p = prevalence from previous study d = precision error. Calculated sample size was 94 patients. A total of 94 patients of the American Society of Anesthesiologists (ASA) physical status (PS) II, in the age group 20-35 years, weight 45-90kr and height 130-160cm undergoing elective cesarean section were included. Uncooperative patients, patients in active labour, placenta previa, twin pregnancy, pregnancy induced hypertension, ruptured membranes, IUGR, abnormal lie and presentation or with significant medical & obstetric morbidity were excluded from the study.

A detailed pre-anaesthetic evaluation of each patients was carried out. Demographic details, general examination & basic lab investigation were carried out. Patients was kept fasting for 8 hours. Weight and height measurement done. Symphysiofundal height (SFH) measured in centimetres from upper margin of uterine fundus to superior margin of pubic symphysis measured in supine position on a horizontal table. In the operation theatre, standard monitors comprising of noninvasive blood pressure (BP), pulse oximetry, and electrocardiogram were connected, and 10 ml/kg of Ringer lactate was infused through peripheral venous access using 18-gauge IV cannula Baseline resting heart rate (HR) and systolic, diastolic, and mean arterial BPs were recorded. Subarachnoid block was given with 25 gauge Quincke needle in sitting position by midline approach under all aseptic precautions. After checking the CSF outflow, 0.5% hyperbaric bupivacaine – 1.8 ml (9 mg) with 10 µg intrathecal fentanyl was given.

Immediately after injection, the patient was given supine position with 15° left lateral tilt of the table. Sensory level was checked along the midline every minute until 10 minutes , and every 5 minutes till 30 minute. After the drug injection via subarachnoid route, the patients' arterial BP, HR, respiratory rate, and arterial oxygen saturation(SpO2) were measured at regular intervals. Injection oxytocin 10 units given by infusion following extraction of the baby. Hypotension was defined as more than 20% fall in systolic BP from the baseline value . It was treated with injection ephedrine 6 mg IV, and the same dose was repeated if there was persistent fall after 2 min. Bradycardia was defined as HR hypotension and the maximum level of sensory block. The degree of hypotension measured by vasopressor (ephedrine) usage and the incidence of nausea and vomiting were secondary measures.

For statistical analysis, the collected data were organised, tabulated, and analysed using "SPSS." Descriptive statistics such as mean with standard deviation or proportions were presented. Mean, median, standard deviation and variance were calculated. Quantitative data such as heart rate, and blood pressure at more than two time intervals were compared using repeated measures ANOVA, with significant pairwise comparisons using Bonferroni's correction. Correlation between the data which is not normally distributed was performed using Spearman's correlation rank test. Level of significance in the study is less than 0.5.

RESULTS

Total 94 patients were enrolled in this study with mean age of patients was 26.57+4.13 years (20-35). Mean weight of patients was 59.43+6.55 kg (48-81). Mean height of patients was 157.66+3.23 cm (150-168). The mean BMI of patients was 23.95+2.31 kg/m2 (19.8-31.5). The mean SFH of patients was 35.53+2.13 (32-42). The mean abdominal girth of patients was 89.72+4.16 cm (83-101). (Table 1) The repeated measures ANOVA showed that there was a statistically significant differences in the heart rate at different time points of assessment. $F(14, 1302) = 34.237$, $p<0.001$(Fig1). there was a statistically significant differences in the systolic blood pressure at different time points of assessment. $F(14, 1302) = 89.073$, $p<0.001$. (Fig 2). There was a statistically significant differences in the diastolic blood pressure at different time points of assessment. $F(14, 1302) = 83.518$, $p<0.0001$.(Fig 3) There was a statistically significant differences in the mean arterial pressure at different time points of assessment. $F(14, 1302) = 113.408$, $p<0.0001$(Fig 4) The maximum incidence of hypotension is seen at 10 min , 15 minute , 20 minute and 25 minute.(Fig 5) There was a statistically significant differences in the systolic blood pressure at different time points of assessment. $F(14, 1302) = 118.32$, $p<0.0001$.(Fig 6) The Spearman's rho obtained was 0.4531 and $p< 0.0001$. This shows that there was a positive moderate significant correlation between SFH and reduction in SBP (Fig 7). The Spearman's rho obtained was 0.3981 and $p< 0.0001$. This signifies that there was a positive weak significant correlation between abdominal girth and reduction in SBP (Fig 8).

Table 1: Distribution of patients according to demographic parameter

Demographic Parameter	Mean	SD	Range
Age	26.57	4.13	20-35
Weight	59.43	6.55	48-81
Height	157.66	3.23	150-168
BMI	23.95	2.31	19.8-31.5
Symphysio-fundal height	35.53	2.13	32-42
Abdominal Girth	89.72	4.16	83-101

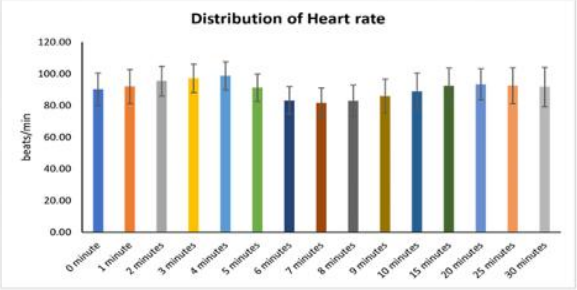

Fig 1: Distribution patients according to heart rate after spinal anaesthesia.

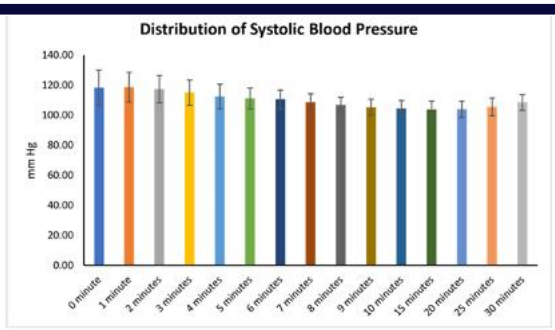

Fig 2: Distribution patients according to systolic blood pressure after spinal anaesthesia.

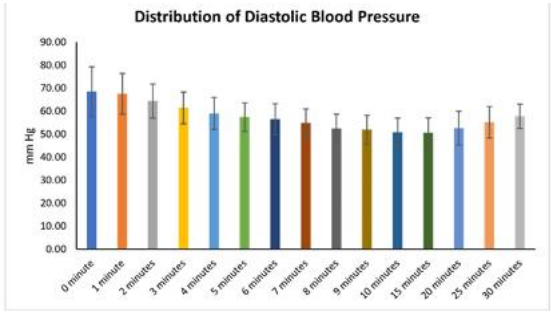

Fig 3: Distribution patients according to diastolic blood pressure after spinal anaesthesia.

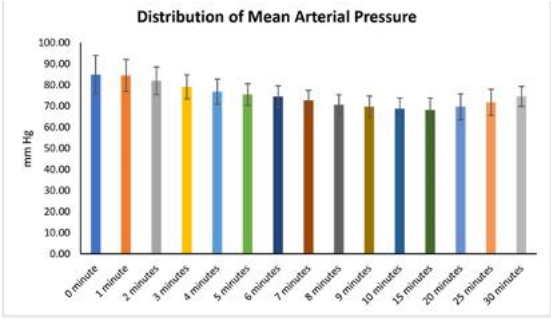

Fig 4: Distribution patients according to mean arterial pressure after spinal anaesthesia.

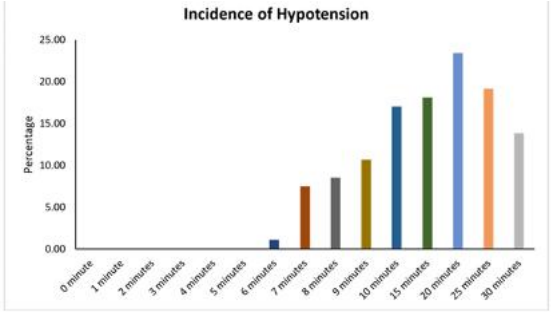

Fig 5: Distribution patients according to incidence of hypotension after spinal anaesthesia.

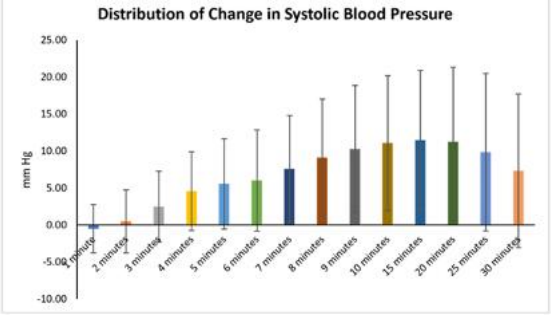

Fig 6 : Distribution patients according to change in systolic blood pressure after spinal anaesthesia.

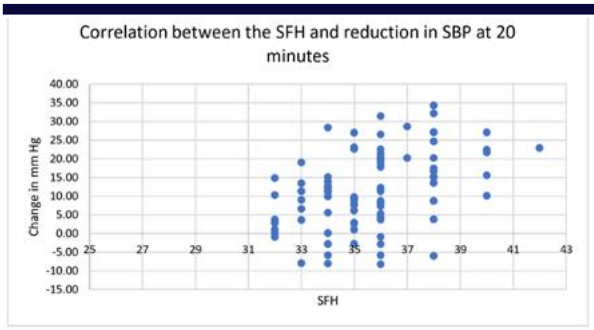

Fig 7: Correlation between the SFH and reduction in SBP at 10 minutes, 15 minutes, 20 minutes and 25 minutes.

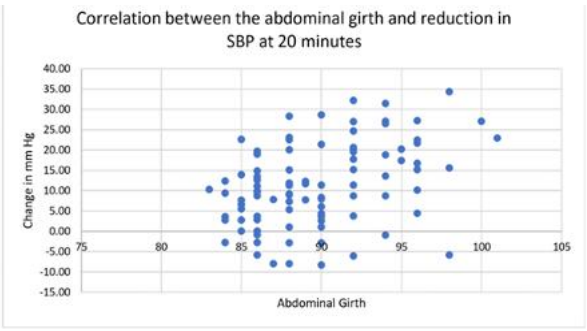

Fig 8 : Correlation between abdominal girth and reduction in blood pressure .

DISCUSSION:

Hypotension is a physiological effect of subarachnoid block. Level of autonomic block has direct influence on the severity of hypotension. Lumbosacral CSF volume plays an important role in the spread of drug injected in subarachnoid space. In the case of parturient women, gravid uterus causes pressure on the Inferior vena cava. This leads to expansion of the lumbar vein and vertebral artery around the spinal cavity. Because of this there is shrinkage of the subarachnoid space with decrease in Cerebrospinal fluid volume. This may result in more cephalad spread of intrathecally administered drug. Symphysiofundal height and Abdominal girth measurements are being used in obstetric to assess the intrauterine growth of the foetus since long. These parameters may give an indirect measure of the extent of Inferior vena cava compression, which may influence the lumbosacral CSF volume.

In our study , the mean age of patients examined for study was 26.57+4.13 years (20-35). The mean weight of patients in study was 59.43+6.55 kg (48-81). The mean height of patients for study were 157.66+3.23 cm (150-168). The distribution of body mass index of patients undergoing cesarean section under spinal anaesthesia for study was 23.95+2.31 kg/m2 (19.8-31.5). The mean SFH of parturients was 35.53+2.13 (32-42). The mean abdominal girth of patients was 89.72+4.16 cm (83-101). In our study, mean SFH of parturients was found to be 35.53+2.13 (32-42). The mean abdominal girth of patients was 89.72+4.16 cm (83-101). The baseline systolic blood pressure in study subjects before giving spinal anaesthesia was 118.17+- 11.71. The systolic blood pressure was measured at regular interval of time. It was measured every minute till 10 minutes and every 5 minutes for 30 minutes. We found that , the repeated measures of ANOVA showed statistically significant differences in the systolic blood pressure at different time points of assessment with F (14,1302)= 89.073 with p value below 0.0001 which is statistically significant. Also we found that out of 94 patients, 17 patients had maximum hypotension at 15 minutes (18.09% of study subjects), 22 patient had hypotension at around 20 minute (23.40%), 18 patient had hypotension at 25 minutes (19.15%).

The change in systolic blood pressure at 1 minute was - 0.51+3.2 , at 2 minutes it was 0.47+4.26, 3 minutes it was 2.47+4.79 with maximum reduction seen at 10 minutes , 15 minutes and 20 minutes after administration of spinal anaesthesia. Spearman's rank correlation test was used to assess the correlation between Symphysiofundal height and reduction in systolic blood pressure at these time intervals after spinal anaesthesia. The Spearman's rho obtained was 0.4531 with p value below 0.0001. This suggests that there was a positive moderate significant correlation between Symphysiofundal height and reduction in systolic blood pressure .

In our study , we also assessed the relation between abdominal girth and incidence of hypotension. The relationship between abdominal girth and reduction in systolic blood pressure at different time intervals. We applied Spearman's rank correlation test to assess this correlation. Spearman's rho obtained which we obtained after application of this test was 0.3981 and p value below 0.0001. This showed a positive weak significant correlation between abdominal girth and reduction in systolic blood and thus ascent of spinal level.

The baseline mean arterial pressure was found to be 84.90+9.08 . Mean arterial pressure was measured at regular intervals of time. The maximum decrease in mean arterial pressure was observed at 10 minutes, 15 minutes with value of 68.64+5.20 68.13+5.70 respectively. There was a statistically significant differences in the mean arterial pressure at different time points of assessment with $F(14, 1302) = 113.408$, p value below 0.0001. These findings are consistent with the study carried out by Prabha Parthasarathy in 2019.[12] Changes in blood pressure with Symphysiofundal height were also comparable with changes observed by Chung SH (2010)[13], Chang-Na Wei(2017)[14], İlkben GÜNÜŞEN (2019)[15] , Jawan B (1998) [16]

In 2019 , Prabha Parthasarathy in their study revealed the incidence of hypotension was higher with increasing SFH (16.9% with SFH of 30–35 cm, 78.37% with SFH of 36–40 cm; correlation coefficient $\rho = 0.338$) and with increasing AG (5.3% with AG between 85 and 89 cm, 35.7% with AG 90–94 cm, 62.8% with AG 95–99 cm; $\rho = 0.341$), and both were statistically significant ($P < 0.001$). There was a statistically significant correlation between increasing SFH and maximum sensory block achieved ($\rho = 0.157$, $P < 0.001$). There was increased level of sensory blockade with increased AG but was not statistically significant ($\rho = 0.011$, $P = 0.32$). [12]

In 2010, Chung SH study showed ephedrine was injected to treat the hypotension, nausea and vomiting after the spinal anaesthesia in 28 of the 52 cases (53.8%), and of the 28 cases, nausea and vomiting accompanied 17 of them. As maximum sensory blockade level increased, the administrated ephedrine dose increased and showed significance (P value 0.045). A significant correlation was found between the ephedrine dose and the Symphysiofundal height when hypotension, nausea and vomiting occurred after the spinal anaesthesia.

Chang-Na Wei et al in 2019 in their study found that Significant correlation between extent of spinal anaesthesia and height, weight, abdominal girth and vertebral column length. Multiple linear regression analysis emphasised that abdominal girth and vertebral column length in pregnant females were the key factors for the spinal spread.($P<0.0001$). It was observed that abdominal girth and vertebral column length in pregnant females have significant predictive value in the cephalad spread of spinal anaesthesia with hyperbaric bupivacaine in term parturients and thus reduction in blood pressure. [14]

Hirabayashi et al in 1997 found that the gravid uterus compressed the inferior vena cava and almost totally obstructed it in supine position .

The extradural venous plexus was engorged leading to rapid spread of local anaesthetic and causing hypotension Conclusion- The gravity uterus leads to compression of inferior vena cava and thus extra dural venous plexus is compressed more in supine position as compared to lateral position.[17]

S Michael Kinsella 43 in 1994 carried out a study on supine hypotension syndrome. In his study he observed that inferior vena cava compression, influenced primarily by the size of the uterus measured by symphysiofundal height and abdominal girth and exact maternal and fetal position, is the major determinant in its development of hypotension. Our observations were also consistent with changes observed in studies by Lee YH (2014)[18] , Kuok CH (2016) [19] , A M Ronenson (2014)[20].

CONCLUSION:

From our study "Relation of Symphysiofundal height and Abdominal Girth with incidence of hypotension in parturients undergoing Cesarean Section under Spinal anaesthesia using Bupivacaine with Fentanyl ," we conclude that in parturients who are undergoing elective cesarean section under spinal anaesthesia, the Symphysiofundal height has a moderate significant positive

correlation with the incidence of hypotension. Abdominal girth also was found to have a weak positive correlation with the incidence hypotension.

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