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Original Research Article

RELATIONSHIP BETWEEN ABDOMINAL CIRCUMFERENCE AND INCIDENCE OF HYPOTENSION DURING CESAREAN SECTION UNDER SPINAL ANESTHESIA

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Abstract

Background: Caesarean section is performed for various obstetric indications for which most commonly spinal anaesthesia is used. Several factors have been identified to be associated with the incidence of hypotension during Caesarean section under spinal anaesthesia. The parturient characteristics that are typically considered while determining the dose of local anaesthetics for Caesarean section include abdominal circumference (AC), height, weight, body mass index (BMI) and vertebral column length. Abdominal circumference (AC) correlates with intra-abdominal contents. **Aims and Objectives:** To evaluate the relationship between the abdominal circumference and incidence of hypotension during Caesarean section under spinal anaesthesia in term pregnant patients and to compare the total vasopressor (ephedrine) dose required during the procedure and neonatal outcomes and APGAR scores. **Materials and Methods:** A total of 100 patients with differing abdominal circumferences were enrolled in the study to examine the influence of abdominal circumference on incidence of hypotension. Patients were allocated in two groups considering their abdominal circumference (AC) on day of surgery. One group comprised of parturients with abdominal circumference of <102 cm (small abdominal circumference (SAC) group) and the other group comprised of parturients with abdominal circumference of ≥102 cm (large abdominal circumference (LAC) group). **Results:** Large abdominal circumference in pregnancy is associated with greater decreases in mean arterial pressure from baseline, but the maximum decrease in mean arterial pressure (mmHg) from baseline in group SAC and group LAC was statistically significant with p-valve of 0.001 no significant difference in incidence of hypotension between larger and smaller abdominal circumference groups neither does it affects the neonatal outcome. **Conclusion:** Large abdominal circumference in pregnancy is associated with greater decreases in mean arterial pressure from baseline but there is no significant difference in incidence of hypotension between larger and smaller abdominal circumference groups neither does it affects the neonatal outcome.

INTRODUCTION

Cesarean Section is a common surgical procedure performed for various obstetric indications for which most commonly spinal anaesthesia is used. However, a major drawback of spinal anaesthesia is the incidence of hypotension that occurs with it, which can adversely affect both maternal and fetal outcomes. Several factors have been identified to be associated with the incidence of hypotension during Cesarean section under spinal anaesthesia including maternal age, weight, height and body mass index (BMI).

Till date, the technique has remained very popular in term parturients. However, it is challenging for anesthesiologist to achieve an adequate spinal spread of drug and achieve optimum degree of anaesthesia for Cesarean section considering a wide range of individual variations among parturients.[1]

The parturient characteristics that are typically considered while determining the dose of local anesthetics for cesarean section include abdominal circumference (AC)[2], height, weight.[3], body mass

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index (BMI).[4], vertebral column length.[5] Abdominal circumference (AC) correlates with intra-abdominal contents. Maternal abdominal circumference increases during pregnancy, and is influenced by the size of fetus, volume of amniotic fluid, and the size of gravid uterus.[6]

Hypotension which is one of the most common complications after spinal anesthesia has an incidence of 15% to 33% in general population and directly related to greater mortality.[7] A high level of sensory block after spinal anesthesia is among the various factors that increase the incidence of hypotension in pregnant women.[8] The compression of the inferior vena cava by an enlarged uterus results in engorgement of the epidural venous plexus which in turn decreases the cerebrospinal fluid volume and can lead to the narrowing of the intrathecal space potentially resulting in more cephalad spread of drug and higher level of spinal anesthesia, and consequently higher degree of sympathectomy leading to more hypotension.[9]

Previous studies have demonstrated associations between larger abdominal circumference (AC) and higher abdominal pressure and level of sensory block.[10] The relationship between abdominal circumference and incidence of hypotension during Cesarean section under spinal anaesthesia is an area of ongoing research and understanding this relationship can help in predicting and preventing hypotension. We hypothesized that the increased AC, which was previously found to be associated with the increased abdominal pressure and the enlarged uterus, was related to the increased incidence of hypotension after spinal anesthesia.[10]

The primary aim of this study was to evaluate the relationship between the abdominal circumference and incidence of hypotension during Cesarean section under spinal anesthesia in term pregnant patients and secondary aim was to compare the total vasopressor (ephedrine) dose required during the procedure and neonatal outcomes and APGAR scores.

MATERIALS AND METHODS

This was a prospective observational study conducted in the department of Anesthesiology and Critical Care, SKIMS, Soura, Srinagar over a period of 18months. After obtaining Institutional Ethical Clearance, a written informed consent was taken from patients atleast 12 hours before spinal anesthesia for elective Cesarean delivery. A total of 100 patients with differing abdominal circumferences were enrolled in the study to examine the influence of abdominal circumference on incidence of hypotension. Patients were allocated in two groups considering their abdominal circumference (AC) on day of surgery. One group comprised of parturients with abdominal circumference of <102 cm (small abdominal circumference (SAC) group) and the other group comprised of parturients with abdominal circumference of ≥102 cm (large abdominal circumference (LAC) group). Patients included in study were term pregnant women aged between 20 to 40 years with ASA class II, III. Patients with high-risk pregnancy, antepartum hemorrhage (placenta previa, abruptio placentae) eclampsia or pre-eclampsia, multiple pregnancies and with any cardiovascular co-morbidity were excluded from the study.

On the day of surgery, the abdominal circumference (AC) of all patients was measured at the umbilical level in the supine position. Hemodynamic variables at baseline including heart rate (beats per minute), systolic blood pressure (mmHg), diastolic blood pressure (mmHg) and mean arterial pressure (mmHg) were also recorded. The spinal anesthesia was conducted with the standard technique by an attending anesthesiologist in the operating room. All patients were monitored with standard monitoring with three-lead electrocardiography and pulse oximetry before initiation of spinal anesthesia. Spinal anesthesia was administered in the sitting position using 0.5%hyperbaric bupivacaine (2.5ml) and Fentanyl (25mcg). A 27-gauge Quincke-tip spinal needle was used. During spinal anesthesia total operative time, blood loss, total crystalloids used, urine output, level of sensory and motor block and dose of ephedrine were noted. The Neonatal parameters that were recorded included; APGAR score at 1 and 5 minutes and neonatal weight. The level of spinal anesthesia was assessed by pin prick sensation and the time at which maximum level of sensory block achieved was also noted. The degree of motor block was assessed using Bromage scale. Crystalloid fluids were infused with a co-loading technique (10-20 ml/kg body weight). Fluid management during the perioperative period was titrated by the anesthesiologist. The blood pressure including systolic blood pressure, diastolic blood pressure, mean arterial pressure and heart rate were obtained at baseline and every minute for 10 minutes and after every 5 minutes after spinal anesthesia by non-invasive technique till the end of the procedure. Intravenous ephedrine was titrated to achieve a mean arterial pressure (MAP) of at least 65mmg. The dosage of ephedrine was recorded. Hypotension was defined as a systolic blood pressure of less than 90mmHg or a MAP of less than 65 mmHg.

Stastical Methods

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc. Chicago, Illinois, USA). Continuous variables were expressed as Mean-SD and categorical variables were summarized as frequencies and percentages. Student's independent t-test or Mann-Whitney U-test, whichever feasible, was employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables.

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Multiple logistic regression analysis was employed for determining independent factors associated with significant hypotension. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Comparison of Demographic profile: The demographic characteristics in both the groups exhibited marked similarities and were comparable with respect to mean age and ASA status. The age of the patients in both the groups were comparable, with mean age of 27.1±4.19 in group SAC and 28.5±4.25 in group LAC and the difference was statistically insignificant with the p-value of 0.087. Similarly, patients in both the groups were comparable in their ASA physical status with the p-value of 0.713, which was of no statistical significance (Table 1).

On comparing the mean BMI (kg/m2) of patients in both the groups it was observed that patients in SAC had a mean BMI of 24.57± 2.21 while patients in group LAC had a mean BMI of 28.76± 2.23 and this difference was statistically significant between two groups with the p-value <0.001 (Table 1).

Comparison of hemodynamic parameters: On comparing the base line hemodynamic parameters in both the groups, no significant difference was observed in any of the two groups with the p-value of >0.005 (Table 2). Similarly, there was no significant difference among the hemodynamic parameters during the intra-operative period. Maximum drop in mean SBP in group SAC was 103.47 at 5 min and in group LAC maximum drop in mean SBP at 5min was 102.22. However, this difference was of no statistical significance with a p-value of >0.05 (Fig 1&2).

Also the comparison of intra-operative mean arterial pressure (MAP) between the two groups didn't show any statistical significance (p-value > 0.05). However, the maximum decrease in mean arterial pressure (mmHg) from baseline in group SAC and group LAC was 26.7% and 34.5% respectively, and the difference was statistically significant with p-valve of 0.001 (Table 3).

The percentage decrease in mean arterial pressure in group SAC and group LAC was also statistically significant with p-valve < 0.014 (Table 4).

Hypotension was reported in 68.8% of patients in group SAC while in group LAC 76.9% of patients developed hypotension and the difference was not statistically significant (p-value of > 0.05). Also, the mean dosage requirement of ephedrine in group SAC was 17.5 ±6.87 and 19.6 ±7.06 in group LAC. This was also of no statistical significance (p-value >0.05) (Table 5).

There was no significantly important difference in any of the groups among the block characteristics and other peri-operative parameters like duration of the surgery, blood loss, amount of crystalloids infused and urine output among the two groups and all of these parameters were comparable.

On comparing the neonatal weight (kg) in both the groups it was observed that in group SAC it was an average of 2.75±0.302 and in group LAC it was 3.06 ±0.432 and this difference was statistically significant with p-value < 0.001. However, there was no significant difference in the Apgar score between two groups neither at 1 min nor at 5 mins (p-value > 0.05) (Table 6).

On univariate analysis Abdominal Circumference and Body mass index were found to be significant factors associated with significant hypotension but on multivariate analysis Abdominal Circumference was indirectly associated with significant hypotension (Table 7).

Table 1: Demographic profile of patients of both the groups

Demographic Characteristics	Group SAC	Group LAC	p-value
Age (in years)	27.1±4.19	28.5±4.25	0.087
ASA (II/III)	46/2	49/3	0.713
BMI (kg/m2)	24.57±2.21	28.76±2.23	<0.001*

Table 2: Comparison of base line hemodynamic parameters

Hemodynamic parameter	Group SAC	Group LAC	p-value
Heart rate (bpm)	89.91±10.85	91.04±12.34	0.578
SBP (mmHg)	118.93±14.17	122.15±15.18	0.276
DBP (mmHg)	71.61±10.73	74.87±12.16	0.159
MAP (mmHg)	87.38±12.17	90.63±13.83	0.217

Table 3: Maximum decrease in MAP (mmHg) from baseline in two groups

Group	Mean	95% CI	p-value
Group SAC	26.7±4.15	24.15-28.93	<0.001*
Group LAC	34.5±5.89	31.14-37.84	

Table 4: Stratification by percentage decrease in MAP from baseline in two groups

Percentage decrease in MAP	Group SAC	Group LAC	p-value
<20%	22.9%	9.6%	<0.014*
20%-40%	62.5%	51.9%	
≥40%	14.6%	38.9%	

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Table 5: Incidence of hypotension and ephedrine requirement among two groups

	Group SAC	Group LAC	p-value
Hypotension	68.8%	76.9%.	0.358
Ephedrine dosage (mg)	17.5 ±6.87	19.6 ±7.06	0.126

Table 6: Comparison based on neonatal weight (kg) and APGAR score in two groups

Variable	Group SAC	Group LAC	p-value
Weight in kg (Mean±SD)	2.75±0.302	3.06± 0.432	<0.001*
Weight in kg (95% CI)	2.66-2.84	2.94-3.18	<0.001*
APGAR score at 1min	8.37±1.064	8.39±0.867	0.961
APGAR score at 5min	9.25±0.668	9.32±0.706	0.578

Table 7: Multiple logistic regression analysis of factors associated with significant hypotension after spinal anaesthesia in study patients

Variable	Crude OR(95% CI)	p-value	Adjusted OR (95% CI)	p-value
Larger AC	2.58 (1.73-5.48)	0.013*	4.19(2.97-9.84)	0.005*
Age (years)	1.13 (0.64-1.89)	0.654	1.07 (0.74-1.75)	0.591
BMI (kg/m2)	1.94 (1.19-2.74)	0.047*	1.62 (0.97-2.38)	0.193
ASA Status >II	0.43 (0.21-0.85)	0.891	0.54 (0.29-0.78)	0.715
Baseline HR	0.97 (0.54-1.35)	0.653	0.82 (0.57-1.28)	0.641
Intravenous fluid (per ml)	1.05 (0.71-1.52)	0.578	0.91 (0.63-1.42)	0.619
Blood loss (per ml)	1.21 (0.78-2.19)	0.341	1.14 (0.75-1.97)	0.417

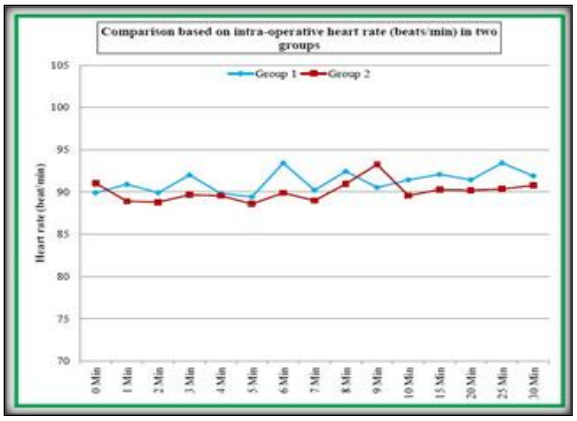
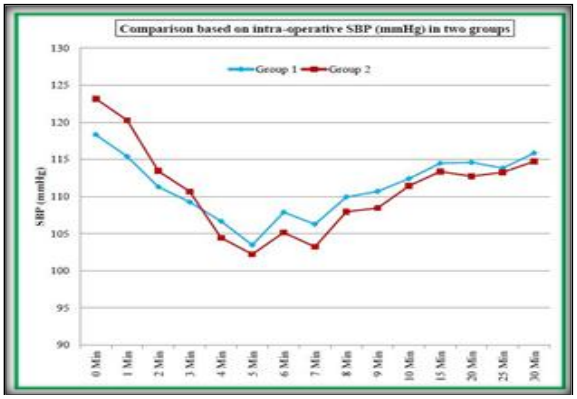


Figure 1 & 2: Comparison of heart rate and SBP in two groups



DISCUSSION

The purpose of this study was to investigate the relationship between maternal Abdominal Circumference and incidence of hypotension following spinal anaesthesia. There are many possible mechanisms for the decline in blood pressure in pregnant women. In a term pregnancy, the enlarged gravid uterus can cause aorto-caval compression leading to decreased venous return and cardiac output when lying supine. During pregnancy, the measurement of abdominal circumference reflects the size of the uterus; thus, the larger the AC, the greater the decline in MAP. Also, parturients with greater AC have less lumbosacral CSF volume owing to greater IVC compression and subsequent greater epidural venous plexus distension. This will cause a higher level of sensory blockade and sympathectomy.[11]

This study was conducted in Obstetric division of Department of Anesthesiology and Critical Care SKIMS to observe the effect of Abdominal Circumference on incidence of hypotension during spinal anesthesia for elective Cesarean delivery. 100 parturients patients scheduled for elective caesarean section under spinal anesthesia were included in the study. Patients were divided into two groups; patients with larger abdominal circumference (LAC group i.e AC≥102cm) and patients with smaller abdominal circumference (SAC group i.e AC<102 cm). Patients were compared with respect to their demographic parameters, BMI, abdominal circumference, hemodynamic variables, vasopressor requirements and on neonatal outcome with regards to neonatal weight and apgar score at 1 min and 5 mins after birth.

The demographic characteristics in both the groups were comparable with respect to mean age and ASA status. The mean age was 27.1±4.19 in group SAC and 28.5±4.25 in group LAC and the difference was statistically insignificant (p-value>0.05) (Table 1). The comparison of BMI (kg/m2) of patients in both the groups was not comparable and had statistically significant difference (p-value <0.001) with the mean BMI of 24.57± 2.21 in SAC group of patients and 28.76± 2.23 in LAC group of patients (Table 1).

The base line hemodynamic parameters in both the groups had no significant difference (Table 2). No significant difference was noted among the hemodynamic parameters during the intra-operative period. Maximum drop in mean SBP in group SAC was 103.47 at 5 min and in group LAC maximum

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drop in mean SBP at 5min was 102.22. However, this difference was also of no statistical significance with a p-value of >0.05 (Fig 1&2). The comparison of intra-operative mean arterial pressure (MAP) between the two groups didn't show any statistical significance (p-value > 0.05). However, the maximum decrease in mean arterial pressure (mmHg) from baseline in group SAC and group LAC was 26.7% and 34.5% respectively, and the difference was statistically significant with p-valve of 0.001 (Table 3). The percentage decrease in mean arterial pressure in SAC and LAC groups were also statistically significant with p-value of < 0.014 (Table 4)

Similar results were found in a study done by Thomard P et al, who in their study describing the relationship between abdominal circumference and incidence of hypotension during Cesarean section under spinal anesthesia, observed that large abdominal circumference in pregnancy was associated with greater decreases in mean arterial pressure (MAP) from baseline. However, the incidence of hypotension defined by standard criteria did not differ between larger and smaller abdominal circumference groups. They had attributed this finding to the preemptive treatment of hypotension after spinal anesthesia before the delivery of the newborn so that any harm to the fetus caused by utero-placental hypoperfusion is avoided.[10] The general practice to give an intravenous fluid bolus or administer a vasopressor early whenever a declining trend of MAP or bradycardia was observed had led to the failure to identify an increased incidence of hypotension in the larger abdominal circumference group. The size of the abdomen do correlates positively with the abdominal pressure and high abdominal pressure has been shown to cause varying degrees of hypotension.[11] Similarly, Anadani et al.[12] also in their study observed that, although there was no relationship between the incidence of hypotension and abdominal circumference during Cesarean section under spinal anesthesia, but the mean arterial pressure in pregnant women with larger abdominal circumference did show a significant decrease from baseline after spinal anesthesia as compared to pregnant women with smaller abdominal circumference. Kuok et al., however did not find any correlation between the incidence of hypotension and abdominal circumference, but their study had a smaller sample size than ours.[13] The possible mechanisms for the more decline in mean arterial pressure in pregnant women with larger ACs as compared to smaller ACs are; firstly, in a term pregnancy, the uterus is large enough to potentially cause aortocaval compression leading to decreased venous return and cardiac output when lying supine.[14] and secondly, parturients with greater abdominal circumference (AC) have less lumbosacral cerebrospinal fluid (CSF) volume owing to greater inferior vena cava (IVC) compression and subsequent greater epidural venous plexus distension. This will cause a higher level of sensory blockade and sympathectomy.[15]

Although the decrease in mean arterial pressure did show a significant change, the incidence of hypotension was not statistically significant (p-value of > 0.05) with 68.8% of patients in group SAC and 76.9% of patients in group LAC were reported to develop hypotension (Table 5). Similar results were observed by Kuok et al, who also in their study observed that there is no correlation between abdominal circumference and the incidence of hypotension[13]. The results are also in concordance with the results of the study done by Thomard P et al, in which also it was reported that there was no relationship between the incidence of hypotension and abdominal circumference during cesarean section under spinal anesthesia[10].The results are also in concordance with study done by Anadani et al., wherein relationship between abdominal circumference and incidence of hypotension during Cesarean section under spinal anesthesia was observed but no significant results were observed.[12]

On univariate analysis Abdominal Circumference and Body mass index were found to be significant factors associated with significant hypotension but on multivariate analysis Abdominal Circumference was indirectly associated with significant hypotension (Table 7).

Ephedrine was the rescue drug to treat hypotensive episodes. The mean dosage requirement of ephedrine in both the groups was comparable and showed no statistical significance (p-value >0.05) (Table 5). In a study done by Ngaka TC et al., who in their study studied the influence of body mass index on sensory motor block and vasopressor requirement during spinal anesthesia for elective Cesarean delivery and reported that there was no statistically significant difference in vasopressor requirement between the groups.[16] Similar results were also in reported in a study done by Elsayed MA et al and didn't observe any significant influence on vasopressor requirement during spinal anesthesia for elective cesarean delivery.[17]

However our results did not correlate with Nani Fs et al 2011 who in their study observed that incidence of hypotension was more in overweight group (BMI >25kg/m2) than eutrophia group (BMI< 25kg/m2) and the use of vasopressors was smaller in the eutrophia group. The contraindication may be explained by dosage of local anesthetic given at the time of spinal anesthesia which is 15mg (3ml) of 0.5% hyperbaric bupivacaine whereas it is 12.5mg (2.5ml) of 0.5% hyperbaric bupivacaine in our study.[18]

The comparison of neonatal weight (in kg) in both the groups was of statistical significance (p-value <0.001). We in our study observed that in patients with smaller abdominal circumference an average weight of neonates was 2.75±0.302 whereas in patients with larger abdominal circumference it was 3.06 ±0.432 and this difference was statistically significant with p-value <0.001. Our study is in

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concordance with Shobeiri F et al who in their study observed that the abdominal circumference and symphysis-fundal height are associated with increased neonatal birth weight.[19]

However, in our study there was no significant difference in the Apgar score between the two groups neither at 1 min nor at 5 mins (p-value > 0.05) (Table 6). Same results were also observed in a study done by with Olang PR et al.[20] and Soxhuku-Isufi A et al.[21] who also did not observed any significant difference in the 1st and five minute Apgar scores between the two groups.

CONCLUSION

Large abdominal circumference in pregnancy is associated with greater decreases in mean arterial pressure from baseline but there is no significant difference in incidence of hypotension between larger and smaller abdominal circumference groups neither does it affects the neonatal outcome.

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