

Effect of Abdominal Circumference and Fetal Weight on Supine Hypotension during C-Section under Spinal Anesthesia

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Abstract

Background: Spinal anesthesia is the safest and most popular technique used for cesarean section worldwide. Certain maternal and fetal conditions such as increased maternal abdominal circumference and fetal weight can have profound effect on degree of hypotension cause by Spinal anesthesia. The study aims to determine the occurrence of spinal hypotension in relation to abdominal circumference and fetal weight.

Objective: To assess the relationship between term parturient's abdominal circumference and the fetal weight with the occurrence of hypotension during cesarean delivery with spinal anesthesia.

Study type, settings & duration: This prospective observational study conducted at Department of Anesthesiology, Dr. Ruth K. M. Pfau Civil Hospital, Karachi from February to June 2022.

Methodology: Total 116 terms parturient at 37 weeks or greater were enrolled after taking consent. The patient's height and abdominal circumference in centimeters was measured using a measuring tape while weight was measured using a digital weighing scale. Two groups of patients were made according to the abdominal circumference. Baseline readings were taken of pulse, blood pressure and mean arterial pressure prior to the surgery. Patients were preloaded using crystalloids and then intra-theal bupivacaine was administered, following the administration of spinal anesthesia mean arterial pressure, heart rate and blood pressure were recorded every three minutes till the delivery of the baby.

Results: Total 39 patients out of 116 developed hypotension. Out of these 39 patients 31 had an abdominal circumference of more than 101 cm. This indicates that large AC has linear relationship with the degree of hypotension and it was not found to be related to increased fetal weight.

Conclusion: There was no relation found between fetal weight and the occurrence of hypotension, however, the larger abdominal circumference to be more likely to develop a greater degree of hypotension following spinal anesthesia in term parturient.

Key words: Abdominal circumference, cesarean section, supine hypotension, spinal anesthesia.

Introduction

Cesarean section is frequently performed surgical procedure in situations where vaginal delivery is not feasible or poses risks to either the mother or the baby. The commonest mode of anesthesia for cesarean delivery is spinal anesthesia, which is thought to be associated with a greater degree of hypotension when higher levels of the block are achieved.¹ More hypotension is observed with a sensory blockade above T4/T5.² Bupivacaine is one of the regularly used intra-theal local anesthetic for cesarean deliveries.³

The incidence of hypotension following spinal anesthesia can vary between 55-90%. Certain factors like an enlarged uterus can elevate

pressure on the vena cava and aorta, leading to decreased venous return and reduced cardiac

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Authors Contribution

HA & FS conceptualized the project. HA & ZB did the data collection. HA, ZB, SR & AP did the literature search. ZB, SR & AP performed the statistical analysis. Drafting, revision & writing of manuscript were done by HA, ZB, SR & FS.

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output, it is also associated with a more cephalad blockade leading to more hypotension^{4,5} Supine hypotension poses a significant risk to both mother and the fetus, potentially resulting in maternal discomfort, nausea, vomiting, dyspnea and fetal distress.⁶

The role of certain patient characteristics including height, weight, and BMI are well established for the likelihood of cephalad spread of local anesthetics,⁷ while studies have been done to establish link between degree of hypotension observed, level of sensory blockade achieved, and use of vasopressors to factors like size of uterus, abdominal girth, and abdominal pressure.⁸ Abdominal girth and vertebral column length are thought to have high predictive values for the spinal spread and can help anticipate the spread of spinal anesthesia.⁹ understanding the relationship between abdominal circumference, fetal weight, and the occurrence of supine hypotension during cesarean section under spinal anesthesia is crucial for optimizing patient care and reducing the risk of complications. So, our rationale was to evaluate the relation between the abdominal circumference of the term parturient and the fetal weight with the incidence of hypotension they develop during cesarean delivery under spinal anesthesia. Identification of these factors among at risk population will result in better management of such patients in low resource settings like ours.

Methodology

This prospective observational study was carried out at the Department of Anesthesiology, Dr. Ruth K. M. Pfau Civil Hospital's, Karachi, from February to June 2022. After taking the written informed consent, 116 term parturients at 37 or greater weeks of gestation belonging to ASA classification II, having ages between 15-45 yrs., with a singleton pregnancy, and with a height of more than 5 ft. were included, while those coming with comorbidities (diabetes mellitus, pregnancy-induced hypertension, severe pre-eclampsia, eclampsia, multiple pregnancies, oligo or polyhydramnios, antepartum or postpartum hemorrhage, vertebral anomalies, who were morbidly obese or who had failed spinal were excluded.

On the day of surgery, measurements were taken of the patient's height and abdominal circumference in supine position (at the umbilicus level) using a measuring tape in centimeters, and weight was measured using a digital weighing scale by a single operator throughout the study. The patients were divided into smaller (less than/equal to 101 cm) and greater (more than 101 cm)

abdominal circumference groups. Standard monitors including a noninvasive blood pressure monitoring cuff, pulse oximeter, and three lead ECGs were applied, and baseline readings were noted. Two wide bore IV cannulas were taken, and patients were pre-loaded using crystalloids at a rate of 10-15 ml/kg. After pre-loading patients were made to sit and L4/L5 vertebral space was identified. The skin was first infiltrated using Inj. Lidocaine 2% plain 2 mL and then Inj. Bupivacaine 0.5% heavy 12 mg was delivered intrathecally using 25 G spinal needle- Quincke type. The patient was then placed supine after the procedure and pillows; one below the head and one below the feet were placed but left uterine displacement was not performed. Surgery was carried out after assessing sensory block up to T4 level and pulse, blood pressure, and mean arterial pressure (MAP) readings were recorded every three minutes till the birth of the baby using OMNI 3 monitors. The weight of the baby born was documented in kilograms. Severe hypotension encountered during the procedure was treated using Inj. Phenylephrine in aliquots of 50 micrograms or Inj. Adrenaline in aliquots of 10 micrograms as needed. Hypotension was defined in the study as a MAP of less than 65mmHg or a systolic blood pressure of less than 90mmHg, and significant hypotension as a 40% fall in MAP from baseline.¹

The main goal of this study was to establish a correlation between fetal weight and abdominal circumference and likelihood of hypotension during spinal anesthesia.

Statistical Package for Social Sciences version 20 was used for data analysis. Descriptive variables including age, height, weight, BMI, and hemodynamic parameters were presented in terms of mean and standard deviation. Percentages and frequency were computed for age groups, BMI categories, birth weight groups, hypotension, and abdominal circumference. ANOVA for hemodynamic parameters at different times in points, T-test for comparison of quantitative variables like hypotension and abdominal circumference was used and chi-square test was applied for categorical variables. A *p*-value of less than 0.05 was taken as significant.

The ethical approval was obtained from the Institutional Review Board of Dow University of Health Sciences, Karachi vide letter no. IRB-1854/DUHS/Approval/2020/720.

Results

A total of 116 pregnant women were included in the study. Out of these patients, 55 patients (47.4%) had abdominal circumference $\leq$ 101 cm, while the

Table 1: No. of patients in each group.

Study variables		Abdominal Circumference	
		≤101 cm	> 101 cm
Age groups	≤25 years	22 (40%)	22 (36.1%)
	>25 years	33 (60%)	39 (63.9%)
Total		55 (100%)	61 (100%)

Table 2: Descriptive statistics of study variables. (n=116)

Study Variables	Minimum	Maximum	Mean	Std. Deviation
Age(in years)	16	40	27.33	4.94
Weight(in kg)	46	110	74.74	13.80
Height (in cm)	120	177	158.87	6.79
BMI	18.7	39	29.48	4.58
Baby Weight	1.5	4.7	2.88	0.49

remaining 61 patients (52.6%) had an AC of >101 cm (Table-1).

The mean age of these women was 27.33 ± 4.94 y, the mean BMI was 29.48 ± 4.58 kg/m², and the average fetal weight was 2.88 ± 0.49 kg (Table-2).

Table-3 demonstrates comparison of hemodynamic parameters at baseline, immediately after administration of spinal and thereafter at every third minute till the delivery of the baby showed

significant differences in SBP, DBP, and MAP (*p*-value 0.05).

Fetal birth weight had no effect on the incidence of hypotension in term parturient, while larger abdominal circumference proved to have a significant impact on the development of hypotension in these patients (Table-4).

Thirty nine patients (33.6%) out of a total 116, and 31 (50.8%) out of 61 having large abdominal circumference developed hypotension. Maternal weight and BMI had significant differences between the hypotensive and non-hypotensive groups having *p*-values of 0.001 and 0.003 respectively.

Discussion

In this study, we tried to establish the association between the hypotension caused during cesarean delivery with maternal abdominal circumference and the weight of the fetus. Spinal anesthesia is considered to be a safe practice modality for patients undergoing cesarean delivery, because it offers better pain control and fewer chances of complications commonly associated with general anesthesia.¹⁰ We labeled hypotension as having a systolic blood pressure under 90 mmHg

Table 3: Descriptive statistics and comparison of study outcomes.

Time Intervals	Parameters			
	Heart Rate	SBP	DBP	MAP
Baseline	101.4+/-16.2	115.4+/-9.3	78.2+/-10.4	92.3+/-11.6
Soon after spinal	103.4+/-18.5	110.9+/-15.6	66.5+/-14.7	80.2+/-15
After 3 minute	99.7+/-15.6	106.9+/-15.2	69.6+/-67.7	77.3+/-13.2
After 6 minute	94.7+/-14.5	106.4+/-13.7	62.7+/-12	76.5+/-10.4
After 9 minute	96.5+/-16.4	109.2+/-13.4	63.8+/-12.5	77.8+/-10.5
After 12 minute	98+/-16.2	107.1+/-14.4	63.4/-13.3	78.8+/-13.1
After 15 minute	93.0+/-12.5	105.8+/-18.7	60.3+/-12.1	75.0+/-11.5
After 18 minute	106.4+/-7.7	120.2+/-14.9	61.2+/-11.9	77.6+/-12.1
<i>p</i> -values (Overall)	0.524**	0.018*	0.025*	0.016*

Repeated measure ANOVA test applied; Significance level<0.05. Mean+/-SD; * = Significant; ** = Non-significant

Table 4: Association of fetal weight and abdominal circumference with hypotension.

Study variables		Hypotension		Total	<i>p</i> -value
		Yes	No		
Birth weight	Low	5 (12.8%)	13 (16.9%)	18 (15.5%)	0.121**
	Normal	32 (82.1%)	64 (83.1%)	96 (82.8%)	
	Macrosomia	2 (5.1%)	0 (0%)	2 (1.7%)	
Abdominal Circumference	≤101 cm	8 (20.5%)	47 (61%)	55 (47.4%)	0.000*
	> 101 cm	31 (79.5%)	30 (39%)	61 (52.6%)	
Total		39 (100%)	77 (100%)	116 (100%)	

Chi-square test and t-test were applied. Significance level<0.05; * = Significant; ** = Non-significant

and a mean arterial pressure of 65 mmHg. Hypotension caused is prevented and treated using various modalities, including use of vasopressors, fluid preloading and co-loading, and different positioning.¹¹ According to W Chen et al. risk factors for the developing of hypotension in this population included the Weight gain during pregnancy, postpartum BMI, gestational exercise history, and dermatome analgesia level.¹²

The weight of the fetus exerts more pressure on the major vessels in abdomen which can lead to decrease venous return ultimately causing hypotension in pregnancy. We tried to find a relation between the incidence of hypotension and fetal weight, and observed that the weight of the fetuses was around 2.88 $\pm$ 0.49 kg in our population, which was not associated with hypotension. This result is consistent with the research done by Sushma KS et al., who tried to establish the link between the level of blockade achieved and the weight of the fetus after spinal anesthesia which can lead to hypotension.¹³

Kuok et al. in his study found that a larger abdominal circumference was associated with a higher level of sensory blockade at 5th minute after spinal anesthesia, and abdominal circumference predicts a simple way to predict the extent of spinal anesthesia.⁴ In our study, we found a positive relation between a larger abdominal circumference and spinal hypotension.

Song et al. studied impact of various anthropometric measurements on spinal hypotension and revealed that except height, body weight, abdominal circumference and body mass index were associated with developing hypotension ($p < 0.05$).¹⁴ Our study also established a positive association between BMI and spinal hypotension with a p value of 0.049. However, we enrolled 116 patients in our study while Song has only 55 participants in the study. Moreover, they defined hypotension as blood pressure that falls below 80% of baseline value.

The factors found to be associated with the development of hypotension in our study should be identified in all the obstetric patients. Abdominal circumference is relatively easy non-invasive and non-operator dependent modality which can help anesthesiologists prepare to encounter hypotension as a result of spinal block. Thus, a low dosage local anesthesia can be used to prevent this from happening.¹⁵

Data was collected from the elective and emergency gynecology and obstetrics theatres of Dr. Ruth K. M. Pfau, Civil Hospital, Karachi only, so this population cannot be representative of all the

term parturient. Moreover, the study was not blinded. We could not find any local data regarding the topic as well.

There was no relation found between fetal weight and the occurrence of hypotension, however, the larger abdominal circumference was found to be related with a greater degree of hypotension during spinal anesthesia in term pregnant women.

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Conflict of interest: None declared.

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