e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2023; 13(1); 195-202

Original Research Article

Relationship between Abdominal Circumference and Incidence of Hypotension During Cesarean Section Under Spinal Anesthesia in Rural Northern Indian Females

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Received: 30-12-2022 / Revised: 19-01-2023 / Accepted: 29-01-2023

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Conflict of interest: Nil

Abstract

Background and Aim: Enlarged uterus can compress the inferior vena cava and cause hypotension when lying supine. Previous studies have shown have a positive association between the abdominal circumference and size of the uterus during pregnancy. The aim of this study was to evaluate the relationship between abdominal circumference and incidence of hypotension during cesarean section under spinal anesthesia.

Methods: The study cohort comprised women undergoing cesarean section under spinal anesthesia. Patients were divided into two groups according to them median abdominal circumference (<101cm and ≥ 101cm). Hypotension was defined as a systolic blood pressure of <90mm Hg or mean arterial pressure of <65mm Hg. The primary outcome of this study was the relationship between the incidence of hypotension and the abdominal circumference after spinal anesthesia in term pregnant women in rural northern Indian females.

Results: The study cohort comprised 50 pregnant women. The incidence of hypotension was noted in both the groups at T1 (80.83±17.27 in the smaller vs 67.35±13.98 in the large abdominal circumference group, P=0.004). However, the decrease in mean arterial pressure and its percentage decrease from baseline were greater in the larger than in the smaller abdominal circumference group (change in mean arterial pressure 8.6mnHg (3.63-12.32mmHg) in the smaller vs 20.27mmHg (4.82-23.45 mmHg) in the larger abdominal circumference group, p=0.011 percentage decrease :8.01% (3.38-11.47%) in the smaller vs 18.40%. (4.38-21.29%) in the larger abdominal circumference group, p=0.049.

Conclusions: Large abdominal circumference in pregnancy is associated with greater decrease in mean arterial pressure from baseline. However, the incidence of hypotension defined by standard criteria did not differ between larger and smaller abdominal circumference groups.

Keywords: Abdominal Circumference, Pregnant Women, Mean Arterial Pressure.

Introduction

One of the most frequently used anesthetic method is spinal anesthesia along with general anesthesia. This main reason of preference of spinal over general anesthesia is fewer airway-related complications, as compared to general anesthesia, the fetus is not exposed to anesthetic, and mother can remember the experience and helpful in managing pain after surgery.[1]

Higher incidence of hypotension is seen in pregnant women after spinal anesthesia when the sensory block level is ≥ T_5 or T [2].

An increase in the maternal abdominal circumference during pregnancy which correlates with the intraabdominal volume is seen mainly due to size of growing fetus, volume of amniotic fluid and size of the uterus. In supine position the gravid uterus contributes to compressive effect on the inferior vena cava (IVC), diverting blood into the vertebral venous system and displacing the lumbosacral cerebrospinal fluid in a cranial direction, which causes enhanced cephalad spread of local intrathecal anesthetic. [3,4,5].

Thus, the incidence of hypotension may be greater in pregnant women with larger uteri than those with smaller uteri.

In previous studies we have seen that increased abdominal circumference is associated with increased abdominal pressure and enlarged uterus, which is related to increased incidence of hypotension after spinal anesthesia. The aim of this study was to evaluate the relationship between the abdominal circumference and incidence of hypotension during cesarean section under spinal anesthesia in pregnant ladies in a rural population of a developing country.

Materials and Methods:

This prospective observational study was conducted at sub district hospital Nowshera from August to December 2022. Written consent was obtained from all the participants of the study after explaining the anesthetic procedure to be conducted during study to the patients in local language.

Inclusion criteria

1. Term pregnant women between the age group of 15-45 years.
2. Patients having physical status2-3 (American society of Anesthesiologists criteria) posted for cesarean section under spinal anesthesia.

Exclusion Criteria

3. High-risk pregnancy, like placenta previa, abruption placentae.
4. Eclampsia or pre-eclampsia.
5. Multiple pregnancy
6. Cardiovascular comorbidities

Abdominal circumference of all patients was measured at the umbilical level in supine position by one operator throughout the study. Patients were given spinal anesthesia with the standard technique. All patients were monitored with standard monitoring, which included automatic non-invasive blood pressure monitoring, three lead electrocardiography and pulse oximetry in the operating room. Spinal anesthesia was administered in the lateral position by using 0.5% hyperbaric bupivacaine.

A 27-gauge quincke-tip spinal needle was used. The level was assessed by pinprick sensation. The operative table was adjusted to achieve T_4 level of spinal anesthesia patients were preloaded with (500 ml of crystalloid fluid, the blood pressure, mean arterial pressure and heart rate was obtained at baseline and every minute for 10 minutes after spinal anesthesia by non-invasive technique. The intravenous me phentermine was titrated to achieve a mean arterial pressure (MAP) of at least 65 mmHg. In this study hypotension was labelled as systolic blood pressure of less than 90mmHg or MAP of less than 65mmHg. Significant hypotension was defined as 40% decreases in MAP from baseline [6].

In this study, we analyzed the relationship between the incidence of hypotension and abdominal circumference in term pregnant women after spinal anesthesia. Patients were divided into smaller abdominal circumference groups (smaller Ac group with abdominal circumference less than 101and larger abdominal circumference group (larger Ac) with Ac more than 101cm using median value of Ac in this study.

Statistical Analysis

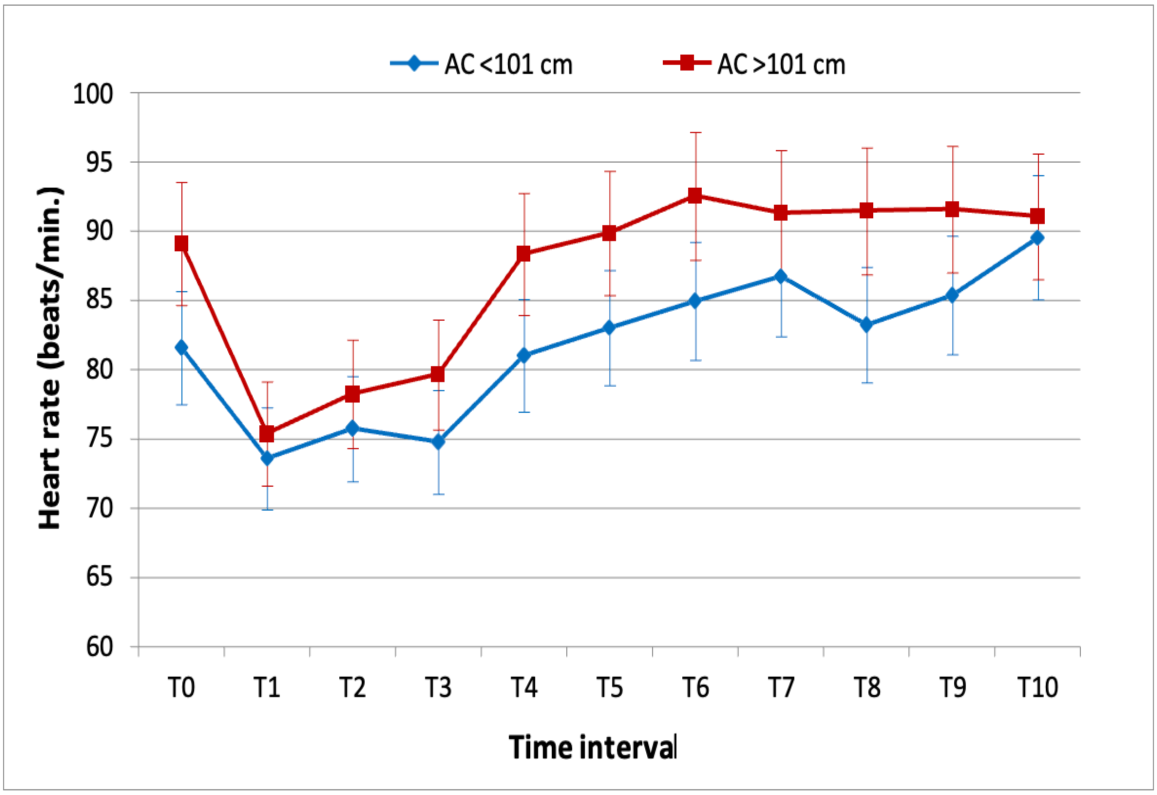
Data obtained from the study was analyzed using the software Statistical Package for Social Sciences (SPSS, version 21.0) and MedCalc version 20.116 χ^2 = Chi-square test was used to compare categorical variables and Fishers t-test and One way ANOVA were used when quantitative variables were compared. Statistical significance was considered when P<0.05.

Table 1: Group comparison for patient's characteristics

Variables	**Mean ± Standard Deviation**		**p-value**
	AC <101 cm (n=25)	**AC >101 cm (n=25)**	
Age (years)	26.80 ± 3.21	27.44 ± 2.95	0.467
Hemodynamic variables at baseline			
SBP (mmHg)	129.20 ± 14.42	123.16 ± 12.31	**0.118**
DBP (mmHg)	76.24 ± 7.51	74.20 ± 5.95	**0.293**
MAP (mmHg)	93.15 ± 8.59	90.80 ± 7.64	**0.311**
Heart rate (beats/min.)	81.60 ± 11.22	89.12 ± 8.51	**0.011**

Table 2: Heart rate

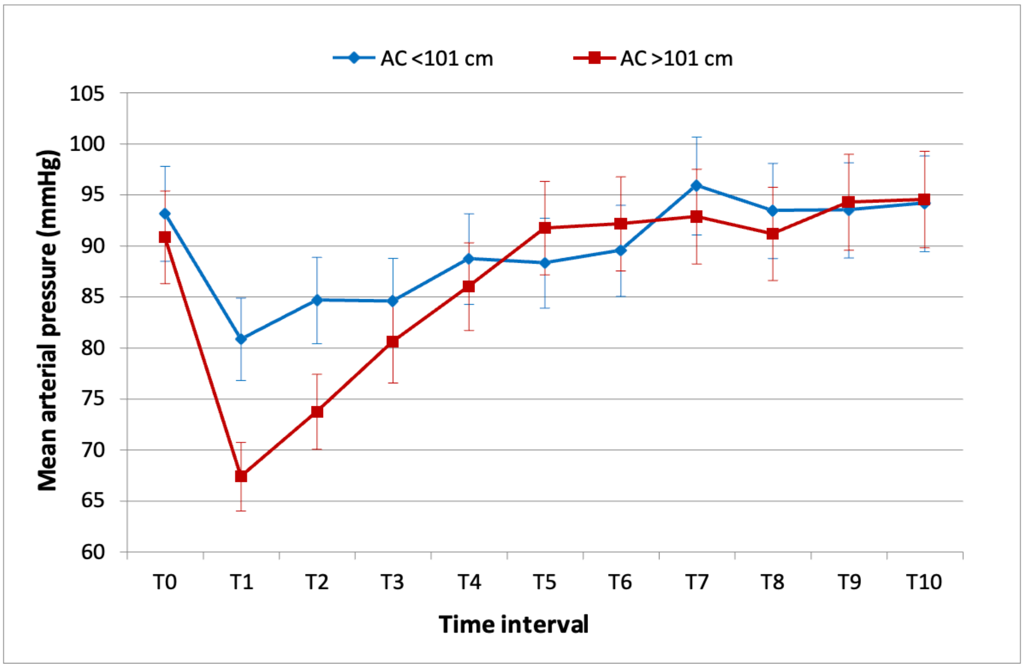
Time interval	**Mean ± Standard Deviation**		**p-value**
	AC <101 cm (n=25)	**AC >101 cm (n=25)**	
T0	81.60 ± 11.22	89.12 ± 8.51	0.011
T1	73.60 ± 11.44	75.36 ± 12.35	0.604
T2	75.76 ± 10.69	78.24 ± 6.31	0.323
T3	74.80 ± 12.33	79.64 ± 6.32	0.087
T4	81.04 ± 10.80	88.36 ± 9.55	0.014
T5	83.04 ± 10.39	89.88 ± 7.28	0.010
T6	84.96 ± 13.00	92.56 ± 5.58	0.010
T7	91.32 ± 12.78	86.76 ± 10.59	0.176
T8	91.48 ± 8.91	83.24 ± 6.58	0.001
T9	91.60 ± 9.31	85.40 ± 6.90	0.010
T10	91.08 ± 7.24	89.56 ± 5.59	0.410



Graph 1: Heart rate

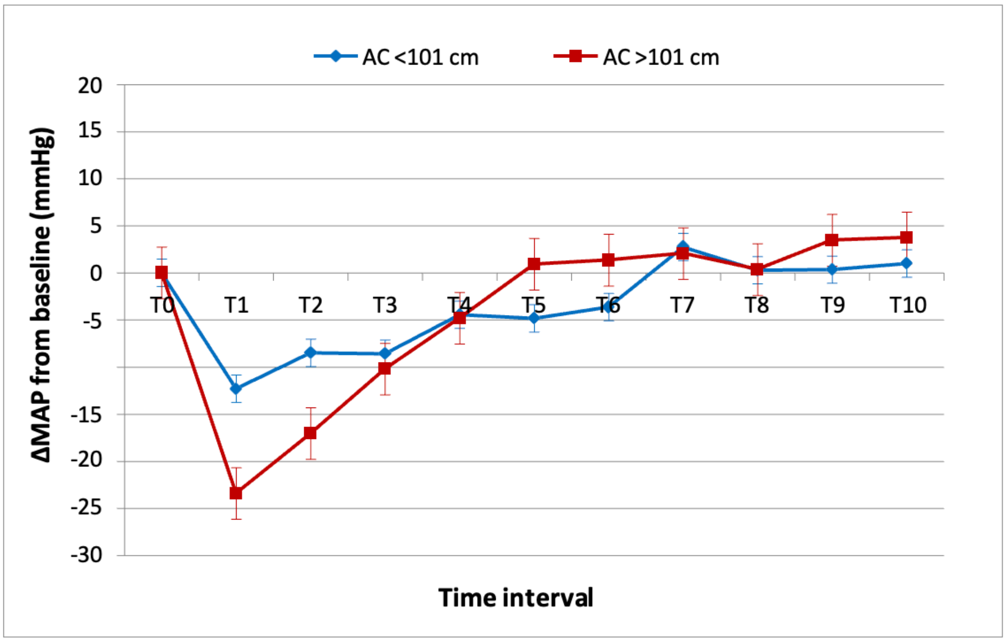
Table 3: MAP

Time interval	Mean ± Standard Deviation		p-value
	AC <101 cm (n=25)	**AC >101 cm (n=25)**	
T0	93.15 ± 8.59	90.80 ± 7.64	0.311
T1	80.83 ± 17.27	67.35 ± 13.98	0.004
T2	84.65 ± 9.85	73.71 ± 11.53	0.001
T3	84.55 ± 5.08	80.56 ± 9.13	0.062
T4	88.70 ± 3.55	85.98 ± 8.90	0.163
T5	88.30 ± 4.50	91.70 ± 5.81	0.025
T6	89.52 ± 5.23	92.14 ± 7.87	0.171
T7	95.88 ± 3.56	92.84 ± 9.26	0.131
T8	93.42 ± 5.47	91.15 ± 4.26	0.108
T9	93.49 ± 8.06	94.26 ± 4.79	0.686
T10	94.14 ± 6.57	94.52 ± 6.00	0.834



Graph 2: MAP

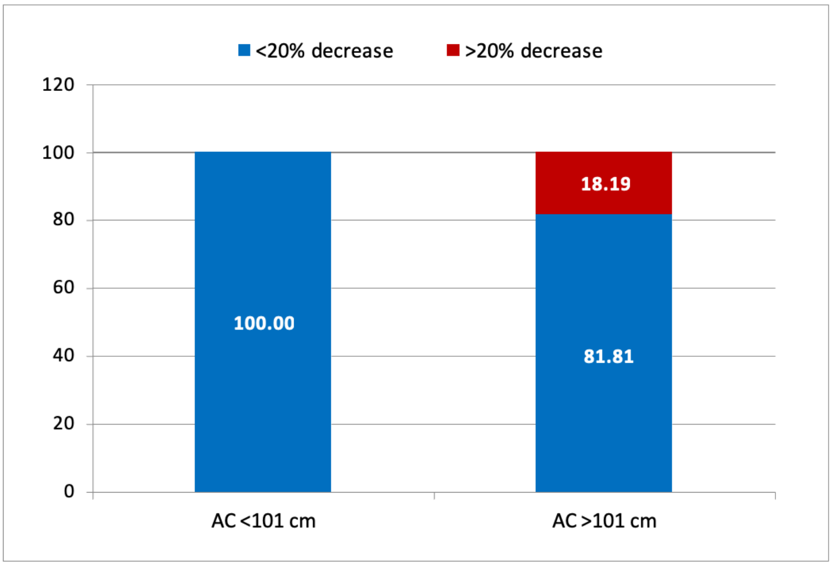
Table 3: ΔMAP from baseline (mmHg)



Graph 3: MAP from baseline

Table 4:

Variables	AC <101 cm (n=25)	AC >101 cm (n=25)	p-value
Maximal MAP decrease from baseline (mmHg)	8.6 (3.63-12.32)	20.27 (4.82-23.45)	0.011
Maximal MAP percentage decrease from baseline (percent)	8.01 (3.38-11.47)	18.40 (4.38-21.29)	0.049



Graph 4: Stratification by percentage decrease in mean arterial pressure

Data obtained from the study was analyzed using the software Statistical Package for Social Sciences (SPSS, version 21.0) and MedCalc version 20.116, χ^2 = Chi-square test was used to compare categorical variables and Fishers t-test and One way ANOVA were used when quantitative variables were compared. Statistical significance was considered when P<0.05.
The study cohort comprised 50 pregnant women, the median of abdominal circumference was 101 cm. a total 25 cases were in the smaller abdominal circumference group and 25 cases were in the larger AC group. When analyzing the hemodynamic changes from baseline (To) and over the following 10 minutes at one-minute interval after spinal anesthesia (T1, T2, T3, T4, T5…. T10) MAP was significantly different between the large abdominal circumference group and the smaller abdominal circumference group at (T1, T2, T5). There was a statistically significant effect on the decrease in MAP from baseline between the larger AC group at (T1, T2) as compared to smaller AC group. The heart rate at T8 show fall in rate for greater circumference and increase in heart rate for circumference less than 101, which is found to be statistically significant.

The overall incidence of hypotension did not differ between groups, however, the maximal decrease in MAP after spinal anesthesia from baseline i.e. (20.27) was higher in abdominal circumference more than 101 as compared to AC < 101 (8.6).

The incidence of significant hypotension seen in stratification by percentage in mean arterial pressure(□MAP) is that of more than 20% from base line was higher in larger AC group (18.40%) as compared to smaller AC group (8.01%), p=0.011. percentage decrease: 8.01% (3.38-11.47%) in the smaller vs 18.40%. (4.38-21.29%) in the larger abdominal circumference group, p=0.049.

Discussion

In this study, we demonstrated that the incidence of hypotension defined by standard criteria (MAP < 65mmHg or SBP < 90mmHg) after spinal anesthesia did not differ between pregnant women with larger and smaller abdominal circumferences. However, in the larger AC group, the MAP decreased significantly from baseline.

There are many possible mechanisms for the more decline in MAP in pregnant women with larger ACs firstly, in a term pregnancy, uterus is large enough to cause potential aortocaval compression which may lead to decreased venous return and cardiac output while lying supine. In pregnancy, the AC reflects the size of the uterus, larger the AC, greater the decline in MAP. Previous study supporting the fall in MAP states that compression of the inferior vena cava by an enlarged uterus results in engorgement of the epidural venous plexuses, leading to decrease in cerebrospinal fluid volume and narrowing the intrathecal space resulting in cephalad spreading of spinal anesthesia and consequently resulting in hypotension (Igarashi T et al 2000) (Takiguchi T et al 2006).[7,8]

In our study, we did not investigate the effect of the level of spinal anesthesia with large AC because the aim was to maintain the level of spinal anesthesia atT4.

Study done by (Kuoketal) found a correlation between the A Cand sensory block level (right side P=0.43, P=0.005; left side P=0.46, P=0.003). The AC from Kuok study was 98.4 ± 6.8cm, whereas in our study it was slightly larger than 101 cm. [9]

Results of this study are consistent with study done by (Thomard Petal 2020) who concluded that large abdominal circumference in pregnancy is associated with greater decrease in mean arterial pressure from baseline. However, he also included parameter like body mass index and systolic BP, diastolic BP, intravenous fluid (per ml) and blood loss (per ml) which has given a better control of hypotension. We can also include such variables for future study along with a study group with more population and including population from different geographical regions.[10]

Similarly (Anadani BH et al 2021) also concluded that there was no significant difference in incidence of hypotension between larger and smaller abdominal circumference groups and there is greater decrease in mean arterial pressure from baseline in large abdominal circumference.[11]

(Parthasarathy P et al 2019) has also commented that AG has a positive correlation with the incidence of hypotension, and he also mentioned that SFH has a significant positive correlation with the incidence of hypotension showing that height of trunk of patient can also has an effect on results [12].

The size of the abdomen correlates positively with the abdominal pressure [13] high abdominal pressure has been shown to cause high spinal anesthesia and hypotension.[14] In this study, we did not measure the abdominal pressure. Thus, we conclude that the decrease in MAP in our study resulted from large ACs which might be the result of enlarged uteri causing aortocaval compression or increased intraabdominal pressure. The limitation of this study was the smaller study group, lack of anthropometry of patients, (trunk length) lack of abdominal pressure data which could explain the mechanism causing hypotension in larger abdominal circumference in a better way.[15]

Thus, we recommend anesthesiologist to include AC as an important parameter along with other vital to deal with hypotensive events after spinal anesthesia, and it can also help them in labelling patients in advance who are at risk for such complications, so they could be treated with early and aggressive treatment to avoid such complications [16].

Conclusion

There was no relationship between incidence of hypotension and abdominal circumference during caesarian section under spinal anesthesia. However, MAP in pregnant women with larger abdominal circumference significantly decreased from baseline after spinal anesthesia

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