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Original Research Article

Association between Abdominal Circumference and Incidence of Hypotension Following Spinal Anaesthesia in Elective Caesarean Sections: A Prospective Observational Study

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Abstract:

Background: Spinal anaesthesia is the preferred technique for elective caesarean sections due to reduced maternal risks compared to general anaesthesia. However, it often leads to hypotension resulting from sympathetic blockade, which can adversely affect both mother and fetus. Identifying predictors of hypotension is crucial for improving maternal safety. This study aimed to evaluate the association between AC (Abdominal Circumference) and the incidence of hypotension following spinal anaesthesia.

Methods: A prospective observational study was conducted in the Department of Anaesthesiology, Government Medical College, Thrissur, after obtaining ethical approval. A total of 240 patients undergoing elective caesarean sections under spinal anaesthesia were enrolled using convenient sampling. Patients were grouped based on abdominal circumference (larger AC vs. smaller AC). Baseline parameters, including height, weight, and AC were recorded. MAP (Mean Arterial Pressure) was monitored at 1-, 5-, and 10-minutes post spinal anaesthesia. The incidence of hypotension, sensory blockade levels, and vasopressor use were also documented. Data were analysed using SPSS version 22.

Results: The overall incidence of hypotension was 37.9%. Patients with larger AC had a significantly greater fall in MAP at 1-, 5-, and 10-minutes post spinal anaesthesia ($p < 0.05$). A significant association was also found between larger AC and the occurrence of hypotensive symptoms, higher sensory blockade levels, and increased vasopressor requirements.

Conclusion: Abdominal circumference is significantly associated with post-spinal hypotension and can serve as a useful preoperative screening tool to predict the risk of hypotension in patients undergoing spinal anaesthesia for caesarean section.

Keywords: Abdominal Circumference, Spinal Anaesthesia, Caesarean Section, Hypotension, Mean Arterial Pressure, Vasopressors.

Introduction

Spinal anaesthesia is the preferred technique for caesarean sections due to its rapid onset, effective sensory and motor blockade, and minimal fetal effects.[1] It avoids maternal complications associated with general anaesthesia, such as aspiration and airway management difficulties.[1] However, a major limitation of spinal anaesthesia is hypotension caused by sympathetic blockade, which can negatively affect both mother and fetus.[2,3]

Hypotension may lead to reduced uteroplacental perfusion, fetal hypoxia, acidosis, and maternal symptoms like nausea, vomiting, and altered consciousness.[1] Its incidence in obstetric patients ranges from 20–100%, significantly higher than the 15–33% seen in the general population.[3] This is due to several pregnancy-induced physiological changes that enhance the effect of local anaesthetics.[4,5] Despite fluid preloading or co-loading, spinal hypotension remains prevalent in up to 80% of parturients.[4]

Vasopressors, particularly sympathomimetic agents like ephedrine, are more effective than fluids in managing spinal-induced hypotension.[6] Supine hypotensive syndrome-caused by a gravid uterus compressing major vessels-also contributes to hypotension in pregnant women.[3]

Various factors, including height, weight, BMI, and fetal weight, may influence the spread of spinal block, though their roles remain debated. [7,8] Obesity, a growing global concern, adds complexity to obstetric anaesthesia due to altered physiology, increased comorbidities, and anatomical challenges.[9] It also increases the risk of prenatal complications and adverse anaesthetic outcomes.

Maternal hypotension can result in serious fetal complications, including low APGAR scores, delayed respiration, prolonged acidosis, poor breastfeeding reflexes, and long-term neurological damage. [10-13] Therefore, identifying predictors of hypotension is critical to improving outcomes.

Studies suggest that larger AC (Abdominal Circumference) correlates with increased intra-abdominal pressure and higher sensory block levels, both of which are associated with a higher risk of hypotension in obstetric patients.[12] This study explores the role of AC as a predictor of post-spinal hypotension in caesarean sections.

Aims and Objectives

This study aims to investigate the relationship between abdominal circumference and the incidence of post-spinal hypotension, a potentially life-threatening complication. Specifically, the objectives are to compare the fall in MAP (Mean Arterial Pressure) from baseline between groups with larger and smaller abdominal circumferences following spinal anesthesia and to assess the occurrence of symptoms associated with severe hypotension in these two groups.

Materials and Methods

Study Design: After obtaining clearance from the Institutional Ethical Committee and informed written consent from participants, a prospective observational study titled "Association between Abdominal Circumference and Post-Spinal Hypotension in Patients Undergoing Caesarean Section under Subarachnoid Block" was conducted over a period of one year. The study was carried out in the elective obstetric operation theatre of the Department of Anesthesiology, Government Medical College, Thrissur. A total of 240 patients scheduled for elective caesarean section under lumbar subarachnoid block were recruited for the study.

Inclusion and Exclusion Criteria: The study included pregnant women aged 18 to 35 years, classified as ASA physical status II, who were scheduled for elective caesarean section and provided written informed consent. Patients were excluded if they were unwilling to give consent, had overt or gestational hypertension, had absolute contraindications to spinal anesthesia, or had other co-morbid conditions such as diabetes.

Sample Size Calculation

Sample size was calculated using the formula

$$N = (Z\alpha + Z\beta)^2 (S_1^2 + S_2^2) / d^2$$

According to a study conducted in Surat by Hiren B. Andani, Malti J. Pandya and Divyang V. Shah using MAP.[3]

S_1- SD of group 1 (larger AC group) = 11.84 S_2-SD of group 2 (smaller AC group) = 10.25 $Z\alpha$- 1.96

$Z\beta$- 0.84

d_1-Mean difference between SD of group 1 = 88.25
d_2 - Mean difference between SD of group 2 = 92.3
n = 7.84 x (140.19 + 105.06) / 16.65 = 116.

Sample size: 120 in each group

Total: 240.

Data Collection Tools: Data were collected using a structured proforma designed to record socio-demographic and clinical details such as age, height, weight, abdominal circumference, and BMI. Blood pressure measurements were systematically documented at specific time intervals-5, 10, 15, 30, 45, and 60 minutes following the administration of spinal anesthesia. A standard measuring tape was used to measure abdominal circumference at the level of the umbilicus in the supine position. All clinical and physiological data were obtained and recorded consistently by the investigators using standardized tools and techniques.

Data Collection Procedure: After obtaining Institutional Ethical Committee approval and informed written consent, 240 ASA class II parturients aged 18–35 years, weighing between 55–65 kg and with a height between 150–160 cm, scheduled for elective caesarean section under spinal anesthesia were enrolled in this prospective observational study conducted at Government Medical College, Thrissur. Each participant underwent a thorough pre-anesthetic evaluation, including medical history, physical examination, and relevant lab investigations. Patients were kept nil per oral (NPO) for 8 hours for solids and 2 hours for clear fluids and were premedicated with T. Ranitidine 150 mg and T. Metoclopramide 10 mg. Abdominal circumference was measured in the operating room by the same investigator prior to anesthesia. Patients were divided into two groups based on abdominal circumference (<101 cm and ≥101 cm). Baseline vital signs were recorded, and standard monitoring was instituted. Following IV fluid preloading, spinal anesthesia was administered using 2 ml of 0.5% hyperbaric bupivacaine via a 25G Quincke spinal needle in the lateral position, targeting a T4 sensory level. Intraoperative hemodynamic parameters, including MAP and heart rate, were recorded at baseline and at regular intervals (T1, T5, T10, T15, T20, T30, T40, T50, T60, and every 10 minutes thereafter). Hypotension was defined as systolic BP <90 mmHg or MAP <65 mmHg, with significant hypotension considered as a ≥20% drop in MAP from baseline. Mephentermine was administered as required to maintain MAP ≥65 mmHg, and the total dosage used was recorded.

Statistical Analysis: The collected data were entered into a Microsoft Excel spreadsheet and subsequently analyzed using SPSS version 22 software. Statistical analysis was performed to interpret the findings and assess the association between abdominal circumference and the incidence of post-spinal hypotension in the study population.

Results

Table 1: Distribution of Study Participants Based on Demographics

Variable	Group	Mean ± SD	95% CI	P-Value	Frequency (%)
Age (in years)	Large AC	25.74 ± 3.69	24.81–26.63	0.195	
	Small AC	26.40 ± 3.60	25.86–26.96		
Gravidity	Large AC	2.75 ± 1.22	2.46–3.04	0.404	
	Small AC	2.62 ± 1.09	2.45–2.79		
Weight (kg)	Large AC	69.25 ± 9.55	67.15–71.47	0.127	
	Small AC	67.40 ± 8.16	66.14–68.72		
BMI (kg/m²)	Large AC	27.91 ± 3.19	27.18–28.69	0.301	
	Small AC	27.44 ± 3.24	26.95–27.95		
Heart Rate (bpm)	Large AC	77.28 ± 12.80	74.47–80.25	0.310	
	Small AC	79.11 ± 12.73	77.22–81.02		
Weight Gain (kg)	Large AC	10.26 ± 1.91	9.81–10.69	0.270	
	Small AC	9.99 ± 1.65	9.75–10.24		
Volume Pre-loading (ml)	Large AC	551.39 ± 115.67	523.65–579.22	0.573	
	Small AC	541.62 ± 125.59	521.61–561.18		

Table 1 shows the baseline demographic and clinical characteristics between large and small AC groups. None of the parameters differed significantly ($p > 0.05$).

Table 2: Distribution of Study Participants Based on General Characteristics

Variable	Category	Frequency	Percentage
Abdominal Circumference	Large AC	73	30.4%
	Small AC	167	69.6%
Gravidity	1	34	14.2%
	2	87	36.3%
	3	66	27.5%
	4	34	14.2%
	5	19	7.9%
BMI Class	Pre-obese	140	58.3%
	Obese type 1	57	23.8%
	Overweight	43	17.9%
Socioeconomic Status	APL	140	58.3%
	BPL	100	41.7%
Education	Illiterate	50	20.8%
	Primary	36	15.0%
	High School	71	29.6%
	Graduate	83	34.6%

Table 2 observes the general distribution of abdominal circumference, gravidity, BMI classes, socioeconomic status, and educational qualification. Most participants were in the smaller AC group, pre-obese, from APL families, and graduates

Table 3: Distribution of Sensory Level Attained

Sensory Level	Large AC (>101 cm)	Small AC (<101 cm)	Total	P-Value
Below T4	27 (15.9%)	143 (84.1%)	170	0.000
Above T4	46 (65.7%)	24 (34.3%)	70	
Total	73 (30.4%)	167 (69.6%)	240	

Table 3 illustrates that a significantly higher proportion of patients with large AC attained sensory levels above T4 compared to smaller AC (p < 0.001).

Table 4: Occurrence of Hypotension and Symptoms

Variable	Large AC (>101 cm)	Small AC (<101 cm)	Total	P-Value
Hypotension (Yes)	28 (38.4%)	63 (37.7%)	91	NS
Symptoms (Yes)	38 (58.5%)	27 (41.5%)	65	0.000

Table 4 shows that while the occurrence of hypotension was similar across groups, symptoms of hypotension were significantly more frequent in the large AC group.

Table 5: Vasopressor Administration

Vasopressor Use	Large AC (>101 cm)	Small AC (<101 cm)	Total	P-Value
No	35 (20.6%)	136 (79.4%)	170	0.000
Yes	38 (54.3%)	32 (45.7%)	70	

Table 5 observes that vasopressor requirement was significantly higher among patients with large AC compared to smaller AC (p < 0.001).

Table 6: Distribution of MAP Over Time

Time Point	Large AC (Mean ± SD)	Small AC (Mean ± SD)	P-Value
Baseline	77.00 ± 5.14	76.58 ± 4.69	0.535
1 min	65.47 ± 3.41	66.72 ± 3.71	0.014
5 min	57.93 ± 3.41	59.40 ± 3.51	0.003
10 min	59.51 ± 3.46	60.52 ± 3.04	0.024
15 min	62.71 ± 2.35	63.17 ± 2.37	0.165
20 min	65.03 ± 2.68	65.33 ± 2.69	0.421
30 min	66.88 ± 2.64	67.51 ± 2.55	0.083
40 min	69.51 ± 2.19	70.30 ± 2.35	0.015
50 min	72.64 ± 2.36	73.10 ± 2.49	0.189
60 min	76.10 ± 3.67	75.96 ± 3.48	0.781

Table 6 demonstrates fluctuations in MAP across time. Significant differences were observed at 1, 5, 10, and 40 minutes, with smaller AC patients maintaining higher MAP.

Table 7: Summary of Outcomes Based on Abdominal Circumference

Outcome	Large AC (>101 cm)	Small AC (<101 cm)	Significant Difference
Sensory Level Above T4	65.7%	34.3%	Yes (p=0.000)
Symptoms of Hypotension	58.5%	41.5%	Yes (p=0.000)
Vasopressor Requirement	54.3%	45.7%	Yes (p=0.000)
Hypotension (Overall)	38.4%	37.7%	No (NS)
MAP Drop (1–10 min, 40 min)	Lower	Higher	Yes

Table 7 consolidates the main findings, indicating that large AC patients had a higher risk of high sensory block, more hypotension symptoms, and greater vasopressor need, though the overall incidence of hypotension was similar between groups.

Discussion

This study was conducted on 240 patients undergoing elective caesarean sections under spinal anaesthesia at Government Medical College, Thrissur. Preoperative parameters including BMI, AC, and volume of fluid preloading were assessed, and intraoperative outcomes such as hypotension, sensory blockade, and vasopressor requirements, were carefully monitored.

The mean age of participants was comparable between the two groups (25.74 years in the larger AC group and 26.40 years in the smaller AC group). Most participants were in the 26–30 years age range, with the majority classified as pre-obese based on BMI. These demographic trends are in line with earlier reports on parturients undergoing caesarean sections.

Incidence of Hypotension: In the present study, the overall incidence of hypotension following spinal anaesthesia was 37.9%**,** which is relatively lower compared to other studies. Somboonviboon et al. reported an incidence of 60%,[14] while In Ae Song et al. observed 65%.[15] The reduced incidence in the current study may be attributed to improved preoperative hydration and fluid optimization protocols adopted in this population.

Abdominal Circumference and Blood Pressure Changes: Pattaraleeya Thomard demonstrated that the incidence of hypotension did not differ significantly between women with larger and smaller AC, though the larger AC group showed a greater fall in MAP from baseline.[16] Similarly, our study revealed a significant decline in MAP at 1, 5, and 10 minutes after subarachnoid block in the larger AC group, highlighting the impact of abdominal circumference on hemodynamic changes.

Hartmann et al. analysed risk factors for hypotension in the general population, reporting that high BMI, hypertension, and chronic alcohol intake were associated with increased risk.[17] However, since their study excluded obstetric cases, it emphasizes the relevance of specifically evaluating pregnant women, as we have done.

Vasopressor Requirement: In this study, 29.2% of parturients required vasopressors to manage hypotension, which is slightly lower than the 40–60% reported by Gupta et al. [18] This again may reflect differences in fluid management strategies and baseline patient characteristics.

Sensory Block Height and Hypotension: Our findings showed that 65.7% of the larger AC group attained a sensory level above T4, compared to 34.3% of the smaller AC group. A higher block level was strongly associated with hypotension, corroborating the findings of Somboonviboon et al., who reported that sensory block above T4 increases the risk of hypotension.[14] The underlying mechanism involves sympathetic blockade extending to the upper thoracic region, reducing compensatory vasoconstriction in the upper extremities and thereby predisposing to hemodynamic instability.[19]

Role of Abdominal Circumference as a Predictor: In Ae Song et al. concluded that abdominal circumference, body weight, and BMI (but not height) were significantly associated with hypotension incidence. They further noted that severe hypotension requiring vasopressors and associated with nausea was strongly related to larger AC. [15] Our study supports these findings, as participants with larger AC experienced more frequent symptoms of hypotension and required vasopressor support more often than those with smaller AC.

Limitations: This study had certain limitations. Firstly, there was a potential for bias as blinding of the anesthesiologist was not feasible. Additionally, the majority of participants had smaller abdominal circumferences, resulting in an underrepresentation of individuals with larger abdominal circumferences, which may have introduced bias in the comparative analysis. The classification of abdominal circumference groups, with <101 cm defined as smaller and ≥101 cm as larger, may also have influenced the study outcomes. These factors should be considered when interpreting the results, and we recommend that future research further explore this association with a more balanced sample and refined grouping criteria.

Conclusion

The study found that the overall incidence of post-spinal hypotension at the study center was 37.9%. The findings suggest that abdominal circumference can serve as a useful screening parameter for predicting post-spinal hypotension in parturients undergoing caesarean section under spinal anesthesia. Being cost-effective, non-invasive, quick to measure, and patient-friendly, abdominal circumference offers a practical tool for routine preoperative evaluation. The study recommends incorporating abdominal circumference measurement into the preoperative assessment to help anticipate and promptly manage this potentially serious complication.

References

1. Nani FS, Torres ML. Correlation between the body mass index (BMI) of pregnant women and the development of hypotension after spinal anesthesia for cesarean section. Revista Brasileira de Anestesiologia 2011; 61:25-30.
2. Rout CC, Rocke DA. Prevention of hypotension following spinal anesthesia for cesarean section. Int Anesthesiol Clin 1994 Spring; 32(2):117-35.
3. Anadani HB, Pandya MJ, Shah DV. Relationship between Abdominal Circumference and Incidence of hypotension during caesarian section under spinal anaesthesia. National Journal of Medical Research 2021;11(3).
4. Riley ET, Cohen SE, Rubenstein AJ, et al. Prevention of hypotension after spinal anaesthesia for caesarean section: 6% hetastarch versus lactated Ringer's solution. Anaesth Analg 1995; 81:838 4.
5. Parthasarathy P, Aithal RR, Raghavendra Rao RS, et al. Correlation of symphysiofundal height and abdominal girth with the incidence of hypotension in cesarean section under spinal anesthesia using bupivacaine with fentanyl as adjuvant: a clinical study. Anesth Essays Res 2019;13(2):214–8.
6. Tsen LC. Anesthesia for cesarean delivery. ASA Refresher Courses in Anesthesiology 2005;33(1):235-45.
7. Bajwa SJ, Kulshrestha A, Jindal R. Co-loading or pre-loading for prevention of hypotension after spinal anaesthesia! A therapeutic dilemma. Anesth Essays Res 2013;7(2):155-9.

8. Norris MC. Patient variables and the subarachnoid spread of hyperbaric bupivacaine in the term parturient. Anesthesiology 1990; 72(3):478–82.
9. Peixoto Mdo R, Benício MH, Latorre Mdo R, et al. Waist circumference and body mass index as predictors of hypertension. Arq Bras Cardiol 2006; 87(4):462-70.
10. Bajwa SK, Bajwa SJS. Delivering obstetrical critical care in developing nations. Int J Crit Illn Inj Sci 2012;2(1):32–9.
11. Reynolds F, Seed PT. Anaesthesia for Caesarean section and neonatal acid-base status: a meta-analysis. Anaesthesia 2005;60(7):633-736.
12. Kuok CH, Huang CH, Tsai PS, et al. Preoperative measurement of maternal abdominal circumference relates the initial sensory block level of spinal anesthesia for cesarean section: an observational study. Taiwan J Obstet Gynecol 2016;55(6):810-4.
13. Maayan-Metzger A, Schushan-Eisen I, Todris L, et al. Maternal hypotension during elective cesarean section and short-term neonatal outcome. Am J Obstet Gynecol 2010; 202(1): 56.e1-5.
14. Somboonviboon W, Kyokong O, Charuluxananan S, et al. Incidence and risk factors of hypotension and bradycardia after spinal anesthesia for cesarean section. J Med Assoc Thail Chotmaihet Thangphaet 2008; 91(2):181-7.
15. Song I, Park SJ, Ryu J, et al. The impact of anthrometric measurements on hypotension during spinal anesthesia for cesarean delivery: comparison of body weight, body height, body mass index, and abdominal circumference. Anesthesia and Pain Medicine 2012;7(4):355-8.
16. Thomard P, Morakul S, Wirachpisit N, et al. Relationship between abdominal circumference and incidence of hypotension during cesarean section under spinal anesthesia. Anesthesiol Res Pract 2020; 2020:6547927.
17. Hartmann B, Junger A, Klasen J, et al. The incidence and risk factors for hypotension after spinal anesthesia induction: an analysis with automated data collection. Anesth Analg 2002;94(6):1521-9.
18. Gupta S. Vasopressors and tight control of maternal blood pressure during cesarean delivery: a rocky alliance. Journal of Anaesthesiology Clinical Pharmacology 2013;29(1):1.
19. Zhang N, He L, Ni JX. Level of sensory block after spinal anesthesia as a predictor of hypotension in parturient. Medicine (Baltimore) 2017;96(25):e7184.