Painless childbirth? Epidural and spinal techniques in obstetric anesthesia

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Chapter 5

Preoperative higher depression scores are associated with risk of hypotension following spinal anesthesia for cesarean delivery

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ABSTRACT

Objective

During pregnancy, depression is linked to altered autonomic functions, including reduced heart rate variability. Reduced heart rate variability is associated with an increased risk of hypotensive episodes following spinal anesthesia for cesarean delivery (CD). This study aimed to evaluate whether antenatal depression is associated with post-spinal hypotension during CD.

Methods

This secondary analysis utilized data from a previously conducted trial involving 290 full-term singleton pregnant women with American Society of Anesthesiologists (ASA) physical status II, undergoing elective CD under spinal anesthesia. Patients were randomized to receive either 100 μg of intrathecal morphine or normal saline, in addition to the standard spinal mixture of 0.5% bupivacaine (2.2 mL) with 10 μg fentanyl. The primary outcome of the present study was the incidence of post-spinal hypotension, defined as systolic blood pressure <80% of baseline. We performed multivariable logistic regression to examine the association between antenatal depression scores (assessed with Hospital Anxiety and Depression Scale) and post-spinal hypotension.

Results

Of the 290 participants, 164 (56%) developed post-spinal hypotension. The median (interquartile range) antenatal depression scores were higher in the hypotensive group compared with the nonhypotensive group (4 [3 to 5] vs. 3 [2 to 4], p = 0.003). Multivariable logistic regression revealed that higher depression scores (OR = 1.15, 95% CI 1.009–1.31, p = 0.036) and sensory block height ≥ T4 (OR = 1.84, 95% CI = 1.03–3.30, p = 0.039) were significantly associated with post-spinal hypotension.

Conclusion

Higher antenatal depression scores are associated with an increased risk of post-spinal hypotension in women undergoing elective CD.

INTRODUCTION

Cesarean delivery (CD) is most often performed under spinal anesthesia (SA); however, hypotension is a common complication that typically manifests within minutes of SA administration. This so-called post-spinal hypotension affects approximately one-third of patients despite routine prophylactic measures.[1] Adverse effects of post-spinal hypotension include maternal dizziness, nausea, and vomiting during the CD, as well as an increased risk of fetal acidosis.[2] These complications may negatively impact the maternal experience during childbirth, hinder recovery, and affect neonatal well-being, emphasizing the importance of accurately predicting and preventing this undesirable complication during CD.[2]

The autonomic nervous system (ANS), along with the cardiovascular and endocrine systems, plays a crucial role in regulating blood pressure during pregnancy.[3] Heart rate variability (HRV) is a key marker of ANS activity and physiological resilience during pregnancy, and it reflects the balance between parasympathetic and sympathetic functions.[3] Reduced HRV, alongside increased baseline sympathetic tone, signifies an ANS imbalance that can affect blood pressure regulation and compromise cardiovascular stability in pregnancy.[4]

Psychiatric disorders, such as depression, can further complicate this regulation, as antenatal depression is associated with alterations in autonomic function, including suppressed HRV.[5,6] In obstetric anesthesia, reduced HRV and elevated baseline sympathetic tone have emerged as predictors of post-spinal hypotension after CD.[7-9] Based on this evidence, we hypothesized that higher preoperative depression scores, indicative of psychological distress and autonomic dysfunction, are predictive of post-spinal hypotension during CD.

METHODS

We previously conducted a randomized clinical trial approved by the Institutional Review Committee of BP Koirala Institute of Health Sciences with the IRC number 1183/017, involving 290 patients undergoing elective CD with SA.[10] All patients had provided written informed consent before enrollment in the study. The aim was to investigate whether intrathecal morphine would reduce the incidence of chronic postsurgical pain. The purpose of this secondary analysis of the previously conducted clinical trial was to assess the relationship between preoperative depression scores and post-spinal hypotension after CD.

The study included full-term singleton pregnant women over 18 years of age with an American Society of Anesthesiologists (ASA) physical status II, defined as patients with a well-controlled disease without substantive functional limitations, scheduled for planned CD under SA. Exclusions were patients with preeclampsia, height < 150 cm, body mass index (BMI) > 40 kg/m^2, recent opioid use, substance abuse history, significant cardiovascular, renal, or hepatic conditions, fetal abnormalities, drug allergies, or contraindications to SA.

Baseline characteristics (age, height, weight, BMI, gestational age, previous CD history, and preexisting chronic pain) were documented along with preoperative anxiety and depression scores (assessed with Hospital Anxiety and Depression Scale), and pain catastrophizing scores, details of which have been previously reported.[10]

Upon arrival at the operating room, standard monitoring (noninvasive blood pressure, electrocardiography, and pulse oximetry) was initiated. Baseline systolic blood pressure (SBP) and heart rate were recorded before SA administration. SA was administered at the L3-L4 or L4-L5 interspace using a 25-G spinal needle. The morphine group received intrathecal hyperbaric bupivacaine 11 mg (2.2 mL 0.5%), fentanyl 10 μg (0.2 mL), and preservative-free morphine 100 μg (0.1 mL). The placebo group received hyperbaric bupivacaine 11 mg (2.2 mL 0.5%), fentanyl 10 μg (0.2 mL), and normal saline (0.1 mL). Patients received IV Ringer lactate solution coloading, 10 mL/kg, and a phenylephrine infusion at 25 μg/min. After spinal injection, patients were positioned supine with a left lateral tilt. Surgery commenced after achieving sensory loss to pinprick sensation at T6 or higher. All patients received intravenous ondansetron 4 mg. Hypotension, defined as SBP <80% of baseline, was treated with phenylephrine or ephedrine at the anesthesiologist's discretion. The primary outcome of this study was the incidence of post-spinal hypotension.

The Shapiro–Wilk test was used to evaluate the normality of the continuous variables. Continuous data with a normal distribution were expressed as mean (SD), while non-normally distributed data were expressed as median (interquartile range). Categorical data were presented as number (percentage). The independent sample *t* tests and the Mann–Whitney *U* test were used to compare normally and non-normally distributed data, respectively, between the hypotensive and nonhypotensive groups. For categorical data, the Pearson χ^2test or Fisher exact test was applied, as appropriate. We conducted univariable and multivariable logistic regression analyses to explore the variables associated with hypotension after SA. Variables for the multivariable logistic regression model were included based on prior research and clinical knowledge: BMI, gestational age, preexisting chronic pain, preoperative pain catastrophizing, anxiety and depression, baseline SBP, baseline heart rate, use of spinal morphine, and maximum sensory block height. The results were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CI). All *p*-values < 0.05 were considered statistically significant. Data were analyzed using Stata 15.0 software (StataCorp. LP, College Station, Texas, USA).

TABLE 1. Comparison of Demographic and Perioperative Profiles Between Hypotensive and Nonhypotensive Group

	All patients n=290	Hypotensive group N=164	Non-hypotensive group N=126	*P*-value
Age (y), mean (SD)	28.14 ± 4.86	28.25 ± 4.98	28.01 ± 4.72	0.68*
Weight (kg), mean (SD)	67 ± 9.34	67.08 ± 9.66	66.88 ± 8.93	0.85*
Height (cm), mean (SD)	156.33 ± 5.47	155.90 ± 5.22	156.88 ± 5.76	0.13*
Body mass index (kg/m^2), mean (SD)	27.41 ± 3.68	27.57 ± 3.71	27.21 ± 3.64	0.41*
Gestational age (wk), mean (SD)	38.77 ± 1.22	38.67 ± 1.12	38.89 ± 1.34	0.13*
Indo-Aryan origin, n (%)	174 (60)	95 (58)	79 (63)	0.41***
Previous cesarean delivery, n (%)	194 (67)	111 (68)	83 (66)	0.74***
Pre-existing chronic pain, n (%)	6 (2)	5 (3)	1 (1)	0.23****
HADS scores (0-21)				
Anxiety, median (IQR)	4.5 (3-6)	5 (3-6)	4 (3-6)	0.54**
Depression, median (IQR)	3 (2-5)	4 (3-5)	3 (2-4)	0.003**
Pain catastrophizing scores (0-52), median (IQR)	8 (5-12)	8 (6-12)	7 (5-12)	0.48**
Baseline SBP (mmHg), mean (SD)	119.98 ± 7.18	119.46 ± 6.97	120.66 ± 7.41	0.15*
Baseline HR (beats/min), mean (SD)	82.74 ± 9.97	83.36 ± 10.32	81.92 ± 9.48	0.22*
Received spinal morphine, n (%)	145 (50)	89 (54)	56 (44)	0.097***
IONV, n (%)	11 (4)	8 (5)	3 (2)	0.35****
Shivering, n (%)	19 (7)	11 (7)	8 (6)	0.90***
Bradycardia (HR < 50/min), n (%)	19 (7)	19 (7)	0 (0)	<0.001****
Pruritus, n (%)	8 (3)	6 (4)	2 (2)	0.47****
Sensory block height ≥ T4, n (%)	227 (78)	137 (84)	90 (71)	0.013***
Duration of surgery (min), mean (SD)	56.77 ± 14.31	57.06 ± 13.86	56.41 ± 14.94	0.70*

Abbreviations: BMI, body mass index; CD, cesarean delivery; HADS, Hospital Anxiety and Depression Scale; HR, heart rate; IONV, intraoperative nausea and vomiting; IQR, interquartile range; SBP, systolic blood pressure.

*Independent sample *t* tests.

**Mann-Whitney *U* test.

***Pearson χ2 test.

****Fisher exact test.

RESULTS

Out of 290 patients who completed the study, 164 patients (56%) developed post-spinal hypotension. Patient demographics and the perioperative variables between hypotensive and nonhypotensive group are depicted in table 1. The median (interquartile range) depression scores were 4 (3 to 5) in the hypotensive group and 3 (2 to 4) in the nonhypotensive group (median difference = 1, $p < 0.003$). Univariable logistic regression analysis showed that an increase in depression scores and sensory block height ≥ T4 were associated with post-spinal hypotension (Table 2). Similarly, in multivariable logistic regression analysis, an increase in depression scores (OR = 1.15, 95% CI = 1.009-1.31, $p = 0.036$) and sensory block height ≥ T4 (OR = 1.84, 95% CI 1.03 = 3.30, $p = 0.031$) were significant independent risk factors for post-spinal hypotension (Table 2).

TABLE 2. Univariable and Multivariable Logistic Regression Analysis of Risk Factors Associated With Post-spinal Hypotension

Variable	Univariable		Multivariable	
	OR (95%CI)	***P*-value**	**OR (95% CI)**	***P*-value**
Body mass index (kg/m^2)	1.02 (0.96-1.09)	0.41	1.02 (0.95-1.09)	0.52
Gestational age (wk)	0.86 (0.71-1.04)	0.13	0.83 (0.68-1.02)	0.149
Preoperative depression (HADS scores)	1.12 (1.009-1.26)	0.034	1.15 (1.009-1.31)	0.036
Preoperative anxiety (HADS scores)	1.03 (0.93-1.14)	0.52	1.01 (0.90-1.14)	0.75
Preexisting chronic pain	3.93 (0.45-34)	0.21	3 (0.32-27.6)	0.33
Preoperative pain catastrophizing scores	1 (0.96-1.04)	0.80	0.98 (0.94-1.02)	0.46
Baseline SBP (mmHg)	0.97 (0.94-1.00)	0.15	0.98 (0.95-1.01)	0.38
Baseline HR (beats/min)	1.01 (0.99-1.03)	0.22	1.01 (0.98-1.03)	0.31
Received spinal morphine	1.48 (0.93-2.36)	0.098	1.48 (0.90-2.41)	0.11
Sensory block height				
< T4	1 (ref)		1 (ref)	
≥ T4	2.02 (1.15-3.57)	0.014	1.84 (1.03-3.30)	0.039

Abbreviations: BMI, body mass index; HADS, hospital anxiety and depression scale; HR, heart rate; OR, odds ratio; SBP, systolic blood pressure.

DISCUSSION

To the best of our knowledge, this is the first study to explore the relationship between antenatal depression and post-spinal hypotension. We observed that preoperative higher depression scores were associated with an increased risk of post-spinal hypotension after adjusting for several confounders in the multivariable logistic regression analysis.

The ANS plays an important role in regulating blood pressure during pregnancy. Surrogate markers of altered autonomic functions, such as reduced HRV and increased baseline sympathetic tone, have been predictive of post-spinal hypotension in the obstetric population.[7-9] Similarly, in highly anxious pregnant women, frequent hypotensive episodes have been reported after SA for CD.[11]

One possible explanation is that altered HRV due to anxiety may have played a role in potentiating hypotension because reduced HRV is considered a potential physiological biomarker of anxiety disorders.[12]

Another negative emotional state during pregnancy, that is, antenatal depression, can have long-term detrimental effects on pregnant mothers and their newborns. During a normal pregnancy, ANS activity shifts towards higher basal sympathetic and lower vagal modulation, such as (HRV). Moreover, the ANS is one of the key physiological mechanisms by which an individual reacts to stress response. Consequently, during psychological distress, there is a further reduction of sympathovagal imbalances. Several studies have explored the relationship between autonomic function and maternal depression during pregnancy. The low-frequency/high-frequency ratio as a component of HRV and baroreflex sensitivity was found to be significantly correlated with depression scores in pregnant women.[5,6] These mechanisms may explain, in part, why depression-induced alterations in ANS might have played a role in post-spinal hypotension in our study.

There are a few limitations related to this study. First, although there is a lack of biological plausibility for an association between spinal-induced hypotension and pre-operative depression, further prospective studies are warranted to explore the role of biomarkers of ANS, such as HRV, in women with antenatal depression and their association with post-spinal hypotension following CD. Second, the exclusion of women with preeclampsia from this study limits the generalizability of our findings. Third, we did not document the magnitude of the fall in intraoperative SBP, and the total vasopressor needed. Finally, the study was not powered to investigate the outcome, that is, post-spinal hypotension.

CONCLUSION

Our study showed that preoperative higher depression scores in pregnant women were associated with a significant risk of post-spinal hypotension during CD. We suggest that the effect of antenatal depression on post-spinal hypotension should be assessed in further studies.

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