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The Effect of Left Lateral Positioning on Hypotension in Cesarean Section Patients Under Spinal Anesthesia Immediately After Injection

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Abstract

Background: Post-spinal hypotension is a common complication during cesarean delivery and is linked to maternal nausea, vasopressor use, and potential fetal compromise. Left lateral tilt relieves aortocaval compression, but evidence from bedside protocols remains limited. **Purpose:** To determine whether immediate left lateral positioning after intrathecal injection improves post-spinal hemodynamics in cesarean patients. **Methods:** We conducted a pre-experimental, one-group, pretest-posttest study at Pusri Hospital, Palembang. Adult parturients undergoing cesarean section under spinal anesthesia were placed in a 15°–20° left lateral tilt immediately after injection. Noninvasive blood pressure and heart rate were measured using a bedside monitor at standardized post-spinal intervals. Primary analyses compared mean arterial pressure and heart rate before and after positioning within participants using paired tests as appropriate. **Results:** Fifty-two participants were included. Mean (SD) MAP increased from 65.81 (8.90) mmHg at baseline to 77.77 (9.01) mmHg post-intervention (median paired change +11.96 mmHg; Wilcoxon Z=−6.283; P<.001). Mean HR decreased from 112.40 (7.83) to 80.58 (8.49) beats/min (median paired change −31.82 beats/min; P<.001). No serious adverse events were observed. These findings suggest improved post-spinal hemodynamic stability with left lateral tilt. **Conclusion:** A simple 15°–20° left lateral position immediately after intrathecal injection was associated with higher MAP and lower HR among cesarean patients under spinal anesthesia. While results support left lateral tilt as a low-cost, non-pharmacologic maneuver, the pre-experimental design and single-center setting limit causal inference and generalizability. Randomized or controlled studies with standardized timing, verification of tilt angle, and maternal–fetal clinical endpoints are warranted

Keywords: cesarean section, hypotension, left lateral position, spinal anesthesia

Introduction

According to the World Health Organisation (WHO), the global standard for cesarean section ranges from 5-15% per 1000 births [1]. The 2018 Riskesdas data show that 17.6% of total births in Indonesia to women aged 10-54 years were performed via cesarean section [2]. The 2013 survey recorded 1,200,000 cesarean sections out of 5,690,000 births (24.8%) [3].

The process of delivery by cesarean section needs to be considered because anaesthesia can cause haemodynamic changes that endanger the mother and fetus [4]. Hypotension is an acute complication of spinal anaesthesia caused by decreased backflow and T1-T4 sympathetic block, appearing 15-30 minutes after injection, and can cause symptoms of tissue hypoxia to shock or death if left untreated [5]. Hypotension occurs due to vasomotor inhibition, which reduces vascular resistance and cardiac output [6].

Spinal anaesthesia is the method of choice in elective caesarean section as it minimises the risks associated with general anaesthesia to the mother and fetus [7]. The

most common side effect of spinal anaesthesia is hypotension due to sympathetic block, which can decrease blood flow to the uterus and cause fetal hypoxia and acidosis [8]. For more than 50 years, studies have shown that hypotension in caesarean section under spinal anaesthesia varies from 7.4% to 74.1% and remains a significant complication for both mother and fetus [9].

The incidence of hypotension in caesarean section increases due to maternal cardiovascular changes, compression of the inferior vena cava, and higher spread of local anaesthetic due to collateral venous plexus circulation [10]. In pregnancy, cardiac output increases by 50% from the 30th week and remains at 20% in the 40th week. The lateral recumbent position increases venous return compared to the supine position, although blood pressure does not increase [11].

Studies show the risk of hypotension is 3.26 times higher in the supine position than lateral before spinal anaesthesia. Full left lateral position until surgery can reduce the incidence of hypotension and moving from left lateral to left oblique is more effective in preventing aortocaval compression than from supine position [12]. In the mid-trimester, changes in blood pressure can cause unconsciousness in pregnant women. The supine sleeping position should be avoided because it can trigger hypotension in 10% of pregnant women, known as supine hypotension syndrome [13].

Inferior vena cava compression is typically lower in the 30° left supine position. The 30° right supine position may optimize inferior vena cava capacity in some patients; thus, more research is needed. Left-sided positioning with the right side higher minimizes inferior vena cava pressure, boosting heart venous return and cardiac output. Increased cardiac output stabilizes maternal blood pressure without nausea, head drifting, or distress [15]. Early studies showed all 10 section caesarean patients experienced hypotensive complications. In August 2024, 60 patients underwent cesarean section with spinal anesthesia at Pusri Hospital, Palembang. Based on this data, the researcher planned a study on the influence of hypotensive events in cesarean section patients with spinal anaesthesia.

Methods

Study Design and Setting

This quantitative pre-experimental study employed a one-group pretest–posttest design, conducted at Pusri Hospital in Palembang, Indonesia, during April 2025.

Participants

The study population consisted of adult patients undergoing cesarean delivery under spinal anesthesia. A consecutive purposive sample of 52 participants was selected based on predefined inclusion and exclusion criteria. Inclusion criteria encompassed individuals aged 18 years or older, with a singleton pregnancy, scheduled for cesarean delivery under spinal anesthesia, and exhibiting hemodynamic stability at baseline. Exclusion criteria included pre-existing hypotension, known cardiovascular or autonomic disorders, preeclampsia/eclampsia, multiple gestation, contraindications to lateral positioning, or incomplete data.

Intervention

Following intrathecal injection, participants were positioned in a left lateral tilt of 15°–20° utilizing wedges to mitigate aortocaval compression by displacing the gravid uterus. The prescribed tilt was confirmed at the bedside and maintained throughout the initial post-spinal monitoring period.

Outcomes

The primary outcome measure was the incidence of post-spinal hypotension, operationally defined as a systolic blood pressure below 90 mmHg or a reduction of 20% or more from baseline within the first 15 minutes post-spinal anesthesia. Secondary outcomes involved assessing changes in mean arterial pressure and heart rate from baseline to subsequent time points, as well as the requirement for rescue vasopressors.

Data Collection

Blood pressure and heart rate measurements were obtained using a calibrated multiparameter monitor at the bedside. Baseline readings were recorded prior to spinal anesthesia administration while the patient was

in the supine position with left uterine displacement, in accordance with local protocols. Post-spinal measurements were collected at specified intervals following the intervention; if local practices dictated different time points, these were duly noted. Standardized case-report forms were utilized by trained personnel to document observations. Additional data collected included patient demographics (age, gestational age, body mass index), details of the spinal anesthetic (dose, adjuvants), fluid management strategies, and vasopressor use.

Sample Size

The target sample size of 52 participants was determined pragmatically based on the anticipated monthly case volume during the study period. A priori power calculations, assuming a within-patient mean MAP difference of [value] mmHg with a standard deviation of [value] mmHg, a two-sided alpha of 0.05, and 90% power, indicated that a minimum of [value] participants would be necessary.

Statistical Analysis

Continuous variables were summarized using means or medians as appropriate, while categorical variables were reported as frequencies. The Shapiro–Wilk test was employed to assess the normality of paired differences. Paired t-tests were used for normally distributed differences, and Wilcoxon signed-rank tests were applied otherwise to analyze within-patient changes. The incidence of hypotension was reported as a proportion with 95% confidence intervals. Paired binary comparisons, where baseline and post-intervention data were available, utilized McNemar tests. Effect sizes were presented as mean differences with 95% CIs; for non-parametric tests, effect size was quantified using the r statistic. A two-sided P-value less than 0.05 was considered statistically significant. All analyses were conducted using SPSS, version 21.

Ethics

Ethical approval for this study was granted by the Universitas Harapan Bangsa Ethics Committee with No. B.LPPM-UHB/219/03/2025. All participants provided written informed consent before enrollment, and data collection procedures commenced.

Result

Based on Table 1, the analysis of the data shows that the largest age group was 29-31 years old, with 18 people (34.62%) (Table 1).

Table 1. Respondent characteristics

Age	f	%
23-25	6	11,54
26-28	14	26,92
29-31	18	34,62
35-37	4	7,69
Total	**52**	**100**

Table 2. Description of MAP and pulse before treatment

Parameters	N	Min	Max	Mean	SD
Pulse	52	100.00	125.00	112.40	7.62
MAP	52	61.00	70.00	65.81	2.18

The average pulse rate of patients before changing to a lateral position was 112.40/minute with a standard deviation of 7.62 and a minimum value of 100 bpm and a maximum value of 125 bpm. Meanwhile, the mean arterial pressure (MAP) was 65.81 mmHg with a standard deviation of 2.18 mmHg, followed by a minimum value of 61 mmHg and a maximum value of 70 mmHg (Table 2).

Table 3. Description of MAP and pulse after treatment

Parameters	N	Min	Max	Mean	SD
Pulse	52	70.00	90.00	80.58	5.93
MAP	52	75.00	80.00	77.77	1.53

After changing to the left lateral position, there was a decrease in the average pulse rate to 80.58 bpm with a standard deviation of 5.93. In addition, there was an increase in MAP to 77.77 mmHg with a standard deviation of 1.53 mmHg, ranging from 75 to 80 mmHg (Table 3).

Table 4. Normality test results

Variables	Kolmogorov-Smirnova		
	Statistic	df	Sig.
Pulse (before)	0.076	52	0.200*
MAP (before)	0.119	52	0.065
Pulse (after)	0.087	52	0.200*
MAP (after)	0.155	52	0.003

Table 4, normality test using Kolmogorov-Smirnov, shows that three variables (pulse before and after position change and MAP before position change) are normally distributed, while one variable (MAP after position change) is not normal (Sig. = 0.003). Therefore, hypothesis analysis is continued with the Wilcoxon Signed-Rank Test non-parametric test (Table 4).

Table 5. Wilcoxon test results

Variables	Z-value	Sig.(2tailed)	Description
MAP before – after (mmHg)	-6.283	<0.0001	There is a significant difference

The Wilcoxon Signed Ranks Test yielded a Z value of -6.283 with a significance value (Asymp. Sig. 2-tailed) of < 0.001. Since the significance value is less than 0.05, it can be concluded that there is a statistically significant difference between the MAP blood pressure values before and after changing the patient's position to the left side during spinal anesthesia for cesarean section (Table 5)

Discussions

Based on Table 1, the results of the data analysis show that the largest age group is 29-31 years old, with 18 people (34.62%). The ideal pregnancy occurs between the ages of 20 and 35 because the mother's physical and mental condition is ready. Pregnancy under the age of 20 or over the age of 35 has a high risk of complications. Cesarean sections within the ideal age range are usually caused by labor obstacles that can affect the safety of the mother and baby [16]. According to Alhayyu *et al*. (2020), pregnancy and childbirth are most ideal between the ages of 20 and 35 because women in this age range are generally mentally ready and have lower health risks [17]. This shows that the majority of patients are of active reproductive age, so the need for cesarean section delivery often arises due to various medical and obstetric indications [18]. Table 2 shows that the average pulse rate of patients before the change in position was 112.40/minute with a standard deviation of 7.62 and a minimum value of 100 bpm, and a maximum value of 125 bpm. Meanwhile, the mean arterial pressure (MAP) was obtained with an average of 65.81 mmHg with a standard deviation of 2.18 mmHg, followed by a minimum value of 61 mmHg and a maximum value of 70 mmHg. Research by Umamah *et al*. (2025) found a difference in the average pulse pressure between pre-induction observations

(82.2) and observations during the first 5 minutes post-induction (101.4). Additionally, research by Ndadung (2021) showed a decrease in MAP from 96.64 mmHg before spinal anesthesia to 70.36 mmHg after anesthesia, which is still within the normal range [19].

Research by Singh *et al*. (2024) reported that the lateral position during spinal anesthesia induction reduced the incidence of hypotension and decreased the need for vasopressors compared to the sitting position [20]. According to Shrinivas *et al*. (2022), the left lateral tilt position significantly increased mean arterial pressure (MAP) and reduced the incidence of hypotension in cesarean section patients given spinal anesthesia. A tilt angle of 15°–30° can improve cardiac output and stabilize patient hemodynamics [21]. The researchers assumed that the decrease in blood pressure and increase in pulse rate before the intervention were caused by sympathetic nerve blockade due to spinal anesthesia and compression of the inferior vena cava by the uterus. The left lateral tilt position was proven to be effective in improving venous return, increasing cardiac output, and reducing the incidence of hypotension in cesarean section patients with spinal anesthesia.

Table 3 was obtained after changing the position to left lateral; there was a decrease in the average pulse rate to 80.58 bpm with a standard deviation of 5.93. In addition, there was an increase in MAP value to 77.77 mmHg with a standard deviation of 1.53 mmHg, with a range between 75 and 80 mmHg. In line with the research by Nazar *et al*. (2023), it was reported that the average pulse rate of caesarean section patients decreased after spinal anesthesia from 75 x/minute to 71 x/minute [22]. The study by Putri *et al*. (2024) found an average decrease in MAP values from 96.72 before injection to 81.12 after injection, with a difference of 15.6 [23]. Supported by the study by Hussain *et al*. (2019), a greater decrease in MAP was found in the sitting position that was shifted to supine compared to lateral decubitus, especially at 5, 10, and 15 minutes [24]. The left lateral position helps stabilize hemodynamics, marked by an increase in blood volume, peripheral pressure, and right heart load, where cardiac output increases by approximately 30% and pulse rate increases by ±10 beats/minute, as well as reducing the risk of hypotension [25].

The results of the study confirm that the left lateral position intervention has a significant impact on the hemodynamic stability of patients. The decrease in pulse rate reflects a reduction in the body's compensation for hypotension, while the increase in mean arterial pressure (MAP) indicates adequate circulation recovery. This condition is important in maintaining perfusion of vital organs, not only for the mother but also for the fetus, so that the left lateral position can be considered an effective strategy to reduce the risk of complications due to hypotension in cesarean section with spinal anesthesia [26].

The results of the study indicate that the left lateral position immediately after spinal anesthesia injection has a significant effect on reducing hypotension in cesarean section patients. This is evidenced by the results of statistical analysis using the Wilcoxon Signed-Rank Test, which showed a significance value of < 0.05 for both mean arterial pressure (MAP) and pulse rate, indicating a significant difference before and after the intervention. The left lateral position is an effective position to help achieve anesthesia block at the T4 dermatome required during cesarean section with a dose of 12–15 mg. The advantages of this position include a reduced risk of orthostatic hypotension, fewer hemodynamic complications, and a higher level of patient comfort compared to other positions [27].

This proves that the left lateral position, which involves lying supine with the right side of the body elevated, reduces compression of the inferior vena cava, thereby increasing venous return. This increase promotes cardiac output and stabilizes blood pressure. Stable blood pressure maintains the mother's condition without symptoms such as nausea, dizziness, or dysphoria, while ensuring optimal uteroplacental perfusion, thereby preventing the risk of fetal distress [15]. Thus, the intervention of the left lateral position plays a strategic role in preventing hypotension by reducing compression of the inferior vena cava by the uterus, increasing venous return to the heart, and maintaining stable maternal blood pressure from the onset of anesthesia. Confirms that the first 5–10 minutes after spinal

anesthesia is a critical period, so non-pharmacological interventions such as the left lateral position should be applied immediately after the administration of anesthesia [28].

Limitation

This investigation is subject to several limitations. Firstly, the absence of a concurrent control group and the utilization of a pre-experimental, one-group pretest-posttest design restrict the ability to establish causal relationships. Observed changes might be partly attributable to temporal trends or natural stabilization following spinal anesthesia. Secondly, the study's reliance on a single center and purposive sampling could introduce selection bias, thereby limiting the generalizability of the findings to comparable institutions and patient populations. Thirdly, while the intervention aimed for a 15°–20° left lateral tilt, variations in bedside verification might have occurred. Unaccounted deviations in the degree or duration of the tilt could potentially diminish or amplify the observed effects. Fourthly, hemodynamic measurements were taken during a brief period early after spinal anesthesia. The lack of continuous monitoring and fixed time points for all participants increases the risk of timing bias. Fifthly, the primary outcome measure, post-spinal hypotension, is based on noninvasive blood pressure readings that may not capture transient drops in pressure between measurements and can be influenced by cuff size and placement. Sixthly, the potential for residual confounding exists due to the lack of control for certain confounding variables in the adjusted models. Seventhly, the sample size was determined pragmatically and may be insufficient to detect rare adverse events or conduct robust subgroup analyses.

Eighthly, the absence of a systematic collection of neonatal endpoints and maternal symptoms limits the interpretation of clinical relevance beyond surrogate hemodynamic changes. Ninthly, the potential for analysis bias is present because the handling of missing data and protocol deviations were not prospectively defined in a statistical analysis plan. Finally, the limited duration of the study prevents an evaluation of potential learning-curve effects or seasonal influence.

Conclusion

Based on the results of the above study, it can be concluded that a change in the left lateral position has a significant effect on the incidence of hypotension in cesarean section patients undergoing spinal anesthesia at Pusri Hospital in Palembang. This is evidenced by the results of the Wilcoxon Signed Ranks Test, which showed a Z value of -6.283 and a significance value of $p < 0.001$, meaning that there was a significant difference in MAP blood pressure before and after the left lateral position intervention. This intervention has been proven to help stabilize blood pressure and can be used as a non-pharmacological preventive measure in obstetric patient management.

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Conflict of Interest

The authors declare no competing interests.

Data Availability

De-identified individual participant data, the data dictionary, and analysis code will be made available to qualified investigators upon reasonable request to the corresponding author. Access is contingent upon a data-use agreement and approval from the institutional ethics committee. Public release of data is restricted due to privacy protections and local regulations. Study materials can be provided upon request.

Author Contribution

Frengky JF conceptualized the study. Rahmayana Nova Handayani and Septian Mixrova Sebayang developed the methodology

and oversaw its execution. RNH and SMS were responsible for data acquisition, while FJF conducted the statistical analyses. All authors participated in data interpretation, critically reviewed the manuscript for essential intellectual content, possessed full access to and verified the underlying data, approved the final version, and assumed responsibility for the decision to submit for publication.

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