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RESEARCH ARTICLE
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HEMODYNAMIC EFFECTS OF LATERAL TILT BEFORE AND AFTER SUBARACHNOID BLOCK DURING CAESAREAN DELIVERY.

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ABSTRACT

Background & Objective: Supine hypotension during cesarean delivery under spinal anesthesia is a common clinical challenge caused by aortocaval compression by the gravid uterus, leading to decreased cardiac output and hypotension. The study aims to evaluate the impact of a 15 degree left lateral tilt on hemodynamic variables, including mean arterial pressure (MAP) and heart rate (HR), before and after spinal anesthesia and following fetal delivery, in a resource-limited setting.
Methodology: A prospective observational study was conducted on 55 term pregnant women at Dow University of Health Sciences, Pakistan. Patients were positioned supine and with a 15 degree left lateral tilt. Hemodynamic parameters were measured before and after subarachnoid block using standard monitors. Statistical analysis was performed using paired t-tests and ANOVA, with significance set at $p < 0.05$.
Results: The 15-degree lateral tilt significantly improved MAP and HR compared to the supine position before and after spinal anesthesia ($p < 0.05$). The incidence of hypotension, dizziness, pallor, and nausea was markedly lower in the lateral tilt position post-block and post-delivery. Vasopressor usage was reduced to 23.21%.
Conclusion: The 15 degree lateral tilt is an effective, non-pharmacological intervention for mitigating hemodynamic disturbances during cesarean delivery under spinal anesthesia. It enhances maternal cardiovascular stability and reduces adverse symptoms, particularly in resource-constrained settings. Further research is needed to validate these findings in broader populations.

Keywords: Supine hypotension syndrome, cesarean delivery, spinal anesthesia, 15-degree lateral tilt, hemodynamic stability, mean arterial pressure, heart rate, aortocaval compression, vasopressor usage, maternal cardiovascular health.

1. INTRODUCTION

Pregnant patients often experience hypotension when lying in a supine position, which is attributed to the aorta being compressed by the gravid uterus. During cesarean delivery under spinal anesthesia, significant hypotension has also been observed in some individuals.[1] According to Crawford et al., using a 15-degree wedge during a cesarean procedure has significantly improved fetal acid-base balance and clinical outcomes.[2] Although the exact prevalence of supine hypotension is not well documented, researchers have recommended a tilt of 12 to 15 degrees.[3] The supine position leads to decreased venous return, ventricular filling, stroke volume, and hypotension due to aortocaval compression, which can be alleviated with a lateral tilt of 15-20 degrees.[4] Patients without a left lateral tilt have been found to have significantly lower systolic pressures and cardiac output, requiring more doses of vasopressors.[5] The left lateral tilt has been shown to be effective in preventing this hypotension.[6] Left lateral displacement helps restore cardiac output, which is compromised by the mechanical obstruction of the aorta and vena cava by the enlarged uterus.[7]

Numerous studies have explored how tilting affects hemodynamic responses in caesarean delivery under spinal anaesthesia. These investigations often assess various hemodynamic parameters using cardiac output monitors, which can be challenging to deploy in resource-constrained settings, particularly in developing countries like Pakistan. Therefore, this study seeks to assess measurable factors that could establish causal relationships between specific variables, aiming to enhance healthcare outcomes despite resource limitations. Our focus is to evaluate the impact of lateral tilt on hemodynamic variables such as mean arterial pressure and heart rate before and after spinal anaesthesia, following foetal delivery in the supine position, and subsequently with a 15-degree tilt.

2. METHODOLOGY

This prospective observational study was conducted at the Department of Anaesthesiology, SICU, and Pain Management, Dow University of Health Sciences, from September 2022 to February 2023, following approval from the ethical review board with letter no. IRB-2677/DUHS/Approval/2012/1040. Written informed consent was obtained from all participants. A total of 55 patients who met the inclusion criteria were enrolled in the study. The study included ASA II parturient aged between 15 and 45 years, excluding those with comorbidities such as diabetes mellitus, pregnancy-induced hypertension, pre-eclampsia, severe pre-eclampsia, eclampsia, morbid obesity, antepartum or postpartum haemorrhage, those who had experienced failed spinal procedures, and those with vertebral anomalies.

Standard monitors including non-invasive blood pressure monitoring cuff, pulse oximeter, and a three-lead ECG were utilized. Baseline measurements such as heart rate, systolic blood pressure, mean arterial blood pressure, and symptoms like dizziness, pallor, and nausea were recorded while patients were in a supine position. Subsequently, a preformed Crawford wedge angled at 15 degrees for left uterine displacement was positioned. Patients received a preload of crystalloids at a rate of 10-15 ml/kg through two wide-bore IV cannulas.

After preload, patients were seated, and the attending anaesthetist located the L4/L5 spinal space. The patient's skin was locally anesthetized with 2 mL of 2% plain lignocaine followed by intra-thecal administration of 10 mg of 0.5% heavy bupivacaine using a 25 G Quincke-type spinal needle. Following the procedure, patients were placed supine with cushions under the head and feet. Readings were taken in the supine position and after the installation of the 15-degree wedge. Surgery was commenced after confirming the sensory block up to the T4 level.

Post-delivery, the same hemodynamic parameters and symptoms were assessed twice: once in the supine position and again after the wedge placement. Each set of readings was taken after one minute of rest following wedge insertion. Use of vasopressors when MAP recorded below 65 mmHg was also documented.

The primary goal was to assess the hemodynamic effects (including mean arterial pressure and heart rate) of lateral tilt before and after subarachnoid block and after delivery of the foetus in the supine position, as well as after 15-degree tilt.

Statistical Package for Social Sciences version 20 was used for data analysis. The data's normality was investigated using ANNOVA in combination with a paired t-test and descriptive analysis on categorical variables. A p-value of less than 0.05 was taken as significant.

3. RESULTS

A total number of 55 pregnant women at term were included in this study. The average age of the women was 27.05±4.73years. Before subarachnoid block, significant difference was observed in mean Heart rate SBP and MAP at 0-degree supine and 15-degree left lateral tilt position (p less than 0.5) as presented in figure 1, 2 and 3.

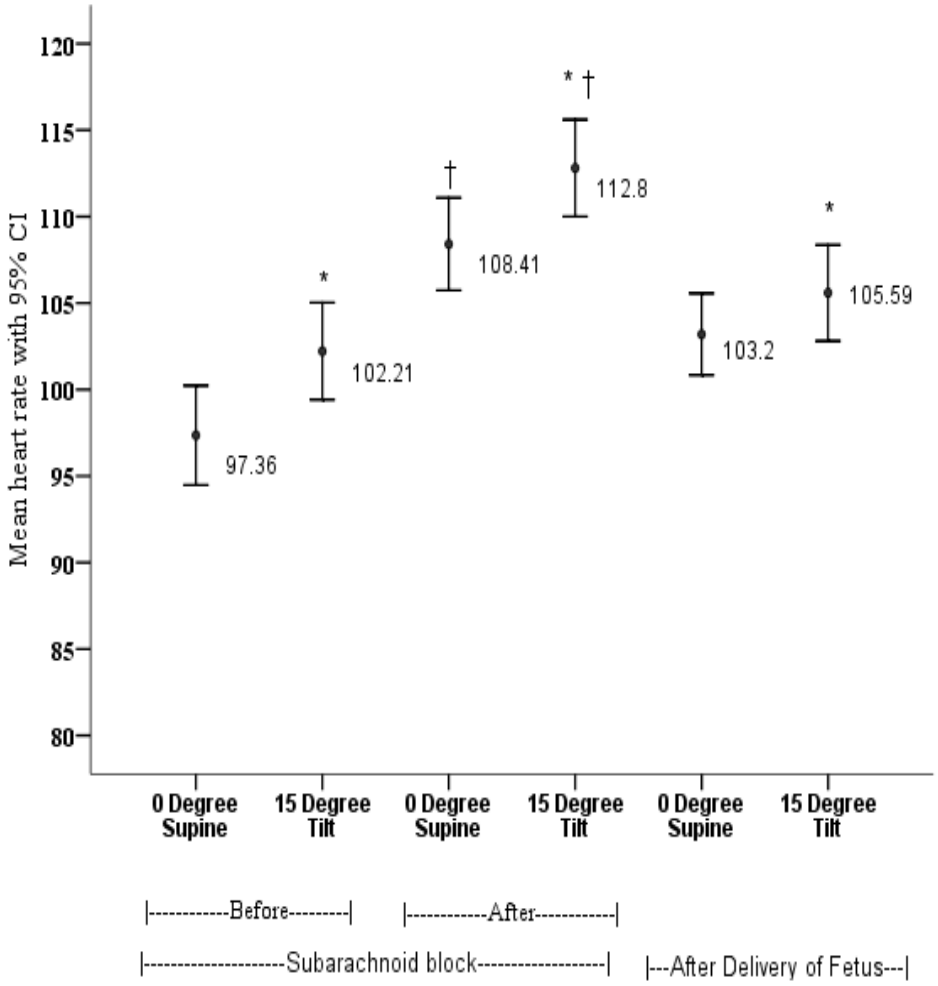

Figure 1: Comparison of mean heart rate changes with different angles. Dot means with 95% confidence interval.

*** denotes significance compared to**
0 degree vs. 15 degree before.
0 degree vs. 15 degree after.
0 degree supine vs. 15 degree Tilt after delivery

† denotes significance compared to before and after block
0 degree supine before vs. 0 degree supine after and
15 degree tilt before vs. 15degree tilt after

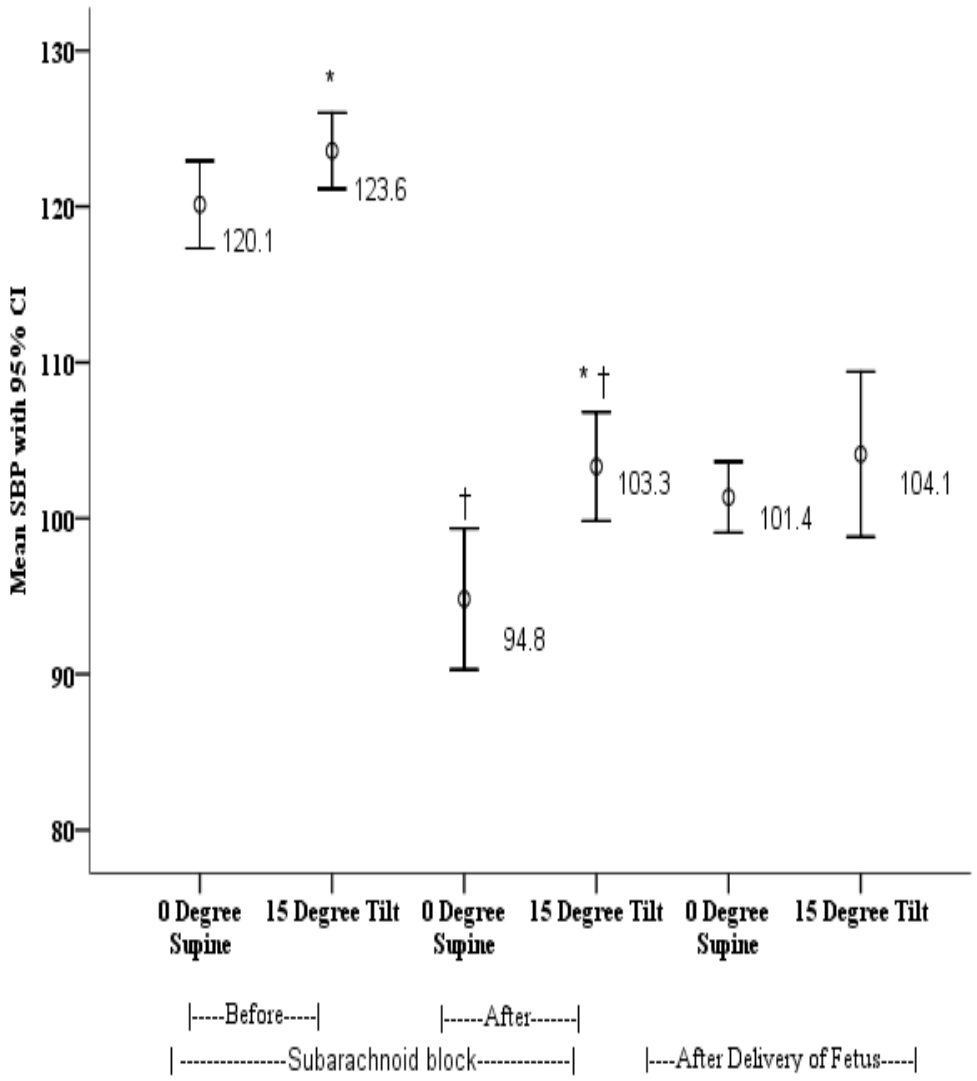

Figure 2: Comparison of mean SBP changes with different angles. Dot represent means with 95% confidence interval.

*** denotes significance compared to**
0 degree vs. 15 degree before.
0 degree vs. 15 degree after.
0 degree supine vs. 15 degree Tilt after delivery

† denotes significance compared to before and after block
0 degree supine before vs. 0 degree supine after and
15 degree tilt before vs. 15degree tilt after

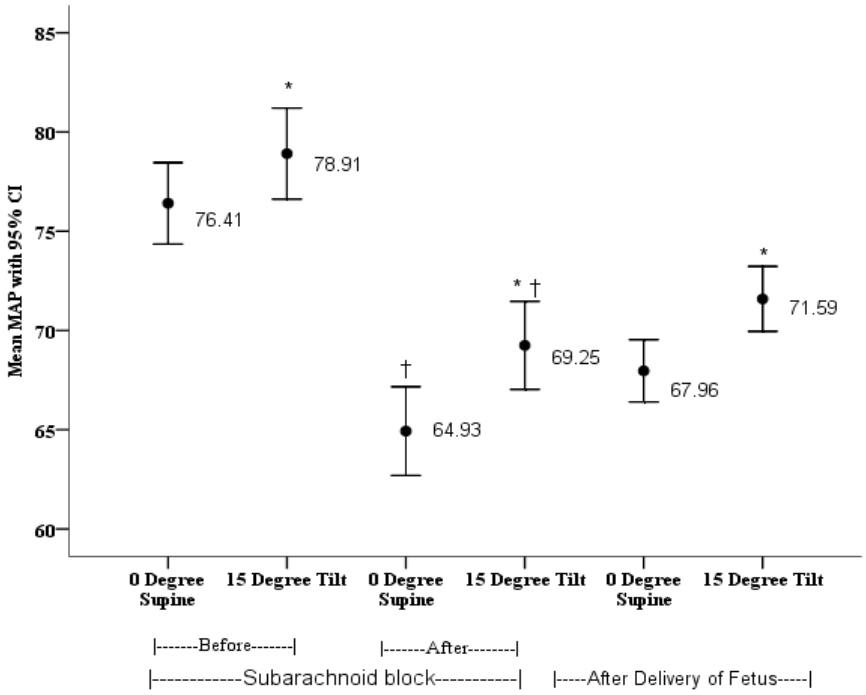

Figure 3: Comparison of MAP changes with different angles. Dot represents means with 95% confidence interval.

*** Denotes significance compared to**
0-degree vs. 15-degree before.
0-degree vs. 15-degree after.
0-degree supine vs. 15-degree Tilt after delivery

† Denotes significance compared to before and after block
0-degree supine before vs. 0-degree supine after and
15-degree tilt before vs. 15-degree tilt after

After the spinal injection, the heart rate increased by 25% when lying flat and by 17.9% when lying on the side. Bradycardia was not observed. Hypotension was significantly low at 15 degree left lateral tilt position as compared to 0-degree supine position similarly dizziness, pallor and nausea were significantly low at left lateral tilt position after subarachnoid block and after delivery of foetus as shown in table 1.

Table 1: Comparison of outcome before after Subarachnoid block and after delivery of foetus (n=55)

Outcome	**Subarachnoid block**				**After Delivery of Fetus**	
	Before		After		Delivery	
	Supine position	Left lateral Tilt	Supine position	Left lateral tilt	Supine position	Left lateral tilt
	0 degree	15-degree	0 degree	15-degree	0 degree	15-degree
Hypotension	0	0	27(48.2%)	16(28.6%)*	19(33.9%)	9(16.1%)*
Significant Hypotension	0	0	3(5.4%)	2(3.6%)	0	0
Tachycardia	0	0	14(25%)	10(17.9%)	0	0
Bradycardia	0	0	0	0	0	0

Dizziness	0	0	27(48.2%)	9(16.1%)*	12(21.4%)	5(8.9%)*
Pallor	0	0	8(14.3%)	1(1.8%)*	5(8.9%)	1(1.8%)
Nausea	0	0	24(42.9%)	13(23.2%)*	9(16.1%)	3(5.4%)*

*Comparison of Tilt vs. supine after block and delivery

4. DISCUSSION

Our study examined the hemodynamic changes in term pregnant women before and after subarachnoid block (spinal anesthesia) in both supine and left lateral tilt positions. While it is ideal for a pregnant woman to lie in a full lateral position to ensure adequate blood flow to the uterus and placenta and to maintain better hemodynamic, this position is not practical for surgical access. Thus, lateral table tilt or pelvic tilt was introduced. The current common recommendation, first introduced by Crawford et al.[8] in 1972, is to use a 15° lateral tilt achieved with a wedge-shaped cushion, which showed improvement in fetal acid-base balance and maternal hemodynamic. Secher et al.[9] also supported these findings. Conversely several studies have showed no improvement in maternal hemodynamics.[10-13] Our findings highlight the advantages of the left lateral tilt for term pregnant women both before and after spinal anesthesia.

We observed significant differences in heart rate (HR), systolic blood pressure (SBP), and mean arterial pressure (MAP) between the supine and 15-degree tilt positions prior to the subarachnoid block. This can likely be attributed to inferior vena cava (IVC) compression in the supine position, which is alleviated in the 15-degree tilt. These results contrast with those of Hasanin et al.[1] and Sunnino et al.[14] who reported no significant differences in HR, SBP, and MAP between supine and lateral tilt positions before spinal anesthesia. Highuchi et al.[15] found that 15-degree lateral tilt did not relieve IVC compression effectively. You et al.[16] also indicated that while a 15-degree tilt relieved IVC compression, it did not have a significant effect on hemodynamic parameters.

Following the subarachnoid block, we noted a significant decrease in HR, SBP, and MAP in the supine position compared to the 15-degree left lateral tilt ($p < 0.01$). This aligns with Lee et al.[17] who reported improved cardiac output in the 15-degree left lateral tilt position. Their findings further suggested that non-laboring women remained asymptomatic for aortocaval compression. Conversely, Sunnino et al.[14] did not observe significant variations in hemodynamics between the supine and 15-degree lateral tilt positions post-block.

After the subarachnoid block, heart rate increased by 25% in the supine position compared to 17.9% in the lateral tilt position, suggesting that the lateral tilt aids in maintaining better cardiovascular stability. This is consistent with the findings of Lee et al.[17] who also noted a more stable hemodynamic response in patients positioned with a lateral tilt during spinal anesthesia. The rise in heart rate in the supine position can be attributed to compensatory mechanisms in response to decreased cardiac output due to aortocaval compression, as described by Choi et al.[18] This contrasts with Chungsamarnyart et al.[19] who found no increase in heart rate, attributing the increase in cardiac output to enhanced contractility and stroke volume rather than myocardial chronotropy.

Hypotension was a significant issue in the supine position, with 48.2% of women experiencing hypotension after the subarachnoid block, compared to only 28.6% in the lateral tilt position. Post-delivery, the incidence of hypotension further decreased in the lateral tilt group (16.1%). These findings corroborate Hawkins et al.[20] who concluded that employing a lateral tilt significantly reduces the incidence of post-spinal hypotension in cesarean sections.

Symptoms such as dizziness, pallor, and nausea were notably reduced in the lateral tilt position, both after spinal anesthesia and post-delivery. These symptoms are commonly linked to hypotension and reduced cerebral perfusion, as highlighted by Pan et al.[21] who emphasized the importance of proper positioning to avoid adverse symptoms during cesarean deliveries.

Interestingly, vasopressors were required in only 23.21% of cases, suggesting that while the lateral tilt helps mitigate hypotension, some patients may still necessitate pharmacological intervention. Previous studies have also indicated that despite non-pharmacological measures, vasopressors like

ephedrine or phenylephrine are often needed to maintain hemodynamic stability during cesarean sections performed under spinal anesthesia.

5. CONCLUSION

In conclusion, the 15-degree lateral tilt is an effective non-pharmacological strategy for preventing significant hypotension, tachycardia, and other hemodynamic disturbances associated with spinal anesthesia during cesarean sections. Future research should focus on the long-term outcomes of such interventions and explore the use of advanced hemodynamic monitoring in resource-limited settings like Pakistan.

6. Conflict of interest

The authors declared no conflict of interest.

7. Disclosure

The authors declare that there are no nonmonetary disclosures related to this manuscript, including thesis work, pilot projects, or ongoing studies.

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