Section: Anaesthesiology

Original Research Article

IMPACT OF MATERNAL LATERAL TILT ON CARDIAC OUTPUT DURING CAESAREAN SECTION UNDER SPINAL ANAESTHESIA: A PROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background: Left uterine displacement (LUD) has been questioned as an effective strategy to prevent aortocaval compression after spinal anaesthesia (SA) for cesarean delivery (CD). We tested if LUD has a significant impact on cardiac output (CO) in patients undergoing cesarean delivery under SA during continuous non-invasive hemodynamic monitoring with OSYPKA MEDICAL Electrical cardiometry. **Materials and Methods:** Forty patients were included in the final analysis. We considered 2 time points of 5 min each: T3=after SA with LUD; T4=after SA without LUD. LUD was then repositioned for CD. The primary outcome was to evaluate the Impact of maternal lateral tilt on cardiac output during caesarean section under spinal anaesthesia. Other Parameters monitored are Heart Rate, Stroke volume, Stroke volume index, Cardiac index, Systemic Vascular Resistance, Systemic Vascular Resistance Index, Mean arterial Pressure, Systolic Blood Pressure and Diastolic Blood Pressure. Data analyzed from 40 patients were presented as mean, standard deviation, frequency and percentage. Continual variables were compared using paired sample t test. Significance was defined by P value less than 0.05 using two tailed test. Data analysis was performed using IBM-SPSS version 21.0(IBM-SPSS Science Inc., Chicago, IL). **Result:** In this prospective observational study, continuous hemodynamic monitoring, Cardiac Output did not show any significant variation after LUD removal under SA for cesarean delivery. Cardiac Output, Heart Rate, Stroke Volume, Stroke Volume Index, Cardiac Index, Systemic Vascular Resistance, Systemic Vascular Resistance Index, Mean Arterial Pressure, Systolic Blood Pressure and Diastolic Blood Pressure did not vary significantly with and without LUD after SA. **Conclusion:** Cardiac Output did not decrease significantly after LUD removal in patients under SA for Cesarean delivery during continuous hemodynamic monitoring. Optimization of fluid and vasopressor therapy may be sufficient to prevent aorto-caval compression by the gravid uterus and the consequent reduction of venous return after SA for Cesarean delivery. LUD did not show a significant impact on Cardiac output during continuous hemodynamic monitoring after SA for cesarean delivery.

INTRODUCTION

Since 1953, the gravid uterus in pregnancies at term has been recognized as a cause of aortic and caval compression in the supine position.[1,2] Later, experiments with venograms provided a visual evidence of the impaired venous return suggesting the adoption of the left uterine tilt in clinical practice.[3] In most patients, venoconstriction of the lower limbs allows complete compensation.[4] but sympathetic blockade following spinal anaesthesia (SA) for cesarean delivery (CD) blunts the cardiovascular compensatory mechanisms, exacerbating maternal hypotension and neonatal depression.[5–7] The introduction of a 15° left uterine displacement (LUD) was proposed for the first time by Crawford and colleagues in 1972, as a result of their experiments on 150 women undergoing CD under general anaesthesia.[8] However, there is no consensus on whether tilting the table improves maternal or neonatal outcome. In fact, not only LUD is rarely effectively achieved in every day practice.[7,8] making its efficacy in preventing aortocaval compression unreliable, but it may make the operation more difficult for the surgeon. The introduction of an optimized vasopressor and fluid therapy posed questions on its effective utility.[9–11] A Cochrane review found no differences in hypotensive events between supine and LUD patients.[12] Lee and colleagues measured CO, stroke volume (SV) and systemic vascular resistances by suprasternal Doppler ultrasound in not anesthetized parturients with four levels of left lateral tilt (0°, 7.5°, 15° and 90°).[13] showing that aortocaval compression can be effectively minimized by the use of a left lateral tilt of 15° or greater. On the other hand, Tsai and colleagues showed that NICOM hemodynamic monitoring could not detect any difference in cardiac index between patients with LUD and supine patients.[14] while Chungsamarnyart showed only modest hemodynamic advantages (higher CO, less hypotension, higher dP / dT) with pre-delivery LUD.[15]

Aim of the Study

The aim of this prospective observational study was to evaluate the Impact of maternal lateral tilt on cardiac output during caesarean section under spinal anaesthesia.

MATERIALS AND METHODS

Statistical Analysis

Data analyzed from 40 patients were presented as mean, standard deviation, frequency and percentage. Continual variables were compared using paired sample t test. Significance was defined by P value less than 0.05 using two tailed test. Data analysis was performed using IBM-SPSS version 21.0 (IBM - SPSS Science Inc., Chicago, IL)

This is a observational study conducted in a Tertiary care Government Hospital during March 2021 – July 2022 in 40 patients undergoing caesarean section under special anaesthesia. Sample size calculation: A sample size of 40 is required to study the impact of maternal lateral tilt on cardiac output during caesarean section under special anaesthesia.

Formula **Calculation** $n = \frac{z^2_{1-\alpha/2}\sigma^2}{\varepsilon^2\mu^2}$

$\sigma=0.8$, $\epsilon=4\%$, $\mu=6.1$

n = (3.84*0.64) / 0.06

n = 40

Inclusion Criteria

1. Written informed consent.
2. Age:18-35 years pregnant patients at term
3. Elective Cesarean
4. ASA I/II

Exclusion Criteria

1. Refusal to participate
2. ASA> 3
3. Cardiac arrhythmias or aortic regurgitation
4. Pregnancy-induced hypertension
5. Preeclampsia
6. BMI > 35 kg/m2
7. Fetal complications
8. Coagulation disorders or contraindication to neuraxial block
9. Emergency surgery
10. Conversion to General Anaesthesia

Methodology

After getting the informed consent. OSYPKA MEDICAL Electrical cardiometry used for the analysis. Anaesthesia was delivered in right lateral position using a 25-G Quinckes spinal needle at the L3-4 vertebral interspace, with hyperbaric 0.5% bupivacaine 2cc. Once the anaesthetic procedure was completed, all patients received a rapid crystalloid co-load of 7 ml/kg over 10 min. During surgery and after delivery, fluid management was left to the attending anaesthesiologist. We considered 2 time points. T3 = after SA with LUD, T4 = after SA without LUD. LUD was accomplished by positioning a wooden wedge and wrapped with cotton, to make it comfortable, and medical sheets with a measured angle of 15° under the right flank of the laying down patient. Hypotension is defined as an absolute value of MAP decreasing 20% from the baseline of 60. After delivery, Oxytocin 10 IU IM was administered

RESULTS

Data analyzed from 40 patients were presented as mean, standard deviation, frequency and percentage. Continual variables were compared using paired sample t test. Significance was defined by P value less than 0.05 using two tailed test. Data analysis was performed using IBM-SPSS version 21.0(IBM-SPSS Science Inc, Chicago, IL).

Table 1: Comparison of Hemodynamics between T3 andT4

Descriptive Statistics	T3		T4		
	Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	**P Value**
Cardiac Output	6.45	1.02	6.59	1.20	0.468
Heart Rate	85.70	13.89	82.80	6.43	0.246
Stroke Volume	77.20	11.85	78.50	12.68	0.54
Svi	46.10	7.49	47.60	4.03	0.151
Ci	3.82	0.49	3.96	0.59	0.137
Svr	1041.40	273.14	1093.10	206.61	0.218
Svr Index	1738.40	373.96	1698.22	305.09	0.498
MAP	84.50	6.01	84.10	9.23	0.591
SBP	111.60	5.13	112.10	5.81	0.53
DBP	71.00	8.14	69.60	12.13	0.137

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There were no statistically significant difference among two groups including cardiac output and other hemodynamic parameters.

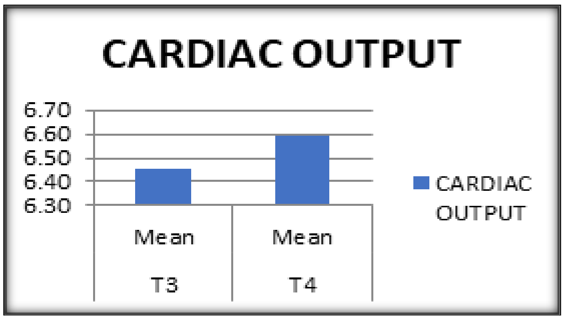

Figure 1: Comparison of Cardiac Output between T3 and T4

There were no statistically significant difference among two groups.

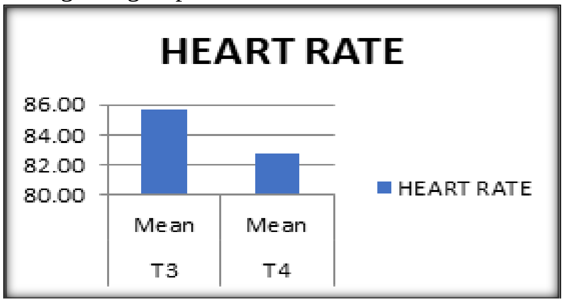

Figure 2: Figure 2: Comparison of Heart Rate between T3 and T4

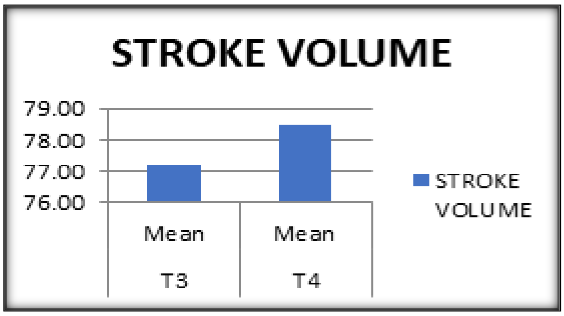

Figure 3: Comparison of Stroke Volume between T3 and T4

There were no statistically significant difference among two groups.

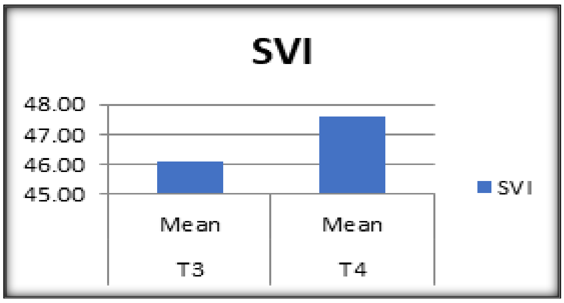

Figure 4: Comparison of Stroke Volume Index between T3 and T4

There were no statistically significant difference among two groups.

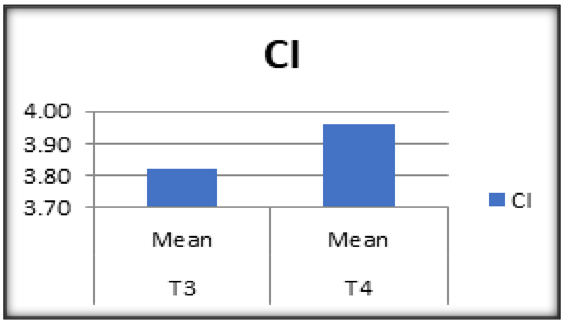

Figure 5: Comparison of Cardiac Index between T3 and T4

There were no statistically significant difference among two groups.

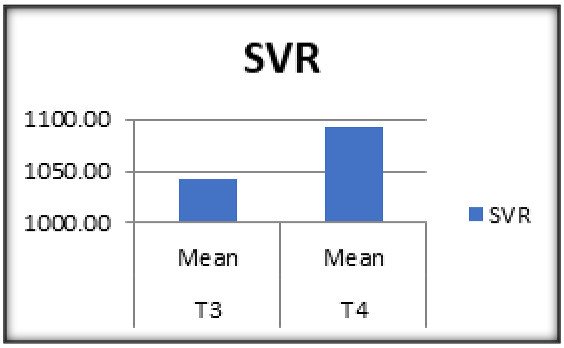

Figure 6: There were no statistically significant difference among two groups

There were no statistically significant difference among two groups.

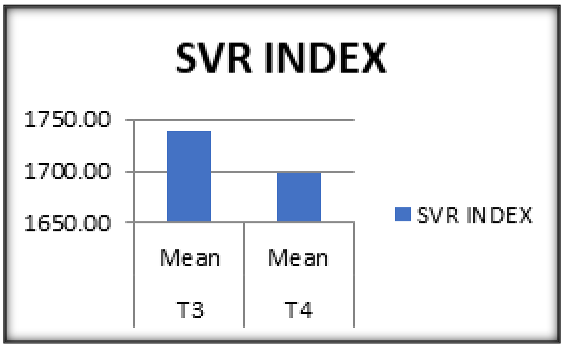

Figure 7: Comparison of Systemic Vascular Resistance Index between T3 and T4

There were no statistically significant difference among two groups.

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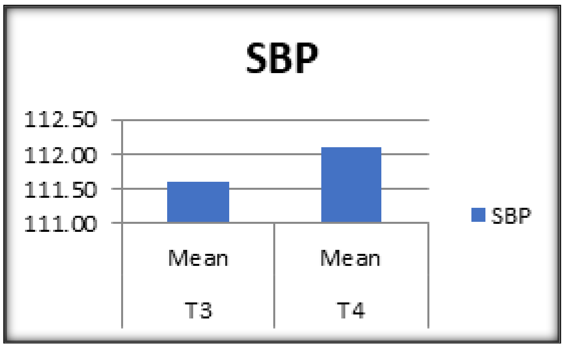

Figure 8: Comparison of Systolic Blood Pressure between T3 and T4

There were no statistically significant difference among two groups.

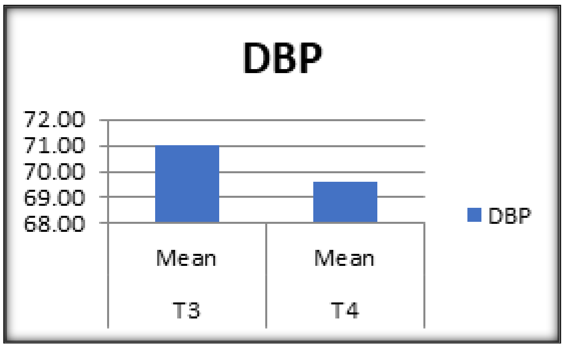

Figure 9: Comparison of Diastolic Blood Pressure between T3 and T4

There were no statistically significant difference among two groups.

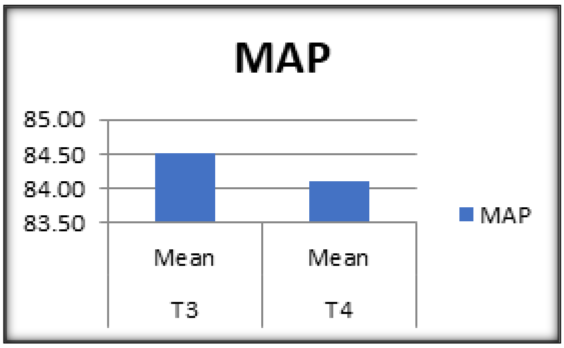

Figure 10: Comparison of Mean Arterial Pressure between T3 and T4

There were no statistically significant difference among two groups.

DISCUSSION

In this prospective observational study, continuous hemodynamic monitoring, CO did not show any significant variation after LUD removal under SA for CD. Cardiac Output, Heart Rate, Stroke Volume, Stroke Volume Index, Cardiac Index, Systemic Vascular Resistance, Systemic Vascular Resistance Index, Mean Arterial Pressure, Systolic Blood Pressure and Diastolic Blood Pressure did not vary significantly with and without LUD either at baseline or after SA. International recommendations suggest non-invasive blood pressure measurements every minute and prophylactic vasopressor infusion. optimal fluid and vasopressor therapy controlled the component of hypotension due to the aortocaval compression by the gravid uterus without consequences for the fetus. Cardiac Output is a better indicator of fetal perfusion than blood pressure, due to the changes in peripheral resistances that occur in pregnancy which do not necessarily reflect fetal perfusion Optimized fluid management and vasopressor therapy may allow an optimal uterine perfusion independently from aortocaval compression. The continuous hemodynamic monitoring allowed to better evaluate the impact of LUD on CO with standard anaesthetic management, correcting for inter-individual variables. Lee and colleagues measured Cardiac Output, stroke volume (SV) and systemic vascular resistances by suprasternal Doppler ultrasound in non-anesthetized parturients with four levels of left lateral tilt (0°, 7.5°, 15° and 90°).[13] showing that aortocaval compression can be effectively minimized by the use of a left lateral tilt of 15° or greater. On the other hand, Tsai and colleagues showed that NICOM hemodynamic monitoring could not detect any difference in cardiac index between patients with LUD and supine patients.[14] while Chungsamarnyart showed only modest hemodynamic advantages (higher CO, less hypotension, higher dP/ dT) with pre-delivery LUD.[15] Sonnino et al.[16] considered 4 timepoints of 5 min each: T1=baseline with LUD; T2=baseline without LUD; T3=after SA with LUD; T4=after SA without LUD.In that study,comparison of Cardiac Output between T1 and T2 ,T3 and T4 ,and other hemodynamic variables: mean, systolic and diastolic blood pressure (respectively MAP, SAP and DAP), heart rate (HR), stroke volume (SV), stroke volume variation (SVV), pulse pressure variation (PPV), contractility (dP/dt), dynamic arterial elastance (Eadyn) at the different time points was done. They found that there is no significant variation was registered for any variable at any time point. In our study we evaluate the Impact of maternal lateral tilt on cardiac output during caesarean section under spinal anaesthesia. Other Parameters monitored are Heart Rate, Stroke volume, Stroke volume index, Cardiac index, Systemic Vascular Resistance, Systemic Vascular Resistance Index, Mean arterial Pressure, Systolic Blood Pressure and Diastolic Blood Pressure. We found that Cardiac Output did not decrease significantly after LUD removal in patients under SA for Cesarean delivery during continuous hemodynamic monitoring. Optimization of fluid and vasopressor therapy may be sufficient to prevent aorto-caval compression by the gravid uterus and the consequent reduction of venous return after SA for Cesarean delivery. LUD did not show a significant impact on Cardiac Output during continuous hemodynamic monitoring after SA for Cesarean delivery.

Limitation

Firstly, its design does not include a control group but patients act as their own control after LUD removal before and after SA. On the other hand, the continuous hemodynamic monitoring allowed to better evaluate the impact of LUD on Cardiac Output with standard anesthetic management, correcting for inter-individual variables.

CONCLUSION

Cardiac Output did not decrease significantly after LUD removal in patients under SA for Cesarean delivery during continuous hemodynamic monitoring. Optimization of fluid and vasopressor therapy may be sufficient to prevent aorto-caval compression by the gravid uterus and the consequent reduction of venous return after SA for Cesarean delivery.

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