

Hemodynamic Effects of Position during Spinal Anaesthesia for Elective Cesarean Section

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ABSTRACT

Background: Gravid uterus beyond 20 weeks of pregnancy may compress aorta and inferior venacava leading to phenomena of supine hypotension, which is well described in obstetric anaesthesia literature. Based on this knowledge, obstetric anaesthetist were recommended to do left lateral tilt on their pregnant patients during cesarean sections. More recently MRI studies of compression effect of major vessels by gravid uterus, has revived interest and clinical trials of its effect on maternal hemodynamics and fetal well being.

Methods: We randomised sixty four women undergoing elective cesarean section into two groups immediately after spinal anaesthesia to either supine or left lateral tilt of 15 degrees. Hemodynamic variable, use of vasopressors and fluids were measured in both groups. Primary outcome is incidence of maternal hypotension and as a secondary outcome fetal blood gases (uterine venous base excess) were taken along with APGAR score to determine effect on fetal wellbeing.

Results: The incidence of hypotension between the two groups (9/32 vs 10/32) is similar and difference is not statistically significant ($p=0.72$). Even the degree of hypotension between two groups is not statistically different. Measures of fetal well being fetal blood gases and APGAR at 5 minutes are not different for supine or tilt group, however APGAR at 1 minute is better in tilt group.

Conclusion: Effect of position does not have any clinically significant effect on incidence of maternal hypotension and consequently on fetal well being.

Keywords: C-section, spinal anaesthesia, pregnant patients

INTRODUCTION

Late in pregnancy assuming supine position is related to aortocaval compression^{1,2}, decreased venous return, ventricular filling, stroke volume and resultant maternal hypotension alongwith compromised fetal blood supply³. This may exhibit within 3-10 minutes of assuming supine position⁴. It becomes even more important following a spinal anaesthesia for caesarean section⁵ when sympathetic blockade diminishes compensatory mechanism, leading to maternal hypotension⁶.

To avoid supine hypotension related to aortocaval compression, a left lateral tilt^{7,8} of 15-20 degree is recommended⁹ during cesarean section under spinal anaesthesia. A practice which is widely employed in United Kingdom and United States but not in Pakistan. We have undertaken a prospective randomised trial in Pakistani population to determine effectiveness of left lateral tilt to prevent hypotension after spinal anaesthesia for cesarean delivery.

METHOD

For this prospective randomised study, sixty four women undergoing elective cesarean section were randomised into two groups immediately after spinal anaesthesia to either supine ($n=32$) or left lateral tilt of 15 degrees ($n=32$). For analysis, α 0.05 and 90% power we calculated sample size of thirty-two per group. Hemodynamic variable, use of vasopressors and fluids were measured. Primary outcome is incidence of maternal hypotension and as a secondary

wellbeing. Patient is clinically managed and monitoring data is collected by unblinded anaesthesiologist.

For inclusion purposes, elective cesarean section of ASA II/III (Pregnancy classed as ASA II, as approved ASA House of Delegates on October 15, 2014) women above 18 year old with term, singleton, uncomplicated pregnancy were included. Women with hypertensive disease of pregnancy, diabetes, abnormal lie of fetus and BMI > 40 kg/m² were not included. Ballot method was used for random allocation of patient into supine or left lateral tilt group.

All patients were monitored with electrocardiogram, pulse oximetry and non invasive blood pressure on arm using standard adult cuff. The width of cuff is at least 20% wider than the diameter of the upper arm.

Baseline recordings of heart rate and blood pressure were made in the sitting position. Fluid Ringer lactate is co-loaded via 18/20 G IV access and patient is positioned sitting up for spinal anaesthesia. A low lumbar interspace L3/4 or L4/5 is palpated, 25G pencil point needle with hyperbaric bupivacaine 0.75%, 1.4-2 ml with no additive is used depending on height of patient. Following which patient is laid either supine or left lateral position depending on the group allocation. Operating room assistant tilted table as directed by randomising person and checked table surface for degree of tilt by anglemeterPRO2 app on smartphone. No supplemental oxygen via facemask is given unless oxygen saturation is <95%.

Following data is collected: heart rate and blood pressure every two minute for first ten minutes and the every five minutes till end of procedure; height of block, defined as no cold sensation using alcohol swab before incision then every 10 minutes; and use of medicines/ fluids. For fetal wellbeing APGAR score at 1-minute and 5-minute along with uterine blood gas is recorded.

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outcome fetal blood gases (uterine venous base excess) were taken along with APGAR score to determine effect on fetal

Immediately after administering drug intrathecally, doses of phenylephrine intravenously were given as required by blood pressure monitoring. Hypotension is taken as 25% decrease from baseline value or systolic blood pressure less than 90 mmHg.

RESULTS

Seventy five women met eligibility criteria and took part in the study. Four women were excluded due to crucial missing data. Seven women were excluded due to protocol violation, surgeon not willing to operate with tilt, conversion to general anaesthesia, maternal request for General anaesthesia.

Demographic data of the two groups is shown in table. This data is comparable with no statistically significant difference between the two groups. The baseline BP for supine 129±10.7 vs tilt group 130±10.3 difference is not statistically significant and the sensory block achieved is T6.

The incidence of hypotension for supine (9/32) versus tilt group (10/32) is similar with no statistically significant difference (p=0.79). Even the degree of hypotension is similar in two groups with supine (19.1±10.5) vs tilt (19.7±11.6). The measures to maintain blood pressure include use of vasopressor drug (phenylephrine) and fluid. Their use is also similar between the two groups, with supine 91mcg [0-800] versus tilt 114 mcg [0-500].

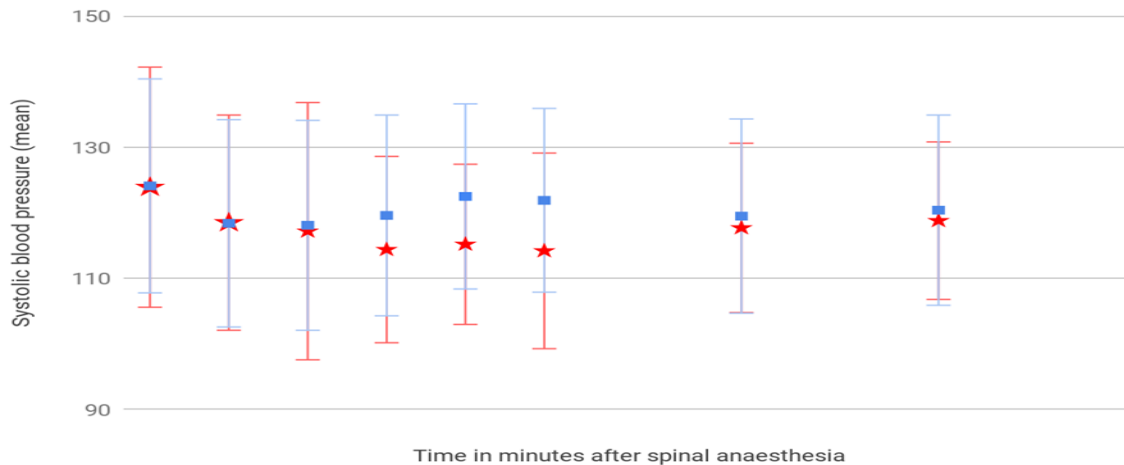
Mean systolic blood pressure at two minute interval for first 10 minutes, every five minutes for next ten minutes shows no statistically significant difference between the supine and tilt group (Graph1).

The fetal wellbeing parameters of APGAR score at 1-minute is statistically significant better for tilt group compared to supine group, however APGAR at 5-minute between two groups is same. Umbilical blood gases (pH and base excess) show no difference between the two groups.

Table 1: Demographic data and details of block

	Tilt (n=32)	Supine (n=32)
Age (years)	30	28

Graph 1: Mean systolic blood pressure and standard deviation over every 2-minutes after spinal anaesthesia for first ten minutes every and then every five minutes for next ten minutes. Blue square= supine group, Red star = tilt group



Graph 2: Mean heart rate and standard deviation plotted against time interval at which recorded for the supine (Blue square) and tilt (Red star) group. No statistically significant difference between the group over time

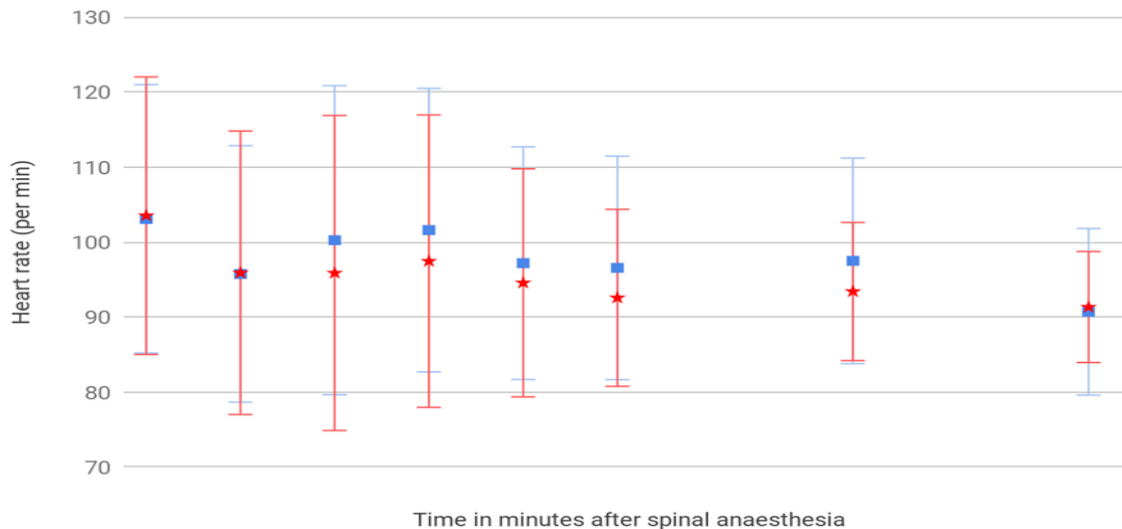
	75	70
Weight (kg)	75	70
Sensory level of block- median/ range	T6 [T4-T8]	T6 [T4-T8]
Duration of surgery (min)- mean/ range	25 [15-35] (+/- 5.4)	22 [14-56] (+/-7.9)
Local anaesthesia dose	1.5ml; 11.25mg	1.5ml; 11.25mg
Previous c section	1[0-4]	0 [0-4]

Table 2: Hemodynamic data of the two group (supine and tilt)

	Tilt	Supine	P value
Baseline systolic BP (mean, SD)	130± 10.3	129± 10.7	0.98
Baseline mean BP (mean)	95±	97±	0.45
Baseline heart rate (mean)	102±	101±	0.87
Cumulative incidence of hypotension	10/32	9/32	0.79
Phenylephrine consumption mean/ range mcg	114 [0-500]	91 [0-800]	0.69
Atropine mcg	0[0-600]	0 [0-400]	0.12
Fluid	1876 [1000-2000]	1741 [1000-2200]	0.18

Table 3: Fetal well being data between the two groups (supine and Tilt)

	Tilt	Supine	P value
APGAR score@1min	7.3	7	0.03
APGAR @ 5 min	9.1	9	0.74
Uterine venous blood gas			
pH	7.32	7.34	0.3
PO2	25	23	0.52
PCO2	44	41	0.09
HCO3	23	22	0.18
Base Excess	-3	-3.4	0.23
Hct	42	43	0.98
Weight of neonate in kg	2.8	2.9	0.75



DISCUSSION

Since 1960s pregnant women at term are positioned with left lateral tilt to avoid 'supine hypotension syndrome'. This was based on study by Scott and Kerr (1963) which showed almost complete occlusion of inferior vena cava¹¹. More recent studies using MRI 12 and cardiac output parameters showed conflicting results for degree of tilt that has effect on inferior vena caval compression however it does show difference between complete left lateral and supine position but only a marginal difference for tilt angles less than 90. Patient can be tilted by either tilting table or putting a wedge under right hip, both are effective ways of achieving pelvic tilt¹³. By excluding high body mass index patients, additional rotational effect of uterus that might change angle of tilt is avoided¹⁴ and weight of newborn is similar in the two groups which may have a differing impact on degree of compression. Tilting patient is not only of concern to anaesthetist who has to reassure a patient who fear slipping off table, take measure to prevent fall and safeguard IV access/ infusion/ attached monitoring but also surgeon who may find it difficult to operate and put fundal pressure when needed. Despite the emerging new data and inconvenience of positioning the prevalent practice of tilting patient continues.

Our study looks at maternal hemodynamics as well as fetal outcome in terms of clinical score APGAR and biochemical parameters.

MATERNAL HEMODYNAMIC

Overall Incidence of hypotension would vary with the way hypotension is defined⁵. There are several cutoff levels of which 25% decrease from baseline systolic blood pressure or <90 mmHg is defined for the purpose of this study. The incidence does not differ between the two groups compared (31.2% tilt; 28.1% supine) and is inline with published studies (<90 mmHg 31.1%; 25% decrease from baseline 38.5%). It is Initial time after spinal anaesthesia which is crucial from blood pressure management point of view. Given that average duration of surgery from skin incision to closure is 25 minutes for tilt and 22 minutes for supine position, detailed breakdown of initial twenty minutes after spinal anaesthesia would help to decipher time

based difference between the two groups. Mean systolic blood pressure of the two groups was plotted against time interval as recorded (every two minute for first ten minutes and then every five minutes for next ten minutes, Refer to graph 1). There is no statistically significant difference at each time interval recorded.

Another parameter by which hypotension can be looked at is the duration of hypotension. The duration of sustained hypotension of more than four minutes is associated with neurobehavioural changes in newborn¹⁵. The post hoc analysis shows similar incidence of duration of hypotension of an average four minutes, however study is not adequately powered for this outcome.

Fetal outcome: APGAR score is commonly used in clinical practice and research studies to show newborn's wellbeing. However, even if scored by pediatrician it is subject to inter-observer variation and is controversial as an indicator of fetal hypoxia or neonatal morbidity.

Choice of vasopressor is also important as it may contribute to fetal acidosis. Therefore, phenylephrine is used in this study as recommended by International consensus statement on the management of hypotension with vasopressors during caesarean section under spinal anaesthesia¹⁵. The two groups have no significant difference in use of phenylephrine, atropine and fluid that could impact fetal acidosis.

APGAR score at -minute is marginally better in tilt group (7.3 tilt vs 7 supine) which is statistically significant ($p < 0.03$). However, it is not sustained at 5-minute when both groups have no significant difference.

The other parameter used is umbilical blood gas, both pH and base excess is considered to assess newborn. pH again is subject to other metabolic stresses and may not accurately reflect current status. Respiratory acidosis¹⁶ is not associated with adverse outcome although it would lower pH. The cut off value of 7.18 is above which adverse neonatal outcome is rare. More recently this cut off is further reduced to 7.017 which is independent predictor of neonatal seizures. Base excess is used to estimate metabolic acid load which is a risk factor of neurological injury¹⁶. It is considered as a linear and relatively simpler measure, with a cut off of -12 mmol/L¹⁸ or lower, associated with adverse events.

Base excess of neonates born of elective cesarean section (without labour contractions) is comparable to normal adult values. In the study base excess is within normal range in both groups and is not statistically different. Only one newborn in supine group had base excess <-12 mmol/L threshold, although pH was 7.25 with normal APGAR score and did not require any cardiopulmonary resuscitation. Of note newborn had a very low hematocrit of 34% which one can only hypothesize to be due to accumulation of lactic acidosis, as blood gas analyser does not measure lactate. There was no below base excess threshold value in tilt group.

This study included ASA 2 women with uncomplicated pregnancy, results of this cannot be extrapolated to women with cardiovascular co morbid or emergency cesarean section in which fetus may already be compromised/ non reassuring.

Data from umbilical blood gas also brings into focus low Hct value of newborns in the population studied. Hematocrit value less than 45% for term infant is considered anemia, whereas normal value is $61\% \pm 7.4\%$ 19. It has implications not only for oxygen delivery and metabolic acidosis but also on brain growth 20.

CONCLUSION

Effect of position does not have any clinically significant effect on incidence of maternal hypotension and consequently on fetal well being.

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