Comparison of incidence of post spinal hypotension between pre-loading and co-loading of fluid in parturient undergoing elective caesarean section with perfusion index greater than 3.5.

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Abstract
Background: Spinal anesthesia is most preferred method of anesthesia in both emergency and elective caesarean deliveries. It helps reduce complications related to general anesthesia but it has spectrum of complications, most common being hypotension due to sympathetic blockade. Perfusion index greater than 3.5 is associated with higher incidence of post spinal hypotension. Preloading and coloading of crystalloid have been studied and showed different results, this study compares preloading and coloading in patients with PI>3.5.
Materials and Method: Sixty-four (32 each group) parturient with PI>3.5, ASA II and posted for elective caesarean delivery were enrolled. Preload group (group P) and Coload group (group C) both received 15ml/kg of fluid through 16 G IV cannula. Preload group received 20 minutes before and group C received right after spinal anesthesia. Vitals were recorded at baseline, every two minutes for first 10 minutes then every five minutes there after till end of operation. Bupivacaine heavy 0.5% 2ml was given at L3-4 in sitting position. Severe hypotension was treated with bolus Mephentermine.
Results: Demographic data were comparable between groups. Systolic, diastolic and mean arterial pressure, heart rate, saturation showed no statistical significance. Incidence of hypotension was 68.75% in group P. 62.5% in group C (p=0.599). 59.37% received vasopressor in group P and 37.5% received vasopressor in group C (P=0.08). There was no statistically significant difference between the two groups.
Conclusion: Both Preloading and coloading of fluid decreased incidence of hypotension in parturient with PI value greater than 3.5. The reduction in incidence of hypotension was more in group C. Need of vasopressor was more in group P. The results being statistically not significant we cannot recommend one method over the other.

***Keywords*:** Caesarean section, perfusion index, crystalloid, hypotension, spinal anesthesia

I. INTRODUCTION

Spinal anesthesia (SA) is the most preferred anesthetic method in caesarean deliveries because it eliminates the potential risks associated with airway management in pregnant women. SA leads to hypotension in approximately 70% of patients (all perfusion index value) which may vary based on the definition of hypotension used (1). Commonly used definition is systolic arterial blood pressure below 90 mmHg (2) and 20% decrease from baseline(3).

Post spinal hypotension (PSH) which may cause severe adverse effects in mothers along with mild symptoms like nausea, vomiting, dizziness, and may cause umbilical arterial acidosis in infants. An ability to identify those who would suffer from hypotension following spinal anaesthesia would give clinicians an opportunity to take preventive measures and treat this complication to reduce maternal and neonatal morbidity (4). On the other hand, unnecessary infusion of large amount of fluid with aim to prevent PSH will be deleterious to the patient especially to those with cardiac, renal compromises (5). Studies have been carried out with noninvasive methods like Tilt test (6), thoracic electrical bioimpedance(7), measurement of heart rate variability(8), cerebral near-infrared spectroscopy (9), point-of-care ultrasound (10), perfusion index (PI) (11) and Pleth variability index (PVI) (12) to predict which parturient would develop hypotension.

Non-invasive blood pressure (NIBP) is standard practice in BP monitoring but its intermittent and may fail to diagnose hypotension timely (13). PI is also non-invasive but gives continuous monitoring. Perfusion Index is the ratio of the pulsatile blood flow to the non-pulsatile static blood flow in a patient's peripheral tissue such as in a fingertip, toe, or ear lobe and is obtained from a pulse oximeter. Previous researches have shown that baseline PI greater than 3.5 as cut off value in identifying parturient at risk of post spinal hypotension (14)(15)(16)((17)(18). The incidence of hypotension in PI less than 3.5 was 18.8% compared to 81.3% in parturient with PI greater than 3.5(16).

Though researches have shown PI greater than 3.5 is a good predictor of post spinal hypotension, there is limited researches comparing use of preload or co-load of fluid as prevention measure of post spinal hypotension in parturient with PI value greater than 3.5. So, whether preload or co-load is better in prevention of post spinal hypotension and to what extent preloading and co-loading of fluid reduces incidence of PSH in parturient with PI greater than 3.5 is still not clear

II. MATERIALS AND METHOD

After obtaining approval from Institutional review committee of Phect Nepal, this prospective comparative clinical study was done in Kirtipur hospital running under phect Nepal. Sixty-four parturient were enrolled in this study after taking informed written consent and meeting the inclusion criteria.

Inclusion criteria included perfusion index greater than 3.5, Singleton pregnancy, term (gestational age >36 weeks) pregnancy, age 18-40 years, ASA II, posted for elective caesarean section, written informed consent provided. Exclusion criteria included patient refusal, emergency cases age less than 18 and greater than 40, gestational age < 36weeks, ASA III and IV, placenta previa, preeclampsia/eclampsia, cardiovascular or cerebrovascular disease, gestational diabetes, twin pregnancy, hypertensive and those who had contraindication to spinal anesthesia. Included 64 parturient were randomly (lottery method) assigned to two groups, Group P (preloading) 32 and Group C (co-loading)32. Baseline measurements including height, weight, age, diagnosis, blood pressure (systolic, diastolic and MAP), heart rate, saturation was recorded once assigned to a group. Participants were confirmed nil per oral status as per protocol for elective surgery. Intravenous line was opened with 16G cannula. Participants assigned to P group got 15ml/kg of crystalloid fluid (Ringer's Lactate) within period of 20 min in supine position. For participants assigned to co-loading (C group) 15ml/kg of similar fluid was given under pressure bag immediately after spinal anaesthesia was given. Spinal anaesthesia included inj. Bupivacaine heavy 0.5% 10mg at L3-4 interspace with 26 G spinal needle in sitting position. Level of spinal blockade was assessed with cold sensation to spirit (ethyl alcohol). Once the level of T4 achieved, operation was started. Hypotension was considered if systolic blood pressure was less than 90 mmHg or 20% decrease from baseline value. After giving calculated fluid participants got maintenance fluid using 4:2:1 method. Mephentermine 6 mg was used if hypotension occurred and repeated if needed. Heart rate less than 50 beats per minute was considered bradycardia and treated with atropine 0.6mg. Patient were withdrawn from the study if excessive blood loss occurred needing transfusion or converted to general anaesthesia. Vitals were recorded at the start (baseline) then every 2 minutes from start of spinal anaesthesia till delivery of baby and every 5 minutes thereafter till the end of surgery.

Results on continuous measurements were presented as mean ± standard deviation (SD), and results on categorical measurements were presented as number (%). Student's t-test was used for quantitative data, Pearson's chi-square test was used for categorial variables for comparison between the groups. P-value of <0.05 was considered to be statistically significant. Data were tabulated using excel and analyzed using SPSS 26.

III. RESULTS

Demographic data were comparable between the groups and showed no any statistically significant difference (Table 1)

	Group P	Group C	P value
	Mean±SD	Mean±SD	
Age	27.69±3.43	28.09±4.21	0.674
Weight	70.19±9.08	69.54±10.27	0.791
Height	5.11±0.25	4.98±0.35	0.082

Table 1: Distribution of cases based on age, weight and height.

The baseline vitals were comparable between two groups and difference between the two groups were not statistically significant (Table 2).

	Group P	Group C	P value
	Mean±SD	Mean±SD	
SBP	122.81±11.59	127.16±12.36	0.152
DBP	78.47±12.86	79.19±7.14	0.783
MAP	90.22±9.44	93.38±9.07	0.178
Pulse rate	97.28±14.96	100.53±13.57	0.366

PI	6.88±2.98	6.28±2.48	0.383

Table 2: Comparison of baseline values between the two groups

The changes in systolic blood pressure during the first hour after spinal anesthesia showed no any statistically significant difference as shown in table 3.

SBP	Group P	Group C	P value
	Mean±SD	Mean±SD	
M1	119.75±15.65	123.03±11.89	0.349
M3	110.56±17.90	114.06±17.84	0,436
M5	109.03±19.28	112.22±17.80	0.495
M7	113.66±17.74	110.48±14.48	0.310
M9	113.44±20.42	113.28±14.77	0.972
M15	115.28±15.25	111.66±15.21	0.345
M20	117.66±11.41	112.22±14.23	0.097
M25	115.66±14.22	117.53±14.53	0.604
M30	114.16±12.70	115.66±11.67	0.628
M35	112.71±11.40	11.44±14.44	0.492
M40	111.66±11.99	111.94±13.97	0.982
M45	112.68±12.89	113.94±10.84	0.686
M50	113.11±13.52	112.17±10.71	0.651
M55	111.22±12.37	112.18±10.18	0.762
M60	113.40±10.69	111.35±10.54	0.531

Table 3: Comparison of systolic blood pressure (SBP) during first hour of spinal anesthesia.

The changes in mean arterial pressure (MAP) during the first hour after spinal anesthesia showed no any statistically significant difference as shown in table 4.

MAP	Group P	Group C	P value
	Mean±SD	Mean±SD	
M1	83.22±14.99	88.00±13.17	0.180
M3	76.34±15.01	81.22±17.00	0.229
M5	74.22±14.81	78.06±15.38	0.313
M7	79.41±16.37	76.91±13.84	0.512
M9	80.41±18.16	78.72±11.46	0.656
M15	80.91±12.92	77.03±12.97	0.236
M20	82.84±10.13	77.66±12.27	0.070
M25	80.25±10.84	79.34±12.60	0.759
M30	79.26±10.82	79.72±10.74	0.866
M35	76.58±9.17	76.59±13.70	0.996
M40	77.29±9.33	76.45±10.98	0.756
M45	76.79±11.08	79.32±7.98	0.313
M50	76.26±9.25	77.30±9.21	0.672
M55	76.83±11.44	76.18±8.23	0.815
M60	80.58±8.82	75.43±7.96	0.052

Table 4: Comparison of MAP during first hour after spinal anesthesia

Comparison of heart rate during the first hour after spinal anesthesia showed no statically significant difference in between the two groups as in table 5.

HR	Group P	Group C	P value
	Mean±SD	Mean±SD	
M1	99.19±17.00	103.22±17.85	0.359
M3	100.88±18.37	101.19±18.05	0.945
M5	97.19±18.55	100.19±19.64	0.532
M7	100.50±16.92	98.97±17.76	0.725
M9	94.88±16.66	95.13±14.81	0.950

M15	94.0622.50	96.31±19.40	0.670
M20	94.34±19.87	95.88±18.03	0.748
M25	91.75±18.85	93.78±16.44	0.648
M30	92.48±14.79	94.72±14.96	0.553
M35	89.87±15.94	96.31±15.63	0.110
M40	90.39±12.66	94.42±18.29	0.335
M45	91.57±14.06	90.97±16.12	0.879
M50	91.00±13.08	92.60±15.25	0.674
M55	90.13±11.15	93.18±17.48	0.473
M60	84.15±8.85	97.05±13.40	0.001

Table 5: Comparison of heart rate (HR) during the first hour after spinal anesthesia.

The incidence of hypotension in group P was 68.75% and 62.5% in the group C, but the difference was not statistically significant. There was difference in need of Mephentermine among two groups but the difference was not statistically significant. 19 parturient needed Mephentermine in group P among them 1 got 18mg, 7 got 12mg and 11got 6 mg of Mephentermine. 12 parturient needed Mephentermine in group C among them 3 got 12 mg and 9 got 6mg of Mephentermine.

	Group P	Group C	P value
Number of patients with hypotension	22 (68.75%)	20 (62.5 %)	0.599
Number of patients requiring inj. Mephentermine	19 (59.37%)	12 (37.5%)	0.08

Table 6: Incidence of hypotension

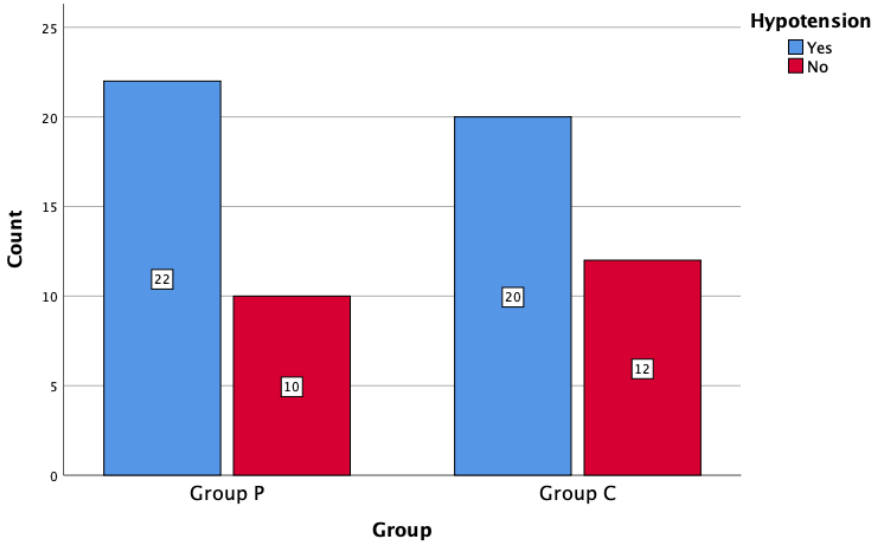

Figure 1: Incidence of hypotension between the group P and group C.

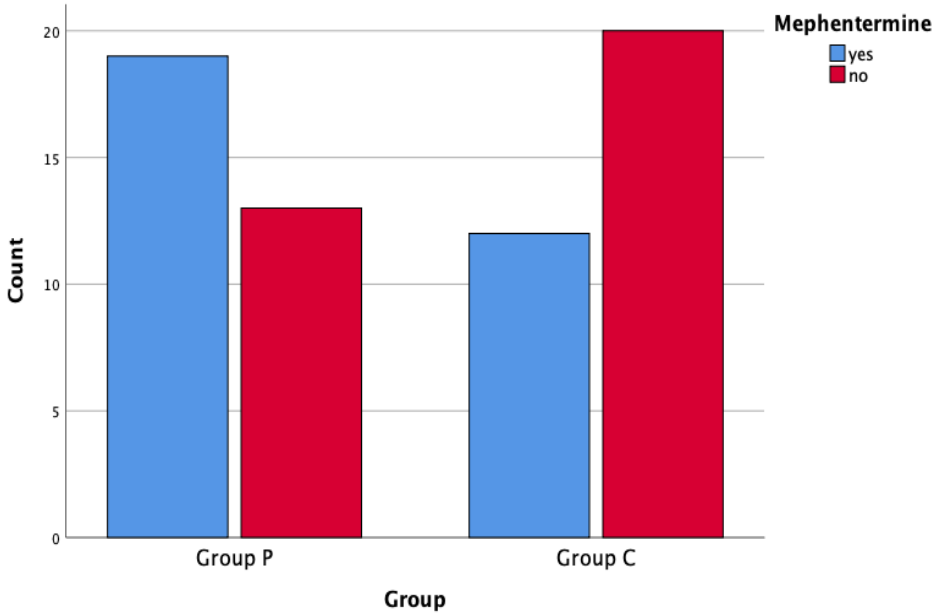

Figure 2: Use of Mephentermine between the group P and group C.

IV. DISCUSSIONS

Spinal anesthesia is choice of anesthesia for both elective and emergency LSCS unless otherwise contraindicated. Spinal anesthesia helps to reduce the complications associated with general anesthesia and also allows mothers to have experience of birth of their baby. Despite the benefits spinal anesthesia also has its associated risks and complications.

Spinal block causes peripheral vasodilation and venous pooling due to blockade of preganglionic sympathetic fibres (19)(7) leading to hypotension of various degree causing mild symptoms to severe complications. Aortocaval compression caused by the gravid uterus is also one of the reason for hypotension in late pregnancy (20). Maternal hypotension could be detrimental to both mother and new born if left unprevented and untreated.

Various methods of preventing hypotension have been studied like preloading and co-loading of crystalloid or colloid, bolus or infusion of various vasopressors, leg raising, applying bandages etc. Instead of applying preventive measure to every patient it would be great if we could predict whether patient is going to develop hypotension or not and apply preventive measures accordingly because bolus of fluid or vasopressor for prevention of hypotension might have deleterious effect in certain patients.

Various methods have been used to predict post spinal hypotension but perfusion index being noninvasive, easy and inexpensive has been used for prediction of post spinal hypotension.

Toyama et al. (2013) found that cut-off PI value of 3.5 identified parturients at risk for spinal anaesthesia-induced hypotension with a sensitivity of 81% and a specificity of 86% (P=0.001)(17).

Pyakurel et al. (2020) found incidence of hypotension in PI<3.5 group was 18.8% compared to 81.3% in those with PI > 3.5 (*P* = 0.000, odds ratio 0.11).

Varghese (2018) (22) showed the incidence of hypotension is 86.67% in group with PI >3.5 whereas it is 6.67% in group with PI < 3.5.

In our prospective comparative study, the incidence of hypotension showed reduction from 81.3% in those with PI>3.5 as per Pyakurel et al. (2020) to 68.75% (group P) and 62.5% (group C) both group in our study comprised PI value greater than 3.5. Of those with hypotension only 59.37 percent needed vasopressor in group P and 37.5% needed vasopressor in group C. Though there is difference in need of vasopressor between group P and C statistical significance was not found (p value=0.08).

Kulkarni et al. (2016) (22) showed the incidence of hypotension was more in preload group (72%) than coload group (46%), P value 0.004. Our study showed the incidence of hypotension 68.75% in group P and 62.5% in group C, lower than that in group P but the difference between the group was not statistically significant. This difference in result could be methodological as we only enrolled parturient with PI greater than 3.5 where they did not have this criterion, we used 15ml/kg of fluid whereas they used 20ml/kg of fluid.

Dyer et al. have compared co-loading and preloading of fluid and their results showed co-loading was better in reducing incidence of hypotension (23). Volume of fluid infused also varies among previous studies. Some used 15ml/kg, some 20ml/kg and some used 30ml/kg.

Heart rate variability during the first hour of spinal anesthesia also showed no significant difference between the groups. There was slight decrease in heart rate after the fluid was given in both the groups. This was similar to Dyer et al. (23) and (22), their study too showed no significant difference in heart rate between the preload and coload group.

We preloaded the fluid within 20 minutes before the spinal anesthesia. Previous study (24) has shown that there was no difference in incidence of hypotension between preloading of fluid in 10 and 20 minutes before spinal anesthesia.

Mean arterial pressure (MAP), Diastolic blood pressure (DBP) and SpO2 changes between two groups were not significant.

Though in literature coloading of fluid has shown better results in prevention of post spinal hypotension in general pregnant population under going LSCS. There are not many studies comparing preloading and coloading of crystalloid only among patients with PI greater than 3.5 (high incidence group). Our study showed there was low incidence of hypotension in coloading group and vasopressor need was also low in coloading group but this difference was not statistically significant. We need more of such studies in patients with PI greater that 3.5 to come with a recommendation in method of preventing hypotension and reducing incidence as low as in group with PI value less than 3.5.

V. CONCLUSIONS

This study showed both preloading or coloading of crystalloid fluids led to reduction in incidence of hypotension compared to incidence of hypotension in patient with PI greater than 3.5. The reduction in incidence of hypotension was greater in group C, use of vasopressor was less in group C compared to Group P. Though there is difference in result between the groups result was not statistically significant so we cannot recommend one method over the other.

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