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Research Article

Comparison of Crystalloid Preloading with Co-Loading on Maternal Hemodynamics in Elective Lower Segment Caesarean Section under Spinal Anaesthesia

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ABSTRACT

Background: Spinal anaesthesia is the most common technique used for lower segment caesarean sections(LSCS). but it has own disadvantages too. Maternal haemodynamic changes is more profound in pregnant population. Aim of the study was to compare the maternal haemodynamic changes with crystalloid preloading and co-loading in patients undergoing elective lower segment caesarean section under spinal anaesthesia.

Methods: 80 obstetric patients with period of gestation (POG) more than 37 weeks, in the age between 18 to 35 years, belonging to ASA class I and II and scheduled for elective LSCS were randomized into two groups. Group P - Patient receiving preloading with Ringer Lactate at a dose of 15ml/kg. Group C – Patient receiving Co-loading with Ringer Lactate at a dose of 15ml/kg. Primary objectives of the study were haemodynamic changes like Heart rate (HR), Systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) and these parameters were recorded baseline, at 1 min interval for first 10 minutes, after that at 5 minutes till 20 minutes and then every 15 min till completion of procedure.

Results: The demographic data were comparable in group P and group C. The mean (SD) HR was significantly higher in group P as compared to group C at 5,6,7,8 and 9 minutes ($p < 0.05$). The mean (SD) SBP, DBP and MBP was significantly lower in group P as compared to group C at 5,6 and 7 minutes ($p < 0.05$). Significant difference was seen in the distribution of nausea/vomiting score between group P and C. (p value<.05).

Conclusion: We conclude that co-loading with crystalloids is provide more Maternal Hemodynamics stability after subarachnoid block rather than preloading with crystalloids.

Spinal anaesthesia is the most common technique used for caesarean sections. but it has own disadvantages too. The sympathetic blockade after spinal anaesthesia causes decrease in total peripheral resistance due to arterial dilation and peripheral venous pooling due to venodilation [1]. Hypotension is more profound in pregnant population. Contributing factors being the effect of gravid uterus causing aortocaval compression, increased susceptibility to the effects of sympathectomy [2]. The catastrophic effects of maternal hypotension are not only limited to mother, but also to the foetus due to reduced placental blood flow, leading to low APGAR scores, foetal acidosis and or permanent neurological damage [3-4].

Various methods are used to prevent this hypotension such as loading IV fluids, timing of administration of IV

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fluids, prophylactic use of sympathomimetics, placing the patient in 15° left lateral tilt, reducing the dose of spinal drug by addition of additives (opioids). Sympathomimetic such as mephentermine, Norepinephrine, phenylephrine and ephedrine are used to counteract hypotension after neuraxial anaesthesia in obstetrics patients [5-6].

Wollman and Marx in 1968, infused patients with fluids prior to administration of the block and they coined the term 'Pre-load' [7]. Infusing the patients with fluids prior to the administration of block i.e. Pre–load increases the blood volume and thus compensate for the "relative hypovolemia" that follows.

Preloading although routinely carried out before the institution of neuraxial block is being questioned now days because distribution of crystalloids fluids from the plasma to the interstitium require 25 to 30 min for the completion [8]. Thus, pre-load fluids rapidly re-distribute into the extravascular compartment thus offsetting the increase in intravascular fluid volume. It also induces atrial natriuretic peptide secretion (ANP) resulting in peripheral vasodilation followed by increased rate of excretion of preload fluids. Since a large volume of fluid is needed to pre-load, it may be disadvantageous in settings of hyperdynamic circulation like pregnancy, renal and cardiac dysfunction leading to cardiac failure and pulmonary oedema [9]. Also, in emergency situations where not much time is available, pre-load cannot be done adequately. Increasing the volume of preloading fluid may not able to maintain hemodynamic stability after spinal anaesthesia. In fact, may have a harmful effect by decreasing the colloidal osmotic pressure to below physiologic values [10].

As crystalloids do not remain in the intravascular space but distribute quickly into the extracellular fluid so the timing of infusion may be the main factor to prevent hypotension. Due to this, the use of the co-loading technique i.e. applying fluids at the time of administering the intrathecal local anaesthetic. Mercier et al. suggested that applying fluid loading at the time of administering the intrathecal local anaesthetic is a more rational approach for the prevention of post spinal hypotension [11]. This may be physiologically more appropriate as the increase in the intravascular volume brought about by co-loading would coincide with the time of maximal vasodilatory effect of subarachnoid block with reduction in degree of hypotension [12].

So, we planned a study to Comparison of crystalloid preloading with co-loading on maternal hemodynamics in elective lower segment caesarean section under spinal anaesthesia. We hypothesise that Crystalloid preloading and co-loading have a similar effect on maternal hemodynamics in patients undergoing elective lower segment caesarean section under spinal anaesthesia. Aim of the study was to compare the maternal haemodynamic changes with crystalloid preloading and co-loading in patients undergoing elective lower segment caesarean section under spinal anaesthesia.

Methods

This prospective Randomised Comparative Study was conducted after approval from institutional ethics committee (IEC/2018/PGIMER/RMLH-1857) between 1st November 2018 to 31st March, 2020. Inclusion criteria were obstetric patients with period of gestation (POG) more than 37 weeks, in the age between 18 to 35 years, belonging to ASA class I and II and posted for elective LSCS. Patients with any contraindication to spinal anaesthesia, any history of drug allergy, patients with chronic hypertension, pregnancy induced hypertension and eclampsia were excluded.

The sample size calculation was based on a study conducted by Aparna G. Kulkarni et al [13]. Based on the above study, 37 patients in each group will provide 95% power at significance level of 0.01 to detect a difference of 7.08 mmHg between the two groups of patients using student "t" test. Total of 80 patients were recruited for our study.

Written informed consent was taken from all the patients. After careful pre-anaesthetic examination and investigation, patients meeting the inclusion criteria were taken for the study. 80 patients were randomly divided into two group of 40 patients each by computer generated random number. Group P - Patient receiving preloading with Ringer Lactate at a dose of 15ml/kg. Group C – Patient receiving Co-loading with Ringer Lactate at a dose of 15ml/kg.

Patients were routinely premedicated with Tab Ranitidine 150 mg night prior to planned surgery. On arrival to the operating room, pre-operative baseline parameters including ECG, heart rate (HR), blood pressure (BP) including systolic, diastolic and mean blood pressure using NIBP technique and oxygen saturation (SpO2) were recorded. Supplemental oxygen was delivered through a facemask to all the patients with FiO2 0.4 @ 6l/min. Two peripheral intravenous catheter, one for administration of fluids and other for administration of drug was prepared. There were two groups in our study: In Group P - 15 ml/kg of RL was given over 20 minutes before spinal anaesthesia (Preload) and in Group C - 15 ml/kg of RL was given over a period of 20 minutes on identification of clear CSF(Co-load). Spinal anaesthesia is administered to both groups using 2 ml of 0.5% heavy bupivacaine and 20µg fentanyl, hereby total volume of drug injected is 2.4ml, at L2-L3 or L3-L4 level with a 25gauge Quincke Babcock spinal needle under all aseptic precautions. Parturient were placed immediately in supine with a 15° left lateral tilt. Maintenance fluid was infused at 8ml/kg/hr throughout the intraoperative period. The level of sensory blockade was checked with pinprick bilaterally in an ascending fashion starting from T12 dermatome. And once T6 dermatomal level was achieved surgery was allowed to get started. For our study purposes, hypotension defined

as a fall in SBP by 20% or more from baseline value or an absolute SBP <90 mm Hg whichever is lower. Hypotension was treated with crystalloid boluses and 6mg Mephentermine given intravenously. Bradycardia is defined as a decrease in HR to more than 20 % from baseline value or an absolute HR <60 b/min whichever is lower. Bradycardia was treated with atropine 0.6mg given intravenously.

Primary objectives of the study were haemodynamic changes like Heart rate (HR), Systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) and these parameters were recorded baseline, at 1 min interval for first 10 minutes, after that at 5 minutes till 20 minutes and then every 15 min till completion of procedure. Secondary objectives of the study were total dose of atropine needed, time of first dose of mephentermine (in minutes) administered after spinal anaesthesia, Nausea and vomiting episodes assessed using a 3point scale, any fall in saturation levels (Spo2) and Apgar scores at 1 min and 5 min recorded after delivery.

In statistical analysis Continuous variables were presented as mean ± SD and Categorical variables were presented in number and percentage (%). Normality of data was tested by Kolmogorov-Smirnov test. If the normality was rejected after that non parametric test was used. Quantitative variables were compared using Independent t test/Mann-Whitney Test between the two groups. Qualitative variables were compared using Chi-Square test/Fisher's exact test. A p value of <0.05 was considered statistically significant. The data was entered in MS EXCEL sheet and analysis was done using Statistical Package for Social Sciences version 21.0.

Results

80 obstetric patients were included in the study. No significant difference was seen in the distribution of age (years) between group P and C. (p value 0.098) No significant difference was seen in age(years) between group P (Mean ± SD 28.25 ± 2.37) and group C (Mean ± SD 28.25 ± 2.37) (p value 0.152). No significant difference was seen in SpO2(%) between group P and group C. No significant difference was seen in weight(kg) between group P and C. (p value 0.116) (Table 1)

No significant difference was seen in heart rate(bpm) at baseline, at SAB, at 1, 2, 3, 4, 10, 15, 20, 35, 50 minutes, at 1 hour 5 minutes, at 1 hour 20 minutes, at 1 hour 35 minutes between group P and group C. (p value >.05) Significant difference was seen in heart rate(bpm) at 5, 6, 7, 8 and 9 minutes between group P and group C. (p value <.05) (Figure 1)

No significant difference was seen in systolic blood pressure(SBP), diastolic blood pressure(DBP) and mean blood pressure(MBP) at baseline, at SAB, at 1, 2, 3, 4, 8, 9, 10, 15, 20, 35, 50 minutes, at 1 hour 5 minutes, at 1 hour 20 minutes, at 1 hour 35 minutes between group P and C. (p value >.05) Significant difference was seen in SBP, DBP and MBP (mmHg) at 5, 6 and 7 minutes between group P and group C. (p value <.05) (Figure 2,3,4).

Significant difference was seen in total intra operative IV fluid given(ml) between group P and C. (p value <.05) Significant difference was seen in the distribution of number of hypotensive episodes between group P and C. (p value<.05) No significant difference was seen in the distribution of number of bradycardia episodes between group P and C. (p value>.05) No significant difference was seen in the distribution of total dose of atropine(mg) between group P and C. (p value>.05) Significant difference was seen in the distribution of total dose of mephentermine(mg) between group P and C. (p value<.05) No significant difference was seen in time of first dose of mephentermine (in minutes) between group P and C. (p value >.05) Significant difference was seen in the distribution of nausea/vomiting score between group P and C. (p value<.05) Significant difference was seen in the distribution of APGAR score at 1 minute between group P and C. (p value<.05) No significant difference was seen in the distribution of APGAR score at 5 minutes between group P and C. (p value>.05) (Table 2).

Table 1- Demographic details

		Group P (n=40)	Group C (n=40)	P value
Age in years (Mean ± SD)		28.25 ± 2.37	27.45 ± 1.81	0.152
Age Distribution in years	21-25	4(10%)	4(10%)	0.098
	26-30	27(67.50%)	34(85%)	
	31-35	9(22.50%)	2(5%)	
Height (cm) (Mean ± SD)		156 ± 3.19	157.35 ± 3.21	0.063
Weight (kg) (Mean ± SD)		70.12 ± 8.09	67.18 ± 7.05	0.116

Table 2- intraoperative events and data comparison between group P and group C

		Group P (n=40)	Group C (n=40)	P value
Total intra operative IV fluid given(ml) (Mean ± SD)		1705 ± 188.04	1538.25 ± 169.79	0.0002
First dose of mephentermine (in minutes) (Mean ± SD)		6 ± 1.98	6.83 ± 3.19	0.551
Number of hypotensive episodes	0	11(27.50%)	28(70%)	0.0004
	1	27(67.50%)	12(30%)	
	2	2(5%)	0(0%)	
Number of bradycardia episodes	0	33(82.50%)	38(95%)	0.154
	1	7(17.50%)	2(5%)	
Total dose of atropine(mg)	0	33(82.50%)	38(95%)	0.154
	0.6	7(17.50%)	2(5%)	
Total dose of mephentermine (mg)	0	11(27.50%)	28(70%)	0.0002
	6	26(65%)	12(30%)	
	12	3(7.50%)	0(0%)	
Nausea vomiting score	0	11(27.50%)	31(77.50%)	<.0001
	1	17(42.50%)	8(20%)	
	2	12(30%)	1(2.50%)	
APGAR score at 1 minute	8	14(35%)	4(10%)	0.014
	9	26(65%)	36(90%)	
APGAR score at 5 minute	8	9(22.50%)	3(7.50%)	0.115
	9	31(77.50%)	37(92.50%)	

Figure 1- Comparison of heart rate(bpm) between group P and group C.

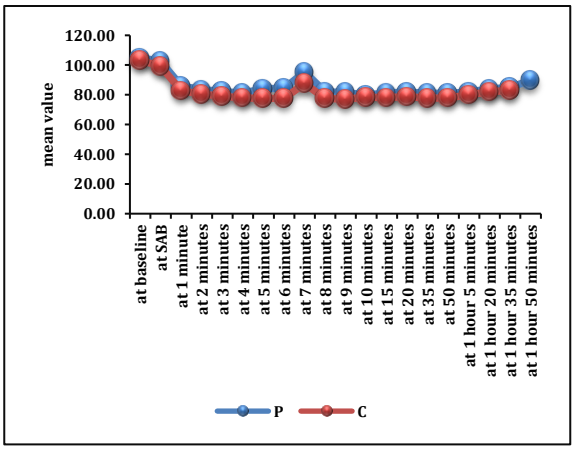


Figure 2- Comparison of systolic blood pressure(mmHg) between group P and group C.

Figure 3- Comparison of diastolic blood pressure(mmHg) between group P and group C

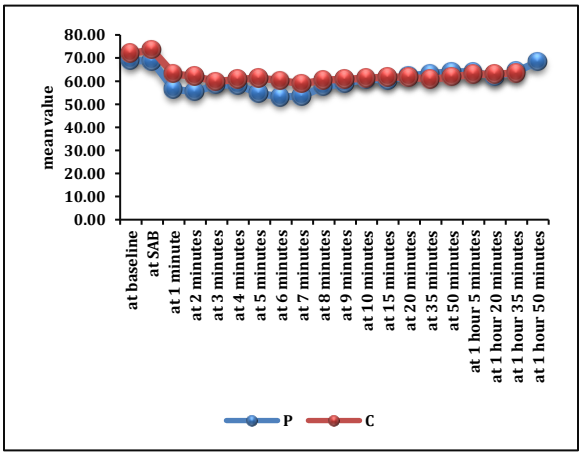
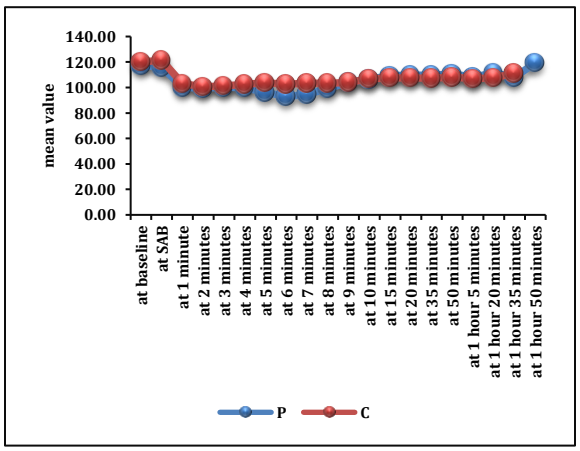
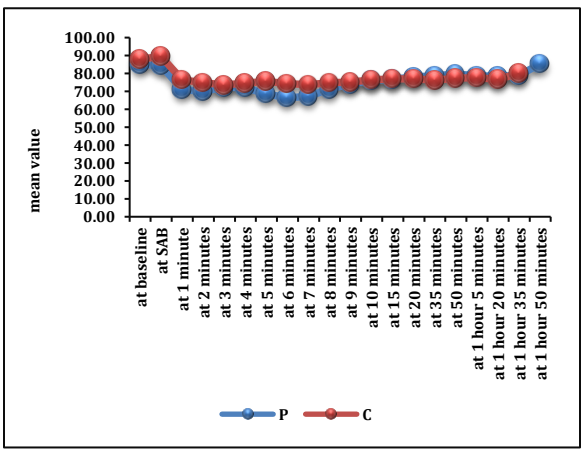


Figure 4- Comparison of mean blood pressure(mmHg) between group P and group C





Discussion

Spinal anaesthesia is commonly used for caesarean section due to its fast onset, dense neural block, low risk of anaesthetic toxicity and minimal transfer of drug to the foetus [14]. However higher chances of hypotension is one of the disadvantages with this technique which ranges from 53% to 80% [14-15].

In our study found that co-loading i.e. hydration at the time of actual block during LSCS was more efficient in preventing hypotension following spinal anaesthesia. It was seen that hypotensive episodes were significantly higher with preloading technique as compared to co-loading technique. However, bradycardia episodes were higher with group P as compared to group C. The side-effects of nausea and vomiting were also found to be significantly higher with preloading technique as compared to co-loading technique.

In our study no significant difference was seen in age(years) between group P (Mean ± SD 28.25 ± 2.37) and group C (Mean ± SD 28.25 ± 2.37) (p value 0.152). No significant difference was seen in Weight(kg) between group P (Mean ± SD 70.12 ± 8.09) and group C (Mean ± SD 67.18 ± 7.05) (p value 0.116). No significant difference was seen in Height(cm) between group P (Mean ± SD 156 ± 3.19) and group C (Mean ± SD 157.35± 3.21) (p value 0.063). Among other studies also, age, weight and height were comparable for both groups. In the study by Kulkarni et al, the age varied from 24.02 vs 23.86 years, weight from 49.94 vs 51.62 kg and height was 157.66 vs 153.24cm which was carried out on 100 parturient of ASA grade I and II who were posted for elective caesarean section [13]. Similarly, in Borse et al study who included 60 parturient of ASA grade I and II, the study participants had comparable mean age (26.8 vs 26.6 yrs.), weight (66 vs 67 kgs), and height (158 vs 162 cm) [16].

In our study, significant difference was seen in SBP, DBP and MAP (mmHg) at 5,6, and 7 minutes such that the blood pressures were significantly lower in Group P as compared to Group C at those minutes. Overall, incidence of hypotension was significantly more in pre-loading group (72.5%) as compared to co-loading (30%).

Our findings were similar to the study by Kulkarni et al, who reported a trend of hypotension from 5 min to 20 min after block with significant difference in the two groups, that is, 72% patients in group P had hypotension while only 46% patients in group C had hypotension ($P<0.05$) (13). In another study by Borse et al, incidence of hypotension was 60% in Group P and 36% in Group C, which was statistically significant [16].

Among other studies, Jacob et al, found that the incidence of hypotension was lesser in the co-loading group as compared to the pre-loading group (46% vs 60%) but this difference was not significant statistically ($P = 0.1607$) [17]. In their study also, the development of hypotension was maximum from 5 to 10 mins of anaesthesia as was seen in the present study. Dyer et al. compared 20 ml/kg of RL solution (administered over 20 min) in parturient and reported 84% hypotension in the pre-loading group and 60% in the co-loading group [18]. Cardoso et al. compared 10 ml/kg of RL as co-loading and pre-loading in parturient and reported the incidence of hypotension as 22.5% and 25% in the co-loading and pre-loading groups respectively [19].

In our study, we also found that the use of mephentermine was significantly more in Group P (72.5%) as compared to Group C (30%). Our findings were similar to the study by Kulkarni et al, where need for vasopressors was higher in the preload group (56%) as compared to co-load group (28%) and the difference between the two groups was statistically significant [13]. Similar findings were also observed by Rao et al, [20] Oh AY et al, [21] R.A. Dyer et al. [18] where the need for vasopressors (ephedrine) was more in group P than group C. In the present study, the heart rate was significantly lower in Group P as compared to Group C at 5,6,7,8, and 9 minutes. Overall, the number of bradycardia episodes 7 (17.50%) in Group P vs 2(5%) in Group C, (P value 0.154) and the use of atropine in controlling the heart rate was also found to be similar among the two groups.

In other study by Kulkarni et al, there was no statistically significant difference in the heart rate in both the groups [13]. In another study by Borse et al, there was drop-in mean heart rate in both groups within first 10 minutes after spinal anaesthesia with maximum drop-in Group P at 5min (9% cases) and at 8min (6% cases) in Group C [16]. Even in this study, mean heart rate had not shown statistically significant difference in both groups. Similar observations were made by M Khan et al., [22] Dyer et al. [18]. A study by Jacob et al, also showed 20% episodes of bradycardia in group p vs 14% in group c without any significant difference, bradycardia being seen maximally between 4-8 mins after spinal anaesthesia [17].

In our study, among the two groups, no significant difference was seen in SpO2(%) during the 2 hours after Spinal anaesthesia. (p value >.05). In one of the studies, Kulkarni et al, measured and reported the changes in Spo2 where they also found that the oxygen saturation among the two groups were comparable and the difference was not statistically significant [13].

Significant difference was seen in the distribution of nausea/vomiting score between group P and C. (p value <.0001) Similarly, in study by Jacob et al, a greater number of patients developed nausea in group P as compared to group C ($P = 0.0473$). The number of patients having vomiting was also higher in group P as compared to group C ($P = 0.0455$) [17]. In contrast, Kulkarni et al, found that incidence of nausea appeared more in Group P (27%) compared to Group C (18%) but was not statistically significant [13].

In our study, significant difference was seen in APGAR score at 1 minute between group P (Mean ± SD 8.65 ± 0.48) and group C (Mean ± SD 8.9± 0.3) (p value 0.007). However there was no statistically difference in the APGAR scores at 5 minutes among the two groups.

Similarly, difference in APGAR scores in both the groups was not statistically significant at 1 min and 5 min in study by Kulkarni et al, [13] Borse et al, [16] Jacob et al, [17] M Khan et al, [22] Rao et al. [20] and Dyer et al. [18]. Our study has certain limitations; the study had a small sample size. The study was conducted in a single center. A multi-centered study may be more informative.

Conclusion

We conclude that co-loading with crystalloids is provide more Maternal Hemodynamics stability after subarachnoid block rather than preloading with crystalloids.

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