Comparative evaluation of co-loading versus preloading for prevention of post-spinal hypotension in elective caesarean section

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Abstract

Aims and Objectives: The aim of the present study was to study the effectiveness of co-loading of crystalloid over preloading of crystalloid in prevention of maternal hypotension during spinal anaesthesia for elective caesarean section.

Material and Methods: Hundred parturients aged 18-35 yrs undergoing elective caesarean section were randomly allocated in two groups of fifty each. Group P received preload of 20ml/kg of ringer's lactate solution over a period of 20 minutes before spinal anaesthesia, while Group C received co-load of 20ml/Kg of ringer's lactate solution at the maximal possible rate by pressurized giving set at the time of administration of spinal anaesthesia. Both the groups received spinal anaesthesia using 2ml of 0.5% hyperbaric bupivacaine at L3-4 level with 23G Quinke's spinal needle. Blood pressure measurements were recorded in both the groups at 2min interval from the start of the regional block for the first 10 min and then at 5min interval till 30min and thereafter every 15min till the end of surgery. Similarly other parameters like heart rate, SPO2, maximum level of sensory block and APGAR scores were also recorded.

Statistical Analysis: Chi-square test was used to find the significance of study parameters on categorical scale between groups. Z test was used to find the significance of study parameters on continuous scale between two groups (intergroup analysis) on metric parameters. Significance was assessed at 5 % level of significance. Any p – value less than 0.05 ($p<0.05$) and 0.01 ($p<0.01$) is considered as significant and highly significant respectively.

Results: Demographic data was comparable in both the groups. The baseline systolic blood pressure was comparable in both the groups and the difference was not statistically significant. The fall in blood pressure was more in Gr. P than in Gr. C at 5 to 30 min after administration of spinal anaesthesia and this difference was statistically significant. ($P<0.05$) Similarly the incidence of hypotension was more in Gr. P (72%) than Gr. C (23%) and this difference was also statistically significant. There was no statistically significant difference in the other parameters like heart rate, SPO2 and APGAR score in both the groups.

Conclusion: Co-loading of crystalloids lowers the incidence of hypotension than preloading after spinal anaesthesia for elective caesarean section.

Key Words: Co-loading, Crystalloid, Hypotension, Preloading, Spinal anaesthesia

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Introduction

Anaesthesia for caesarean section, whether for elective or emergency has always been a challenging proposition. Spinal anaesthesia is frequently used for caesarean section due to its rapid onset, dense neural block, little risk of anaesthetic toxicity and minimum transfer of drug to the fetus[1]. However higher incidence of hypotension is one of the disadvantage with this technique[2]. Traditionally pre-hydration/preloading of fluids was recommended for prevention of hypotension after spinal anaesthesia. However the efficacy of preload has been questioned and it was found that co-loading i.e. hydration at the time of actual block during caesarean delivery was more effective in preventing hypotension following spinal anaesthesia. Crystalloids do not remain in the intravascular space but distribute rapidly into the extracellular fluid and hence the timing of infusion may be the main key to prevent hypotension because the volume expanding effect is maximal at the time of administration of crystalloids.

The present study was undertaken to know whether co-loading of crystalloids would be beneficial over preloading in preventing maternal hypotension following spinal anaesthesia for elective caesarean section.

Material and Methods

After approval from institutional ethical committee, this prospective randomized controlled study was carried out on 100 parturients of ASA grade I and II who were posted for elective caesarean section. The sample size was calculated by simple random sampling method. The study period was of six months. Patients aged 18-35 years scheduled for elective caesarean section were randomly allocated in two groups of 50 each using computerised randomisation technique. Patients of ASA grade III, IV and V, patients not nil by mouth, with history of allergy to local anaesthetics, history of hypertension, any cardiac

disease or any major illness, or having contraindication to spinal anaesthesia were excluded from the study. Preoperatively blood group, haemoglobin, urine (routine and microscopy), serum bilirubin, serum creatinine of the patients were checked.

Written informed consent and nil by mouth status of the patient was checked and the patient was shifted to operating room. On the operating table an intravenous access was obtained with 22gauge intravenous cannula and ringer's lactate solution was kept ready. Patient's baseline blood pressure and heart rate was recorded. The patients in preload group (Gr. P) received 20ml/kg of ringer's lactate solution (approximately 1000ml) over a period of 20 minutes before spinal anaesthesia and no additional fluid was given other than that required to keep the intravenous cannula patent. Spinal anaesthesia was administered in both the groups using 2ml of 0.5% of hyperbaric bupivacaine injected slowly at L3-4 interspace with 23G Quinckes spinal needle under all aseptic precautions. Patients of co-load group received identical fluid load of 20ml/kg via a pressurized giving set with a pressure of 300mmHg applied, to administer the fluid at the maximal possible rate at the time of identification of cerebrospinal fluid. Systolic blood pressure measurements were recorded in both the groups at 2min interval from the start of the regional block for the first 10 min and then at 5min interval till 30min and thereafter every 15min till the end of surgery. Similarly heart rate and SPO2 readings were also recorded. No wedge was applied under the buttock of any patient as it may interfere in the blood pressure readings and the extent of hypotension will not be judged accurately.

Hypotension was defined as fall in systolic blood pressure more than 20% of baseline or < 90mmHg. Hypotension was treated with intravenous injection of ephedrine 5mg. Bradycardia was defined as fall in heart rate >15% from baseline or heart rate <60/min. Injection atropine was kept ready for treatment of bradycardia. Continuous monitoring of oxygen saturation was done. Respiratory depression was defined as respiratory rate < 10breaths/min. After delivery of the baby 20 IU of injection oxytocin was given to the mother as an infusion in the intravenous fluid running. APGAR scores were recorded at 0 and 5 min interval after birth to assess the fetal outcome.

Statistical analysis

Descriptive statistical analysis was carried out in the present study. Results on continuous measurements were presented as Mean±SD and results on categorical measurements were presented in number and percentage. Chi-square test was used to find the significance of study parameters on categorical scale between groups. Z test was used to find the significance of study parameters on continuous scale between two groups (intergroup analysis) on metric parameters. Significance was assessed at 5% level of significance. Any p – value less than 0.05 ($p<0.05$) and 0.01 ($p<0.01$) is considered as significant and highly significant respectively.

Results

The demographic data was comparable in both the groups and the difference was not statistically significant. (Table 1)

Table 1: Distribution of cases with respect to age, weight, & height

	Group P n=50	Group C n=50	P Value
	Mean±SD	Mean±SD	
Age (years)	24.02±3.56	23.86±3.96	0.8322
Height (cm)	157.66±6.97	153.24±6.16	0.3972
Weight (kg)	49.94±3.53	51.62±4.94	0.05325

The baseline heart rate and systolic blood pressure were comparable in both the groups and the difference of these parameters in the two groups was not statistically significant. (Table 2)

Table 2: Comparison of baseline (pre-operative) pulse rate and blood pressure in both groups

	Group P n=50	Group C n=50	P value
	Mean±SD	Mean±SD	
Pulse rate(beats/ min)	83.68±5.34	82.16±7.20	0.238337
systolic BP(mm of Hg)	120.24±7.27	117.80±8.08	0.119438

The changes in heart rate in both the groups was statistically not significant as shown in Table 3 and Fig. 1

Table 3: Comparison of changes in pulse rate during first hour after the Sub-arachnoid injection

Pulse rate (beats/min)	Group P n=50	Group C n=50	P Value
	Mean±SD	Mean±SD	
pre-op	83.68±5.40	82.16±7.27	0.238337
During LP	85.74±5.47	83.64±7.32	0.110737
1min	87.34±4.66	85.84±6.18	0.178069
3 min	88.84±4.49	88.02±5.76	0.428992
5 min	87.30±7.59	89.84±5.54	0.155521
7 min	88.28±5.89	89.2±5.72	0.6874
9 min	88.84±4.49	88.02±5.76	0.428992
10 min	86.68±11.31	89.96±6.04	0.675322
15 min	88.96±12.57	90.10±7.55	0.791064
20 min	93.16±10.00	90.40±9.17	0.106522
25 min	92.44±7.70	89.86±9.01	0.066136
30 min	92.20±7.77	90.10±7.14	0.122013
45 min	92.26±7.34	89.64±6.92	0.063225
60 min	91.18±5.69	89.64±7.51	0.250431

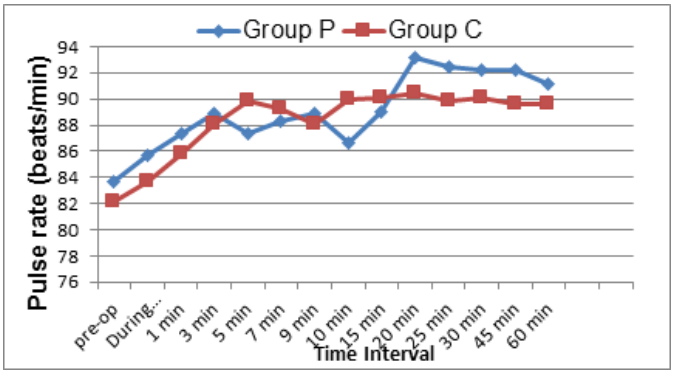


Fig. 1: Comparison of changes in pulse rate during first hour after the subarachnoid injection

Table 4 shows the changes in systolic blood pressure in both the groups after administration of spinal anaesthesia. There was a significant fall in systolic blood pressure in Gr. P from 5min to 20 min after administration of spinal anaesthesia and the difference was statistically significant. (P<0.05)

Table 4: Comparison of changes in systolic blood pressure during first hour after the Subarachnoid block

Blood pressure (mm of hg)	Group P n=50	Group C n=50	P Value
	Mean±SD	Mean±SD	
pre-op	120.24±7.35	117.80±8.16	0.119438
During LP	122.04±7.35	120.2±8.37	0.250448
1 min	115.98±7.01	115.04±7.65	0.527603
3 min	109.60±6.98	110.60±8.40	0.518762
5 min	105.12±6.62	105.64±8.47	0.003608
7 min	101.08±6.72	102.48±7.18	0.000191
9 min	92.8±8.6	96.2±6.5	0.028
10 min	92.96±6.78	100.04±7.57	<0.0001
15 min	86.92±6.39	94.56±8.19	<0.0001
20 min	88.60±5.47	91.52±8.09	0.037135
25 min	90.32±4.79	93.08±5.93	0.011948
30 min	92.72±5.94	95.84±5.91	0.009801
45 min	96.24±4.56	98.04±5.66	0.083309
60 min	99.76±3.80	100.48±5.26	0.43485

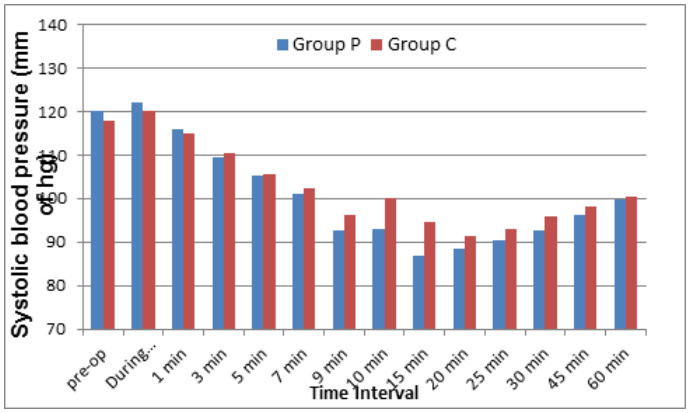


Fig. 2: Comparison of changes in systolic blood pressure during first hour after the Subarachnoid block

The changes in Spo2 in both the groups were comparable and the difference was not statistically significant as shown in Table 5 (P>0.05).

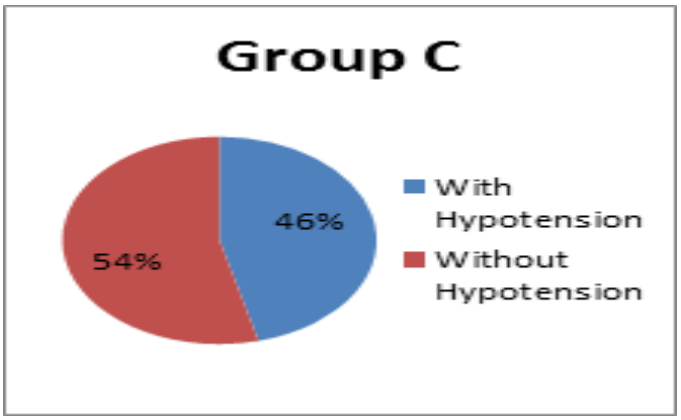
Table 5: Comparison of changes in SpO2 during first hour after the Subarachnoid injection

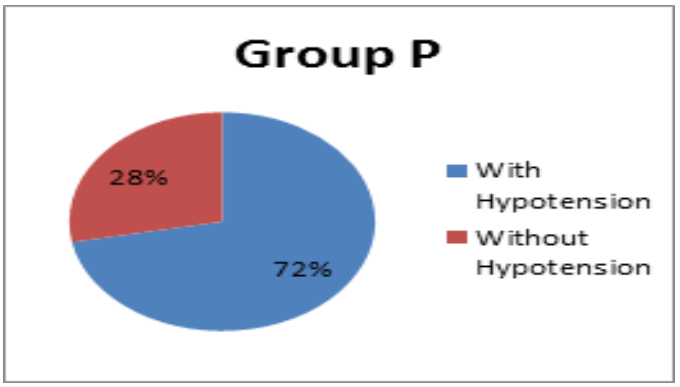
SpO_2 (%)	Group P n=50	Group C n=50	P – Value
	Mean±SD	Mean±SD	
pre-op	98.04±0.75	98.06±0.77	0.793613
During LP	98.18±0.79	98.1±0.72	0.603899
1 min	98.18±0.74	98.34±0.73	0.28645
3 min	98.06±0.77	98.18±0.77	0.438104
5 min	98.24±0.76	98.04±0.75	0.707804
7 min	98.10±0.84	98.22±0.73	0.685049
9 min	98.60±0.96	98.62±0.46	0.89
10 min	98.02±0.81	98.10±0.84	0.54527
15 min	98.04±0.75	98.20±0.81	0.308781
20 min	98.16±0.82	98.24±0.80	0.62129
25 min	98.06±0.77	98.12±0.77	0.601759
30 min	98.04±0.75	98.16±0.82	0.447442
45 min	98.20±0.81	98.10±0.74	0.519048
60 min	98.10±0.84	98.36±0.75	0.105437

The incidence of hypotension was 72% in group P while it was only 46% in group C as shown in Table 6 and this difference was statistically significant (P< 0.05). Similarly the need for vasopressors (ephedrine) was more in Gr. P (56%) than Gr. C (28%) and this difference was also statistically significant(P<0.05).

Table 6: Incidence of hypotension

	Group P	Group C	P value
No. of patients with hypotension	36 (72%)	23 (46%)	0.0041
No. of patients required Additional Ringer's Lactate	36 (72%)	23 (46%)	0.0041
No. of patients required inj. Ephedrine	28 (56%)	14 (28%)	0.00228





The neonatal outcome was comparable in both the groups and the difference in APGAR scores in both the groups was not statistically significant as shown in Table 7.

Table 12: Neonatal APGAR SCORE

Duration After Birth	Group P n=50 (mean ± SD)	Group C n=50 (mean ± SD)	P value
0 min	7.28±1.40	7.66±1.39	0.17698
5 min	*9.56±0.58*	*9.62±0.60*	0.612191

Discussion

Spinal anaesthesia is now widely used for both elective as well as emergency caesarean section. The main reason is its advantages which includes rapid onset of action, better sensory and motor blockade as compared to epidural anaesthesia, ease of administration and conscious patient with intact protective airway reflexes. Disadvantages are hypotension, bradycardia, high or total spinal, limited duration of blockade and no facilities for top-up doses if required.

Hypotension after spinal anaesthesia remains a common and potentially very serious complication. Maternal hypotension is detrimental for both the mother and the foetal outcome. Both the degree and duration of hypotension are important factors following subarachnoid block for LSCS in affecting both maternal and foetal outcomes. Thus it is very important and relevant to prevent or reduce the degree and the duration of maternal hypotension at any cost. To achieve this some of the techniques used are left lateral tilt or manual displacement of uterus or both, to relieve aorto-caval compression, use of vasopressor prophylactically, low dose local anaesthetics in subarachnoid block with or without additives, preloading or co-loading with IV fluids. Even with the use of these preventive measures the incidence of spinal hypotension in parturients can be as high as 53% to 80%[1]. This fall in blood pressure is attributed to sympathetic blockade with the resulting relaxation of the capacitance vessels, the reduction in the venous return and thus causing a decrease in the cardiac output[3].Preloading serves the purpose by protecting the blood vessels, by increasing the blood volume and thus compensating for the "relative hypovolemia" that follows. The rise in the hydrostatic pressure helps to maintain the blood pressure. Recent work has challenged this historical belief that acute intravenous crystalloid administration, prior to the sympathetic blockade, to increase the intravascular volume can

prevent the spinal hypotension that follows. In fact crystalloids rapidly and very easily leave the intravascular space and migrate to interstitial space. Therefore they do not expand the volume in the real sense. Also, the association of increased volume of the intravenous fluids, with a decrease in the colloid osmotic pressure has always raised concern regarding the potential risk of pulmonary oedema in the compromised patients. Thus increasing the volume of preloading fluid may not only fail to maintain haemodynamic stability after spinal anaesthesia, but in fact may have a detrimental effect by decreasing the colloidal osmotic pressure to below physiologic values[4].

Hence, administration of crystalloids rapidly at the time of administration of subarachnoid block can help to prevent the hypotension resulting from the sympathetic blockade. In our study we found that the incidence of hypotension was more in preload group from 5 min to 20 min after subarachnoid block and the difference in the two groups was statistically significant.72% patients in group P had hypotension while only 46% patients in group C had hypotension and this difference was statistically significant(P<0.05).Also the need for vasopressors was more in the preload group(56%) as compared to co-load group (28%) and the difference in the two groups was statistically significant. Similar findings were also observed by Dr. A. Ramakrishnarao et al[5], OhAY, Hwang JW et al[6] R.A. Dyer et al[7]. C.C. Routet al[8] in 1992 studied twenty parturients undergoing elective Caesarean section who were allocated randomly to receive crystalloid preload 20 ml kg^{-1} over either 20 min or 10 min before spinal anaesthesia. Both groups had a significant ($P < 0.05$) increase in central venous pressure during the preload period. This study demonstrated that rapid administration of crystalloid preload before spinal anaesthesia did not decrease the incidence or severity of hypotension, and questions the role of crystalloid preload. Similar findings were observed by Tercanil S et al[9]. Recent work suggest that use of vasopressors along with rapid loading of crystalloids at the time of administration of spinal anaesthesia is a good strategy in preventing hypotension after spinal anaesthesia.[10]

Various studies have concluded that there is no role of preloading of crystalloids to prevent hypotension following spinal anaesthesia and so it is unnecessary to delay the surgery in order to deliver a preload of fluids. Also American Society of Anesthesiologists (ASA) clinical practice guideline recommendation concerning spinal anesthesia for cesarean delivery states: "Although fluid preloading reduces the frequency of maternal hypotension, initiation of spinal anesthesia should not be delayed to administer fixed volume of intravenous fluid.[11]

The secondary outcome of our study was that there was no statistically significant difference in the heart rate in both the groups. Both the groups had tachycardia from 5 to 20 min after administration of subarachnoid block and thereafter the heart rate remained stable. Similarly there was no significant difference in Spo2 and neonatal APGAR score in both the groups as found in other studies.[12]

One of the limitations of our study was that we did not record the mean arterial pressure which would be more specific in defining hypotension rather than systolic blood pressure alone.

Conclusion

Finally to conclude, we can say that co-loading of crystalloids is more beneficial in preventing hypotension after subarachnoid block rather than preloading, and would be the best strategy in managing hypotension following spinal anaesthesia if supplemented with vasopressors.

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Conflicts of interest: Nil

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