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Co-Loading Versus Pre-Loading for Preventing Post-Spinal Hypotension in Caesarean Section

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ABSTRACT

Objective: To compare the frequency of post-spinal anaesthesia hypotension occurring with co-loading versus pre-loading in patients undergoing caesarean section.

Study Design: Cross-sectional analytical study.

Place and Duration of Study: Department of Anaesthesiology, Pak-Emirates Military Hospital, Rawalpindi Pakistan, Sep 2020 to Mar 2021.

Methodology: A total of 70 patients undergoing spinal anaesthesia for caesarean section and meeting the sample selection criteria were included. Patients with emergency procedures or a history of blood pressure disorders were excluded. Patients in Group-A underwent co-loading with ringer lactate, while patients in Group-B underwent pre-loading. All participants had their systolic and diastolic blood pressure and mean arterial pressure measured at the time of anaesthesia induction and then at 5, 10, 15, and 30 minutes post anaesthesia induction.

Results: There was difference in mean systolic pressure at 10 and 15 minutes, p=0.001 and p=0.027, respectively. The difference in diastolic blood pressure was only significant at 10 minutes, p=0.001. While, mean arterial pressures were significantly higher at 10 and 15 minutes with co-loading, p<0.001 and p=0.019, respectively.

Conclusion: Co-loading is associated with less frequency of post-spinal hypotension than pre-loading and may be employed as a standard practice pre-operatively with spinal anaesthesia.

Keywords: Co-loading, Leg Elevation, Post-Spinal Hypotension, Pre-loading.

How to Cite This Article: *Saeed MT, Rao A, Saeed MN, Alam T, Riaz A, Ahmad H. Co-Loading Versus Pre-Loading for Preventing Post-Spinal Hypotension in Caesarean Section. Pak Armed Forces Med J 2024; 74(2): 401-404. DOI: https://doi.org/10.51253/pafmj.v74i2.8150*

INTRODUCTION

Compared to general anaesthesia, caesarean sections conducted under spinal anaesthesia have been increasingly employed for both elective and emergent procedures, as the technique is known to have a lower degree of maternal morbidity and mortality.[1,2] However, like all interventions, spinal anaesthesia is associated with complications, which include the development of hypotension, which may present with nausea and vomiting or may cause grave complications like altered/loss of consciousness and cardiovascular shock resulting in fetal compromise.[3]

Spinal anaesthesia for caesarean section requires a block level of up to the T6-T10 dermatome while causing minimal adverse effects to the foetus and the mother; as a rule, when the spinal anaesthesia ascends higher, the incidence of hypotension is greater.[4] As this complication is commonplace, patients are loaded with fluid intravenously to prevent or reduce the intensity.[5]

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Received: 09 Feb 2022, revision received: 10 Mar 2022; accepted: 11 Mar 2022

Various modalities have been used for treatment, including measures like compression stockings, leg wrappings, placing the patient in the Trendelenburg position, vasopressor and intravenous fluid administration with varying degrees of efficacy.[6,7] Intravenous fluid administration is an important element in the treatment of post-spinal anaesthesia-induced hypotension; assorted types of fluid have been administered at different times prior to surgery to prevent hypotension, such as before the induction of anaesthesia, known as pre-loading and at the time of induction, known as co-loading, again with varying success.[8,9]

Caesarean sections are a commonly performed surgery, and in the vast majority of cases, it is performed under spinal anaesthesia. Post-spinal hypotension is a frequent complication with this method of anaesthesia and one which occurs despite a myriad of treatment modalities available for it. The available literature is conflicted over the optimal prevention/treatment, especially in terms of the timing of fluid administration.[10] We conducted this study to determine the optimal time for administration of fluid

relative to the time of administration of anaesthesia. This study was conducted to establish which of the two techniques, co-loading or pre-loading, is superior in preventing post-spinal anaesthesia hypotension in our centre.

METHODOLOGY

The Cross-sectional analytical study was conducted at the Department of Anaesthesiology, Pak-Emirates Military Hospital, Rawalpindi Pakistan, from September 2020 to March 2021 after approval by the Hospital Ethical Committee (IERB certificate number A/28/EC/313/2021). WHO sample size calculator was used to calculate the sample size, keeping population standard deviation (σ) of 12.5, population variance (σ2) of 156.25, test value of the population mean of 109.2 and anticipated population mean of 121.2.[11]

Inclusion Criteria: All gravid patients aged 18-45 years, with ASA class I to II, who were to undergo caesarean section with spinal anaesthesia, were included.

Exclusion Criteria: Patients who had contraindications to spinal anaesthesia, did not give consent, had multiple pregnancies, were allergic to local anaesthetics, had a past history of high systolic pressure >135 mmHg, had basal systolic pressure>90 mmHg, or had cardiac abnormalities were excluded.

The study targeted patients chosen via non-probability consecutive sampling. All patients filled out a questionnaire to collect demographic data upon enrollment in the study. Patients gave informed written consent.

Patients were divided equally into two groups: Group-A received one L Ringer lactate 10 minutes before the induction of anaesthesia, which was continued at the time of induction (co-loading). At the same time, Group-B was given one L Ringer lactate fluid, which was started 1 hour before spinal anaesthesia induction and completed in 50 minutes (pre-loading). Both groups received spinal anaesthesia with 0.5% bupivacaine 10 mg injected between the L3 and L4 vertebrae. All patients had their systolic and diastolic blood pressure and mean arterial pressure was measured at the time of anaesthesia induction and then at 5, 10, 15, and 30 minutes post anaesthesia induction.

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test and Independent sample t-test was applied to explore the inferential statistics. The *p*-value lower than or up to 0.05 was considered as significant.

RESULTS

We studied 70 patients with a mean age of 30.93±6.97 years. The mean body mass index for the sample was 27.37±2.41 kg/m2. Age and BMI were not significantly different across both groups, with *p*-values of 0.77 and 0.15, respectively. The difference in mean systolic pressure at 10 minutes was statistically significant, $p=0.001$, which was also the case at 15 minutes, $p=0.027$, while it was not significant at 0, 5 and 30 minutes. The difference in diastolic blood pressure was only significant at 10 minutes, $p=0.001$. At the same time, mean arterial pressures were significantly higher at 10 and 15 minutes with co-loading, $p<0.001$ and $p=0.019$, respectively, shown in Table.

Table: Comparison of Study Variables Between Study Groups (n=70)

Variables	Group-A	Group-B	*p*-value
Age (years)	31.17±7.37	30.69± 6.65	0.77
Body Mass Index (kg/m²)	26.9±2.4	27.79±2.3	0.15
ASA Scale			
ASA I	24(68.6%)	29(82.9%)	0.16
ASA II	11(31.4)%	6(17.1%)	
Systolic Blood Pressure (mmHg)			
At 0 mins	111.03±12.21	113.09±14.98	0.53
At 5 mins	106.60±9.13	101.57±9.81	0.3
At 10 mins	91.95±10.01	84.86± 6.47	0.001
At 15 mins	87.74±5.73	84.60±5.87	0.027
At 30 mins	101.29±18.52	101.97±18.37	0.87
Diastolic Blood Pressure (mmHg)			
At 0 mins	72.86±7.61	74.83±7.12	0.27
At 5 mins	67.71±14.16	64.77±8.13	0.29
At 10 mins	68.46±6.03	63.60±5.75	0.001
At 15 mins	63.40±6.10	61.43±4.38	0.13
At 30 mins	69.89±7.03	66.77±8.42	0.098

DISCUSSION

Our study showed that Co-loading is associated with less frequency of post-spinal hypotension than pre-loading and may be employed as a standard practice pre-operatively with spinal anaesthesia. Artawan et al. studied a similar population with a mean age of 31.5±5.15 years, and age did not appear to affect the incidence of hypotension.[11] Kaufner *et al*. reported on a slightly older population of 33 (range: 28 – 36) years,[12] while Oh *et al*. reported on a population with a mean age of 33.6±3.75 years.[13] We

attributed this difference to the higher incidence of pregnancies at later ages in pregnant populations in developed countries. As the patients were pregnant, the body mass index (BMI) was higher than the national average in our study. Jacob *et al.* made similar observations in their study and noted no relationship between obesity and the incidence of hypotension in post-spinal anaesthesia.[14]

In the co-loading group, a total of 24(68.6%) patients were ASA class I and 11(31.4)% were ASA class II, while in the pre-loading group, 29(82.9%) were ASA class I and 6 (17.1%) were ASA class II, p=0.16. Rehmani *et al*. demonstrated that advancing ASA class was associated with a higher incidence of hypotension post-spinal anaesthesia.[15]

Our study showed no difference in mean systolic blood pressure (SBP) at the time of anaesthesia induction, p=0.53, similar to the difference in mean SBP at 5 minutes post-induction, p=0.3. However, the difference between the two groups became significant at 10 minutes, p=0.001, with mean SBP being significantly higher in the co-loading group, a finding also seen at 15 minutes, p=0.027. After that, the difference became statistically insignificant, p=0.87, between the two groups at 30 minutes. Similarly, Artawan et al. showed that co-loading was superior to pre-loading in the maintenance of SBP at all times from baseline to 30 minutes post-spinal anaesthesia induction, p<0.001.[11] We attributed this difference to how hypotension was defined in their study and the different doses of fluid used.

A similar picture was seen with diastolic blood pressure (DBP): no statistically significant difference was seen at 0, 5, 15 and 30 minutes, with p-values of 0.27, 0.29, 0.13 and 0.098, respectively, while the co-loading was superior to pre-loading at 10 minutes, p=0.001. Khan *et al*. reported in their study that there was no statistical difference between co-loading and pre-loading for SBP and MAP at different time intervals, but there was a difference in DPB between 6-15 minutes post-spinal anaesthesia, which translated into a statistically significant requirement for vasopressors, p=0.017.[16]

Mean arterial pressure (MAP) was higher with co-loading at 10 and 15 minutes with p-values of <0.001 and 0.019, respectively. The p-values at 0, 5 and 30 minutes were non-significant, 0.19, 0.075 and 0.32, respectively. We found co-loading to be superior to pre-loading in the maintenance of all blood pressure parameters, a finding that was echoed by Reshan *et al*.[17] However, not all studies have come to the same conclusion, Teoh *et al*. reported that there was no difference between pre-loading and co-loading in terms of improving cardiovascular parameters.[18] At the same time, Varshney *et al*. went a step further and said that pre-loading is superior to co-loading in preventing post-spinal anaesthesia hypotension.[19] We believe this difference is due to the choice of fluids: both these studies used colloid fluids.

Post-spinal anaesthesia hypotension is a commonly encountered complication seen during regional anaesthesia given for caesarean section. Fluid co-loading is a viable treatment solution with a statistically superior effect on blood pressure compared to pre-loading. However, it does not eliminate the risk of hypotension post-spinal anaesthesia, and there is some difference in its utility in the literature. The results may prove better if co-loading is combined with other treatment modalities, such as vasopressors.

LIMITATION OF STUDY

Our study did not look at other parameters, such as heart rate and pulse oximetry, and was not double-blinded. In addition, we did not look at the outcomes of the pregnancy for both the foetus and mother. Further research is required to look at the utility of co-loading in combination with other treatment modalities, the choice of fluid, and the effect on foeto-maternal outcome.

CONCLUSION

Co-loading with fluid at the time of induction of spinal anaesthesia results in a reduced incidence of post-spinal hypotension. It may be adopted as standard practice during surgeries requiring spinal anaesthesia. Prevention of this complication is paramount as the development of hypotension may result in foetal compromise, which can complicate an otherwise simple surgical procedure. A single crystalloid infusion during anaesthesia induction provides a simple, cheap and effective method of preventing morbidity and mortality.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MTS & AR: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

MNS & TA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AR & HA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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