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# COMPARISON OF PRE-LOADING AND CO-LOADING WITH CRYSTALLOID IN SPINAL ANAESTHESIA UNDERGOING TOTAL ABDOMINAL HYSTERECTOMY

Anaesthesiology

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## ABSTRACT

**Introduction:**Hypotension after spinal anaesthesia is a common clinical problem which is treated with fluid and vasopressors. Conventional teaching of Pre-loading is nowadays challenged with Co-loading. The purpose of this study was to find out the ideal timing of fluid administration.
**Material and Methods:** This prospective, randomized, double-blinded study was performed in 54 patients of spinal anaesthesia undergoing total abdominal hysterectomy. Patients were randomized to receive either 20 ml/kg of crystalloid over 20 min intravenously, before spinal anaesthesia (Group-P) or immediately after spinal anaesthesia (Group-C). Incidence of hypotension & the vasopressor required were compared. Results were analysed statistically by SPSS software.
**Results:**There was significant difference between the groups in the incidence of hypotension (Group-P 63.0% and Group-C 14.8%) and total doses of vasopressor required. There were no differences in complications.
**Conclusion:**It is unnecessary to delay surgery in order to deliver a pre-loading of crystalloid. Crystalloid co-loading is more effective than pre-loading for maintaining blood pressure after spinal anaesthesia.

## KEYWORDS

Pre-loading; Co-loading; Spinal Anaesthesia induced hypotension

## INTRODUCTION

Spinal anaesthesia or subarachnoid block (SAB) was first given by Dr. August Bier for lower extremity surgery on august 16, 1898. Over the century, it becomes technique of choice for different lower abdominal and lower extremity surgeries[1]. Although it has many advantages like blunting of surgical stress response, less intra-operative blood loss, lower post-operative thromboembolic events[2]; hypotension, bradycardia, nausea, vomiting is known to occur during SAB, incidence ranging from 7-42%[3].

The sympathectomy associated with SAB reduces systemic vascular resistance and produces relative hypovolemia secondary to increased venous capacitance, leading to hypotension[4]. Hypotension with up to 80% incidence is associated with increased morbidity like nausea, vomiting, syncope, dysrhythmia[5]. Prevention of hypotension results in better outcomes than treatment of established hypotension.

Hypotension can be minimized or prevented by intravenous (iv) fluid pre-loading, and by the prophylactic and therapeutic use of vasopressors. Pre-loading means administration of fixed amount fluid before giving SAB[6]. Current methods of crystalloid pre-loading are challenged by co-loading in preventing hypotension. Administering the fluid immediately after performing the SAB, is called co-loading[7].

Several studies have been done on fluid administration in SAB with colloid or crystalloid, but mostly in partituent patients. There is a lack of study regarding appropriate method of fluid administration during SAB in general population in other surgeries. We have taken total abdominal hysterectomy (TAH) under SAB as a reference case to compare two different method of fluid administration.

The purpose of this double blinded randomised controlled trial was to determine whether the timing of the fluid infusion, influences the incidence of hypotension and the dose of vasopressor needed.

## AIM & OBJECTIVES

To study the effects of crystalloid pre-loading and co-loading following spinal anaesthesia by comparing incidence of hypotension and total vasopressor requirement along with incidence of bradycardia, headache and nausea/vomiting.

## MATERIAL AND METHODS

After approval from institutional ethical committee and written informed consent from the patients, our study was carried out on the patients undergoing elective TAH. Patients with ASA (American Society of Anesthesiologists) physical status I/II, from age 40-65 years with weighting 40-100 kg were included in the study. Patients who had initial Systolic blood pressure<100 mg of Hg, intra-operative blood loss>1200 ml, Spinal Induced Hypotension> 50%, surgery duration>3 hours, conversion to general anaesthesia were excluded from the study. All patients in this study were subjected to detailed pre-anaesthetic evaluation and investigations as per standard medical protocol. Standard pre-operative fasting guideline & pre-medication were followed. Patients were randomly allocated using card drawing method in two groups to receive either pre-load (Group P) or co-load (Group C).

In the operating theatre (OT), baseline vitals were noted. Group P received 20 ml/kg lactated ringer solution over 20 min before SAB and Group C received 20 ml/kg of same fluid rapidly, immediately after SAB. Additional maintenance fluid was given @ 2ml/kg/hour throughout the surgery.

Non-invasive Blood Pressure (NIBP), Heart Rate (HR) were measured every 3 minute after SAB till 15 minute, then every 5 minute till completion of surgery or 90 minutes. If the mean arterial blood pressure (MAP) was reduced by more than 20% of the initial value, 100 µg of injection Phenylephrine iv bolus was administered and may be repeated accordingly. Total vasopressor dose and occurrences of nausea, vomiting, headache were recorded.

Other rescue drugs used were Atropine (HR<60/min), Ondansetron (Nausea/Vomiting), Epinephrine (MAP< 65 mm of Hg).

Statistical Analysis was performed with IBM SPSS Statistics 20.0**.** The sample size for this study was estimated based on a previous study by Dyer and colleagues[7]. P<0.05 was considered statistically significant. Kolmogorov-Smirnov test, Unpaired Student T test, Mann Whitney U test, Fischer's exact test, Mixed design repeated measure ANOVA were used.

## RESULT

Total 70 patients were assessed for study eligibility but 7 patients failed to meet the inclusion criteria and 3 patient refused. Remaining 60 patients were included in the study for randomisation, but another 6 patients were excluded for conversion to general anaesthesia. Hence 54 patients were included in the final study analysis.

**Table-1: Demographic, Initial Hemodynamic & Fluid Data**
Patients' demographics, initial haemodynamics and total fluid volume were comparable in both groups (table-1).

| Variable | Group P (n=27) | Group C (n=27) | P value |
|---|---|---|---|
| Age (year) | 47.22 ± 6.03 | 46.59 ± 6.76 | 0.366 |
| Weight (kg) | 59.74 ± 6.64 | 61.26 ± 6.37 | 0.766 |
| ASA (I/II)* | 15/12 | 14/13 | 0.785 |
| MAP (mm of Hg) | 96.36 ± 5.14 | 96.20 ± 7.27 | 0.325 |
| HR (mm of Hg) | 80.78 ± 12.49 | 73.70 ± 8.50 | 0.416 |
| Total Fluid (ml) | 1362.59 ± 151.75 | 1380 ± 156.80 | 0.946 |

Data given as mean ± SD, unless otherwise indicated
* - number

**Table-2: MAP variations with time**

| MAP | Group P (n=27) | Group C (n=27) | P value |
|---|---|---|---|
| MAP_0 | 96.36 ± 5.14 | 96.2 ± 7.28 | 0.325 |
| MAP_3 | 97.21 ± 8.43 | 97.43 ± 8.78 | 0.992 |
| MAP_6 | 91.8 ± 8.70 | 93.33 ± 10.30 | 0.565 |
| MAP_9 | 88.53 ± 8.58 | 88.01 ± 9.52 | 0.808 |
| MAP_12 | 86.65 ± 8.38 | 86.52 ± 9.52 | 0.758 |
| MAP_15 | 84.72 ± 10.22 | 85.17 ± 7.55 | 0.023 |
| MAP_20 | 86.04 ± 12.14 | 84.78 ± 8.16 | 0.099 |
| MAP_25 | 85.89 ± 8.44 | 85.94 ± 9.33 | 0.686 |
| MAP_30 | 81.69 ± 7.90 | 87.41 ± 6.35 | 0.015 |
| MAP_35 | 81.32 ± 10.23 | 86.78 ± 7.82 | 0.025 |
| MAP_40 | 85.58 ± 7.31 | 87.04 ± 8.85 | 0.551 |
| MAP_45 | 82.68 ± 8.40 | 88.58 ± 6.39 | 0.049 |
| MAP_50 | 84.63 ± 7.90 | 87.38 ± 8.29 | 0.894 |
| MAP_55 | 86.25 ± 8.14 | 88.89 ± 7.55 | 0.506 |
| MAP_60 | 87.36 ± 8.04 | 89.14 ± 6.82 | 0.599 |
| MAP_65 | 86.99 ± 8.08 | 89.93 ± 6.04 | 0.458 |
| MAP_70 | 86.64 ± 6.95 | 89.91 ± 5.96 | 0.617 |
| MAP_75 | 88.07 ± 6.77 | 90.48 ± 6.00 | 0.425 |
| MAP_80 | 87.03 ± 8.97 | 90.36 ± 5.97 | 0.078 |
| MAP_85 | 88.31 ± 6.99 | 90.76 ± 5.10 | 0.164 |
| MAP_90 | 88.59 ± 7.67 | 91.53 ± 4.97 | 0.163 |

Data given as mean ± SD, unless otherwise indicated
Unit- mm of Hg

Mean blood pressure of both groups was presented here in different time from initial (MAP_0) value to 90 minutes (MAP_90) (table-2). Statistically lower MAP was seen in Group-P at 15, 30, 35 & 45 minutes.

**Table-3: Comparison of complications & vasopressor dose**

| Variable | Group-P (n=27) | Group-C (n=27) | P value |
|---|---|---|---|
| Hypotension | 17 (63.0%) | 4 (14.8%) | <0.001 |
| Phenylephrine dose (µg)* | 166.67 ± 164.08 | 29.63 ± 82.34 | <0.001 |
| Nausea | 10 (37.0%) | 7 (25.9%) | 0.379 |
| Vomiting | 0 (0.0%) | 1 (3.7%) | 0.313 |
| Headache | 8 (29.6%) | 6 (22.2%) | 0.535 |
| bradycardia | 3 (11.1%) | 6 (22.2%) | 0.273 |

Data given as number (% in the group), unless otherwise indicated
* - Data given as mean ± SD

Number of patients having of hypotension and the total dose of vasopressor required were significantly less in Group-C than group-P. There was no significant difference in the incidence of complications between the groups (table-3).

## DISCUSSION

After the introduction of SAB by August Bier[1], following some period of waxing and waning popularity, it became the choice for lower abdominal and lower limb surgeries replacing general anaesthesia[8]. Though SAB is very safe, it is associated with complications such as hypotension, bradycardia, neurologic injury, total spinal anaesthesia and accidental intravascular injection of local anaesthetic. Among these, hypotension is one of the most common but avoidable side effect. Sudden hypotension due to sympathetic blockade and peripheral vasodilatation can lead to headache, nausea, compromised organ perfusion, and lastly hemodynamic instability.

The physiological objective of SAB is the maintenance of haemodynamics, normally blood pressure is used as a surrogate index of haemodynamics. Various techniques are used to prevent this SAB induced hypotension. Methods includes mostly fluid therapy (crystalloid or colloid) and vasopressors. Pre-loading with IV fluids has been considered a safe and effective method to prevent hypotension; but in different studies, the efficacy of pre-loading was questioned[9]. Pre-loading also delays the procedure; decreases OT turn over. So a newer approach of co-loading has come into effect[7], where fluid bolus infusion is started with the SAB, not before that. There were very few study in non-obstetrics surgery. In the present study, we have attempted to the study the efficacy of pre-loading versus co-loading with RL in SAB induced hypotension in total abdominal hysterectomy. In our study, we have found less incidence of hypotension after SAB in the co-loading group than conventional pre-loading group. This was also presented as significantly less amount of vasopressor use in co-loading group.

There are very few study on comparing pre-loading and co-loading with crystalloid. The result of our study is matched with the result of a prospective randomized controlled study by Oh AH et al.[10]; which recommends co-hydration with crystalloid than pre-hydration before the block. Also, Dyer et al.[7] and Khan et al.[11] found that rapid crystalloid infusion at the time of SAB was more effective at preventing hypotension than a pre-load. The same findings were published by Mojica et al.[12] in non-obstetric patients.

Our study contradicts the finding of Bose et al.[13] and Jacob et al.[14] who found no significant difference of hypotension between pre-loading and co-loading groups. But they have used fluid bolus of 15ml/kg instead of 20 ml/kg as used in our study. Sayyid et al.[15] and Nishikawa et al.[16] found pre-loading and co-loading similar with no superiority.

However, the above analysis combined crystalloids and colloids both, and there are limited data available for crystalloids. These two different types of fluid should be evaluated separately. It is known that colloids remain in intravascular space longer than crystalloids. So, after volume loading in the patients, colloid remained in the vascular space and the percentage increase in blood volume and that of cardiac output had a significant correlation[4]. Therefore, it can be assumed that when colloids were administered for prevention of hypotension after SAB, no significant difference in the incidence of hypotension or vasopressor requirement was found between the pre-load and co-load groups[6,15,16]. Colloids are expensive and having a potential risk of allergic reactions. That's why, many anaesthesiologists use crystalloid as a first choice of fluid for prevention of hypotension.

Crystalloids are not confined to intravascular space and rapidly distribute into the extracellular space. So Pre-load is rapidly redistributed, and may induce atrial natriuretic peptide secretion, resulting in peripheral vasodilatation followed by an increased rate of excretion of the pre-loaded fluid[14]. Pre-loading may be associated with volume over-load[6]. Concept of co-loading can be explained by the timing of hemodynamic events after SAB. Sympathetic nerve blockade is completed within the first 10 minutes after administration of local anaesthetic in subarachnoid space. There is increased chance of hemodynamic changes like hypotension and bradycardia in this period. Co-loading makes available extra fluids in intravascular space during period of the highest risk of vasodilatation due to SAB. So, it leads to timely compensatory changes in cardiovascular system and limits fluid redistribution and excretion with reduced risk of fluid overload[17]. Thus, co-loading is physiologically more appropriate and rational approach. But in dehydrated or cardiac compromised patients, the choice of fluid therapy should consider individual patient characteristics.

Moreover, it is very difficult to deliver pre-load in all the time with busy operation theatre, as it decreases the yield of operation theatre. Co-loading is more efficient for rapid turn-over of operation theatre.

In the future this study can be extended using larger sample size, invasive arterial monitoring, ASA III/IV patients as study population patients.

## CONCLUSION

The method of rapid co-loading with 20 ml/kg of crystalloid immediately after SAB is associated with less incidence of hypotension and less phenylephrine consumption without causing untoward side effects. It is unnecessary to spend time to deliver pre-load and delay surgery. Routine co-loading would increase OT turnover also besides reducing incidence of hypotension.

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