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Comparative study of preloading and Co-loading with ringer lactate for prevention of spinal hypotension in elective cesarean section

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Abstract

Background: Prevention of spinal induced hypotension was remained challenge to anaesthesiologist for years as it poses risk to mother as well as baby. Prehydration with various volumes of crystalloid or colloids was attempted in the past variable success rate. Recently the principle of preloading with fluids has been challenged by various studies. This prompted us to evaluate the effectiveness of crystalloid preloading compared to preloading for prevention of spinal hypotension. We evaluated vasopressor requirement and neonatal Outcome in the form of APGAR score as well.

Material and method: ASA grade I parturients posted for elective cesarean section were randomly allocated in two study groups of 30 each to receive either preload or co-load with Ringers lactate solution. Blood pressure, heart rate, SpO₂, vasopressor requirement and other outcomes recorded at regular interval.

Results: Hypotension was observed significantly less in co-loading group (36%) than preloading group (60%). Mean vasopressor requirement was also significantly more in preload group. Heart rate change, nausea, vomiting and fetal outcome remained same across both the groups.

Conclusion: Co-loading with crystalloids is more effective strategy than preloading in prevention of spinal induced hypotension. We can save valuable time given for preloading in case of emergency cesarean sections.

Keywords: Cesarean section, spinal hypotension, crystalloid, preload and co-load

Introduction

Spinal anesthesia always remained preferred technique of anaesthesia for cesarean delivery over general anaesthesia due to lower maternal mortality and morbidity^[1]. However, higher incidence of hypotension is one of the disadvantages of this technique^[2]. This hypotension has detrimental effects like nausea, vomiting, cardiovascular collapse and loss of consciousness in mother. Hypotension has adverse effects on fetal outcome due to fetal acidosis and hypoxia^[3]. Hence various methods have been tried to prevent and treat hypotension with varying degree of success^[4]. Traditionally, pre-hydration with crystalloid solutions is preferred for the prevention of hypotension^[5]. Preloading with various volume of crystalloid and colloid was attempted but could not prevent the maternal hypotension reliably^[6, 7, 8]. Recent studies demonstrated that preloading failed to prevent hypotension due to rapid redistribution among the body fluid compartments. So, trials were conducted to assess the effectiveness of co-loading i.e. rapid fluid administration at the time of giving spinal anaesthesia^[9, 10, 11]. This approach may limit fluid redistribution and prevent hypotension.

The present study conducted to test the effectiveness of rapid administration of crystalloid solution at the time of spinal anaesthesia compared to preloading in prevention of maternal hypotension.

Material and Methods

The prospective, randomized study was conducted in department of Anaesthesiology, Shri Bhauasaheb Hire Government Medical College Hospital, Dhule, Maharashtra. Approval of Institutional ethical committee taken wide IEC reg. no. ECR/472/INST/MH/2013. Informed written consent was obtained in patient's language (Marathi). Study included 60 parturients of ASA grade I and II, between 18-40yrs scheduled for elective cesarean section.

Patient with known hypersensitivity to local anesthetics, opioids or NSAID, Local infection, past history of tingling numbness in limbs, major systemic disease, gestational age < 37wks, multiple gestation, fetal distress and preeclampsia were excluded from the study.

All patients were nil by mouth for solid food for minimum 6 hrs. All patients were given Tab ranitidine 150mg on the prior night and day of surgery with sips of water. All patients received injection Metaclopramide 10 mg, 30 min prior to surgery.

All Subjects were randomly allocated in two groups using sealed envelope.

Group P (preload) was given rapid infusion of 10 ml/kg Ringer lactate solution, 10 min before spinal anesthesia, after arrival in the operating room.

Group C (co-load) was given rapid infusion of 10 ml/kg Ringer lactate solution just after intrathecal administration of local anesthetic solution for spinal anesthesia.

Before starting spinal anesthesia, systolic, diastolic, mean arterial blood pressure, heart rate and SpO₂ were recorded as baseline. Spinal anesthesia conducted in the left lateral position. After skin preparation lumbar puncture was done using 27gauge spinal needle at the L 3–4 interspace. After assuring flow of clear cerebrospinal fluid, 0.5% hyperbaric Bupivacaine 10 mg was injected intrathecally. Parturients, then immediately placed in the 15 degree tilted supine position. All patients were catheterized for urine output monitoring. Blood pressure and heart rate were recorded at 1 min interval starting 1 min after Intrathecal injection for first 10 min and every 5min thereafter. SpO₂ and ECG were monitored continuously.

Hypotension as primary outcome was defined as a decrease of systolic blood pressure by 20% or more from the baseline value and treated with intravenous Inj Mephentermine in increments of 6 mg. Before starting the procedure, parturient were instructed to report if they feel nauseated. Nausea and vomiting were reported. The extent of sensory block was checked with pinprick at 3 min interval starting 3 min after Intrathecal injection until stabilized.

Neonatal APGAR score was recorded at 1 min and 5 min after delivery.

Results

Both study groups were comparable with respect to age, sex, height and weight. Majority cases were of previous cesarean section suggestive of rising trend of LSCS.

Table 1: Patients characteristics

Parameter	Group P	Group C	P value
Age (years)	26.8 ± 4.2	26.6 ± 3.2	0.78
Weight (kg)	66 ± 6.2	67 ± 5.8	0.07
Height (cm)	158 ± 4.2	162 ± 3.2	0.06

Table 2: Baseline parameters

Parameter	Group P	Group C	P value
Heart rate(bpm)	88.6 ± 8.4	84 ± 7.4	0.70
Systolic BP	124.2 ± 8.7	120.7 ± 8.9	0.22
Diastolic BP	82.3 ± 4.6	84.1 ± 4.1	0.53
Mean BP	92.2 ± 3.6	93.1 ± 2.6	0.72

Baseline Heart rate, Systolic blood pressure, diastolic blood pressure and mean blood pressure were comparable in both groups. Median sensory level achieved was T4 and was statistically not significant across the groups. Duration of

surgery also was comparable across the groups.

Table 3: Perioperative adverse events

Parameter	Group P	Group C	P value
Hypotension	20(60%)	12(36%)	0.02
Nausea	9(27%)	6(18%)	0.47
Vomiting	2(6%)	2(6%)	1
Bradycardia	3(9%)	2(6%)	0.76

There was drop in mean heart rate in both groups within first 10 minutes after spinal anaesthesia. Maximum drop in Group P was at 5min and 8min in Group C. Incidence of hypotension was 60% (20/30) in Group P and 36% (12/30) in Group C, which was statistically significant. Incidence of nausea appeared more in Group P (27%) compared to Group C (18%) but was not statistically significant. Incidence of bradycardia and vomiting was comparable across the groups. Mean Mephentermine requirement was 4.6mg and 3.4mg respectively.

Table 4: Neonatal outcome

APGAR score	Group P	Group C	P value
At 1 min	9.23 ± 0.78	9.26 ± 0.56	0.86
At 5 min	9.38 ± 0.52	9.46 ± 0.48	0.88

APGAR scores at 1 min and 5 min were also similar in both groups.

Discussion

Despite of popularity of spinal anaesthesia for cesarean sections, hypotension remained the unsolved mystery for anaesthesiologists. Causative factors considered are raised venous capacitance, fall in systemic vascular resistance and aortocaval compression [12, 13]. In view of raised venous capacitance, various volumes of crystalloid and colloid solutions were infused before spinal anaesthesia to prevent subsequent hypotension [14]. Various strategies like left uterine displacement, preloading with crystalloids and colloids with various volumes, pneumatic tourniquet and vasopressors tried for prevention and treatment of spinal hypotension. Unfortunately, all these regimens alone were not enough for the prevention of spinal hypotension. According to Starling's law, the exchange of fluid is determined by the capillary and interstitial fluid hydraulic pressure and oncotic pressure [15]. The capillary hydraulic pressure increases over time during crystalloid infusion, which may lead to increased hydraulic pressure difference and fluid filtration from plasma into Interstitium. Timing of crystalloid infusion plays the crucial role as it gets distributed across extracellular space into interstitial space leading to suboptimal intravascular expansion [9, 10, 11]. Pouta *et al.* described role of increased atrial natriuretic peptide [16]. Since natriuretic peptide type C is a potent vasodilator produced in the endothelium of great vessels [17] rapid fluid administration before induction of anesthesia may exacerbate peripheral vasodilatation and facilitate fluid excretion [17, 18]. There is increased risk of development of pulmonary oedema in parturients because of physiological changes in cardiovascular system during pregnancy. Although preloading group did not show sign of pulmonary oedema in our study, it might be instrumental in high risk case such as preeclampsia and preexisting heart disease. In this study we have compared crystalloid Coload against preloading for prevention of spinal hypotension.

In our study mean heart rate had not shown statistically significant difference in both groups. Similar observations were made by Zainab Farid *et al.* M Khan *et al.* and Dyer *et al.*

Incidence of hypotension and mean vasopressor requirement was significantly less in Coload group in our study [6, 7, 9]. Zainab Farid *et al.* and Jacob *et al.* compared preloading and Coload with lactated Ringer's solution in patients undergoing cesarean section and found reduced incidence of hypotension in co-load group but was statistically not significant [6, 19]. Both the researchers suggested that waiting for preloading is not advisable when time is precious in case of emergency cesarean section. Findings of our study were supported by study results of M Khan *et al.* Dyer *et al.* A Rao *et al.* and Ah Young Oh *et al.* stating that crystalloid Coload is more effective than preloading for prevention of spinal induced hypotension [7, 9, 20, 21].

APGAR score in babies from both groups was comparable and statistically not significant. Similar findings were recorded by Zainab Farid *et al.* M Khan *et al.* Jacob *et al.* A Rao *et al.* Ah Young Oh *et al.* and Dyer *et al.* [6, 7, 19, 20, 21].

Conclusion

Thus our study could conclude that co-loading with crystalloids is more effective strategy than preloading in prevention of spinal induced hypotension. We can save valuable time given for preloading in case of emergency cesarean sections when time matters the most. Limitations of our study were small sample size and non-monitoring of fetal blood gases. Role of vasopressors like phenylephrine and noradrenaline could have been evaluated for effectiveness against crystalloid infusions.

Conflict of Interest: Authors declare no conflict of interest.

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