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A Comparative Study of Preload versus Coload by crystalloid for Parturients undergoing caesarean section under spinal anaesthesia

Anaesthesiology

KEYWORDS: Caesarean delivery, Crystalloid, Spinal anesthesia, Hypotension.

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ABSTRACT

Background: Prophylactic fluid preloading before spinal anesthesia has been a routine procedure to prevent maternal hypotension during caesarean delivery. Unlike colloid, timing of infusion of crystalloid may be important because of its short stay in intravascular space.

Methods: In this prospective controlled study, seventy parturients were randomised to receive 15 ml/kg of crystalloid before (preload Group A) or after (coload Group B) intrathecal drug injection for spinal anaesthesia. Maternal hypotension was defined as a decrease in SBP to more than 20% of the baseline of SBP value. Hypotension was treated with crystalloid boluses and 6 mg mephentermine was given intravenously every 3 min, until the SBP recovered to the baseline value. Bradycardia was defined as a HR less than 50 beats/minute. Blood pressure, heart rate, nausea, vomiting and shivering were assessed. Neonatal outcomes were evaluated with Apgar scores.

Results: The incidence of hypotension was lower in the Group B compared to the Group A (62.86% vs. 77.14%, P=0.29 NS) and was comparable statistically. More number of patients developed nausea (11 vs 3, P = 0.036 S) and vomiting (2 versus 0, P = 0.47 NS) in group A as compared to group B. The mean total dose of mephentermine was used (8.91±5.118 mg and 5.66±4.814 mg in groups A and B respectively) in the groups was statistically significant.

Conclusions: Both preloading and coloading with 15 ml/ kg of RL solution are ineffective to the prevent spinal-induced maternal hypotension. Frequent monitoring of maternal blood pressure and prompt treatment of maternal hypotension with vasopressors recommended for better neonatal outcomes.

Introduction

Spinal anaesthesia is popular, simple and well accepted reliable technique for below umbilicus surgeries. It is frequently used for lower segment caesarean section because of its rapid onset, a dense neural block, avoidance of risk of airway, little risk of local anesthetic toxicity and minimal transfer of drug to the fetus, as well as little risk of failure of block.[1]

However, a higher incidence of hypotension is one of disadvantage of this technique that poses increased risk threat to mother and fetus, leading to maternal nausea, vomiting, dizziness, aspiration, syncope, cardiac arrhythmias and fetal hypoxia[2]. Hypotension following spinal is mainly occur due to sympathetic blockade leading to peripheral vasodilation and venous pooling of blood. As a result there is decrease venous return and cardiac output leading hypotension[3]. The risk of hypotension is increased in parturients due to the higher level of block (T4) required for caesarean section, unique physiological and anatomic changes of pregnancy and increased susceptibility to the effect of sympathectomy due to reduced sensitivity to the endogenous vasoconstrictors coupled with increased synthesis of endothelium derived vasodilators.[4]

The prevention and treatment of maternal hypotension associated with spinal anaesthesia for lower segment caesarean section is still challenge to all anesthetists. Without preventive measure, the incidence of post spinal hypotension can be as high as 82%[5]. Even with use of various preventive measure the incidence of hypotension following spinal anesthesia has been reported as 53% to 80%.[6] Thus prevention of hypotension may be beneficial for both mother and fetus.

The anaesthetists have used various method and technique such as leg wrapping, elastic stocking, left uterine displacement, optimizing patient's position, intravenous fluids and vasopressor from time to time to offset these hypotensive effects of spinal anesthesia with varying degree of success.[7]

One of the most commonly used method to reduce spinal anaesthesia induced hypotension is administration of fluid before implantation of spinal anaesthesia, a technique named pre loading, described by wollman and marx8 and another method that administration of fluid in the period just following spinal injection called co-load. 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. In fact crystalloids rapidly and very easily leave the intravascular space and migrate to interstitial space.[9]

Although recent studies have shown that colloids are more effective in prevention of hypotension than crystolloids[10]. Many institutions still using crystalloids because of potential disadvantages of colloids, such as cost, allergy and effect on coagulation.

The present study undertaken to compare the efficacy of crystalloid (Ringer lactate) preload versus coload for prevention of spinal induced maternal hypotension & associated outcomes in patients scheduled for lower segment caesarean sections under spinal anaesthesia.

MethodsAfter Institutional Review Board approval and written informed consent, a total of 70 ASA I and II parturients scheduled for elective caesarean delivery under spinal anesthesia were enrolled. Exclusion criteria were gestational age < 37 wks, multiple gestation, fetal distress, pre-eclampsia, cardiovascular disease, and diabetes. Venous access was prepared with 18 gauge intravenous canula and the standard monitoring including noninvasive blood pressure measurement, ECG and pulse oximetry was applied. Parturients were randomized into one of the two groups using chit in box method.

Tablet ranitidine 150 mg orally was given to all patients on the night before and in the morning of the day of surgery. Injection metoclopramide 10 mg was given intravenously to all patients 30 min prior to surgery. The preload group received rapid infusion of 15 ml/kg of Ringer Lactate solution (sodium 131 mmol/L, chloride 111 mmol/L, lactate 29 mmol/L, potassium 5 mmol/L, calcium 2 mmol/L, osmolarity 279 mOsm/L) over 20 minutes on arrival in the operating room before spinal anesthesia. The same amount and type of fluid was infused in the coload group, but it was started just after performing the subarachnoid block. All patients received 2 ml of 0.5% hyperbaric bupivacaine over 15 sec intrathecally, in the left lateral position in the L3-4 inter vertebral space with 25 gauge Quincke's spinal needle. Parturients were then immediately placed in the tilted and wedged supine position. Urinary catheter was inserted to all patients. The following parameters were recorded every 2 minute after the spinal injection till the first 10 min, every 5 min till next 20 min and every 10 min thereafter till the end of the surgery: HR, SBP, DBP, MBP and SpO_2. Hypotension as primary outcome was defined as a decrease of systolic blood pressure by 20% or more from the baseline value and was treated with IV mephentermine in increments of 6 mg. The lowest blood pressure checked was recorded and nausea, vomiting were evaluated peri-operatively. The extent of sensory block was checked with pinprick method at an interval of 3 min, starting after 3 min of intrathecal injection until it stabilized. No sedation was given to any patient. Neonatal APGAR scores were recorded at 1 min and 5 min after delivery.

Statistical Analysis

Data was tabulated using Microsoft excel (2007) and analyzed using the Epi Info (version 8) software. Student's t-test was used for quantitative data and the Chi square for qualitative data. A p-value of less than 0.05 was considered to be statistically significant.

Result

The patient characteristics like age, weight, height, duration of surgery, highest sensory block level, and duration of surgery and average total IV fluid administered were comparable among the two groups [Table 1]. The baseline mean values of maternal HR, SBP, DBP and MBP for the two groups were comparable statistically [Table 1]. The minimum mean SBP values recorded were 106.34 ± 9.13 mm Hg in Group B and 104.83 ± 12.55 mm Hg in Group A (P = 0.566) and were comparable statistically [Figure 1]. Table 1 depicts the average Heart Rates of the study groups which were comparable statistically at all times.

The incidence of hypotension was lower in the Group B compared to the Group A (62.86% vs. 77.14%, P = 0.29 NS) and was comparable statistically. More number of patients developed nausea (11 vs 3, P = 0.036 S) in Group A as compared to Group B [Table 2].

The number of patients having vomiting was also higher in Group A as compared to Group B (2 versus 0, P = 0.47 NS). The incidence of bradycardia and shivering were not observed in both the groups [Table 2].

The mean total dose of mephentermine used (8.91 ± 5.118 mg and 5.66 ± 4.814 mg in groups A and B respectively) was more in the Group A and statistically significant. None of the neonates had an APGAR Score of < 7 at 1 min and 5 min intervals [Table 3].

Discussion

Hypotension is the most common side effect after spinal anaesthesia. Various techniques have been used to prevent spinal anaesthesia induced hypotension. Some of these techniques are preloading with I.V fluids, low dose local anesthetics in spinal anaesthesia with or without additives and use of vasopressors prophylactically. Of these preloading with I.V fluids has been considered safe and effective method. But, studies did not consistently prove the efficacy of preloading[11] and also preloading before commencement of spinal anaesthesia is time consuming. It is not possible to deliver preload in all the time with heavy routine work schedules and large no. of emergency surgeries in the country like India with higher population. The first study to challenge the role of preloading was conducted by Clark et al[12], who studied the use of fluid loading, both with and without uterine displacement, comparing them with controls with neither prophylactic measure. As much as 75% of any crystalloid diffuses into the interstitial space, is one of the possible reasons for the decreased efficacy of crystalloid solutions as prophylaxis against spinal induced hypotension.[13] Pouta et al[14] suggested that preload may induce atrial natriuretic peptide secretion resulting in peripheral vasodilatation and its rapid redistribution followed by an increased rate of excretion of the preloaded fluid.

Although crystalloid administration is safe in most patients, there is evidence to suggest that large volumes of crystalloid preload can be counterproductive by inducing hemodilution15 and can predispose the susceptible parturient to the development of pulmonary edema possibly because of an increase in the lung water during pregnancy.[16]

It was suggested by Mercier et al[17] that loading fluid at the time of administering the intrathecal local anesthetic (coloading) might be a physiologically more appropriate and rational approach as the maximal effect can be achieved during the time of the block. Dyer et al18 suggested that coloading might increase intravascular volume expansion during vasodilatation from the sympathetic blockade and limit fluid redistribution and excretion.

Our findings are similar to those of J.Jacob et al[19] who reported the incidence of hypotension in coload group 46% as compared with 60% in the preload group in study of crystalloid preload versus crystalloid coload for parturients undergoing cesarean section under spinal anaesthesia. They found the difference between the two groups to be statistically not significant (P-Value 0.1607).

Our findings are similar to those of A Sharma et al[20] whom study was carried out in 120 patients undergoing elective lower segment caesarian section under spinal anaesthesia. Hypotension occurred in 19 of 60 patients (31.6%) in prehydration group whereas in 15 of 60 patients (25.0%) in cohydration group, but the difference was not significant (P>0.05).

Our findings are similar to those of Syed Ali et al[21].They concluded coloading may be used instead of preloading in patients undergoing spinal anaesthesia for prevention of hypotension.

Contrary to our study results, Bouchnak et al[22] reported a higher incidence of hypotension in the coload group (96.6%) than in the preload group (86.6%) while comparing 20 ml/kg of crystalloid (given over 15 min) as coload or preload in the obstetric population. They used crystalloid administration rate 20ml/kg and time period of 15 min for crystalloid administration unlike (15ml/kg and 20 min) to our study. It may be the cause of contrary results from our study.

In our study, hypotension was not completely prevented by preloading or coloading in any group. It should be kept in mind that hydration only is not sufficient for the prevention of maternal hypotension and it should be treated by using appropriate vassopressors.

Persistent hypotension has adverse effects on the maternal well-being in the form of nausea, vomiting, dizziness[9] and it decreases the uterine blood flow[23] resulting in deleterious effects on the fetus.[24] In our study as the incidence of nausea and vomiting was found in Group A, which experienced more hypotension as compared to Group B. Our study result was similar to Oh et al[25]. They found that incidence of nausea was significantly lower in the coload group (27% vs. 60%, P=0.019). These results supports the mechanism of the nausea alone or along with vomiting may be due to maternal hypotension and hypoxemia in the chemoreceptor trigger zone as a consequence of the maternal hypotension.[26]

Crystalloid coload has been reported to decrease Vasopressor requirement to maintain the maternal blood pressure. Our study result similar to A.Sharma et al[20] study in which significantly less patients developed hypotension in the cohydration group (2 of 60 vs 18 of 60) and required vasopressor (mephentermine) therapy before delivery of baby (P<0.001).

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Our study result similar to M Khan et al[27] who studied that APGAR Score at birth and at 1 and 5 minutes after birth was statistically comparable in the two groups.

The limitation of our study is that it was not blinded to an investigator who recorded blood pressure, though anaesthesiologist was blinded when spinal anaesthesia was conducted. However, the judgement of hypotension or mephentermine administration was done under clear cut standard and the effect of this unblended method on our results might be small.

Table 1: Patient characteristics

Parameter	**Group A** (n = 35)	**Group B** (n = 35)	P-value
Age (years)	23.83 ± 3.4	23.86 ± 3.079	0.97
Weight (kg)	57.31 ± 6.038	57.26 ± 5.382	0.96
Height (cm)	155.06 ± 3.235	154.71 ± 2.915	0.32
Highest Sensory block level	T5 (T4 – T6)	T5 (T4 – T6)	0.970
Baseline SBP (mm Hg)	123.49 ± 7.747	123.17 ± 7.917	0.867
Baseline DBP (mm Hg)	80.43 ± 6.955	81.03 ± 5.813	0.697
Baseline MBP (mm Hg)	94.78 ± 6.804	95.08 ± 5.625	0.844
Baseline HR (beats/min)	94.26 ± 13.149	89.89 ± 11.463	0.14
Total fluid given (ml)	1294.29 ± 106.44	1258.57 ± 88.688	0.133
Mean total dose of Mephentermine(mg)	8.91 ± 5.118	5.66 ± 4.814	0.008

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MBP: Mean blood pressure, HR: Heart rate, Values are given as mean ±SD

FIGURE: 1

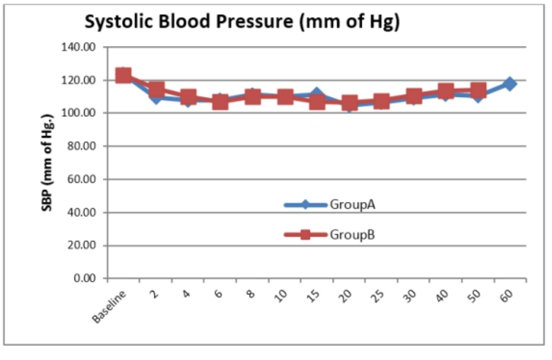

Table 2: Peri-operative adverse effects

Parameter	**Group A** (n = 35)	**Group B** (n = 35)	P-Value
Hypotension	27 (77.14)	22 (62.86)	0.29
Nausea	11 (31.43)	3 (8.57)	0.036*
Vomiting	2 (5.71)	0 (0.00)	0.47
Bradycardia	0 (0.00)	0 (0.00)	NA
Shivering	0 (0.00)	0 (0.00)	NA

Data is presented as number (%), *P- value < 0.05

Table 3: Neonatal outcomes: APGAR Scores

Apgar Score	**Group A** (n = 35)	**Group B** (n = 35)
at 1 min	7 (6–8)	7 (6–8)
at 5 min	8 (7–9)	8 (7–9)

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