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Management of Hypotension during Spinal Anesthesia in Pregnant Patients Using Crystalloids and Colloids without Using Any Inotropes and Vasoconstrictors

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Abstract **Original Research Article**

Background: Prevention of hypotension during spinal anesthesia for cesarean section avoids maternal and fetal side effects. The aim of this study was Management of hypotension during spinal anesthesia in pregnant patients using crystalloids and colloids without using any inotropes and vasoconstrictors. ***Materials and Methods*****:** In this prospective observational study 70 full term pregnant women aged between 20 to 30 years for elective lower segment caesarean section belonging to ASA-I and II class were randomly allocated equally to one of (CR Group) crystalloid or (CL Group) colloid groups. ***Results:*** Hypotension occurred in the crystalloid Group, 51.4% compared with 28.5% in the colloid Group and the statistical difference between two groups was significant (P = 0.005). The incidence of nausea was %11.42 (04 patients) in crystalloid group vs % 17.14 (6 patients) in colloid group. ***Conclusion:*** In conclusion, Prophylactic prehydration with colloid was more effective than prehydration with crystalloid for preventing hypotension in healthy parturient undergoing spinal anesthesia for elective cesarean delivery.

Keywords: Cesarean delivery, hypotension, spinal anesthesia, prehydration, crystalloids and colloids.

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INTRODUCTION

Today Spinal anaesthesia is used for almost any procedure below umbilicus [1]. Spinal anaesthesia, one of the most commonly preferred anaesthesia types in the practice, is used widely, especially in lower extremity surgery, anorectal, urologic, obstetric, and gynecologic and lower abdominal surgery [2]. Compared to general anaesthesia Spinal anaesthesia has decreased mortality, cardiovascular morbidity, deep venous thrombosis and pulmonary embolism, blood loss, duration of surgery, pain, opioid-related adverse effects, cognitive defects, and length of hospital stay. It is also known that SA improved rehabilitation compared with general anaesthesia [3, 4].

It has long been held that the dominant mechanism of hypotension in the patient for Caesarean section is caval compression [5]. However treatments based on the caval compression theory have not proved effective and the principles behind this theory have been challenged in a fairly recent editorial [6, 7]. This editorial suggests that a reduction in arterial sympathetic tone is more likely to be the dominant mechanism of spinal hypotension, and this has subsequently been supported by studies which used continuous cardiac output monitors during spinal anaesthesia [8, 9]. The typical response to spinal anaesthesia is therefore hypotension due to decreased systemic vascular resistance and a resultant increased heart rate [10] although a small proportion of patients may respond with hypotension and bradycardia [11]. It has also been noted that pre-eclamptic patients are relatively resistant to the effects of spinal anaesthesia which several authors propose is due to circulating vasoconstrictors offsetting the effects of the loss of arterial vascular tone [12, 13]. It has also been shown that increased preoperative positional blood pressure change correlates with an increased incidence of spinal hypotension and higher ephedrine requirements [14]. The authors postulated that an increased level of sympathetic activity was the mechanism behind this phenomenon. A higher level of preoperative anxiety has been shown to be predictive of an increased incidence of hypotension under spinal anaesthesia[15].

Several strategies have been suggested to reduce the incidence, or mitigate the severity, of hypotension, such as patient positioning, fluid administration, and use of vasopressors to prevent or correct hypotension [16]. The last decade has seen extensive research efforts to devise the optimal regimen for prevention or treatment of spinal anaesthesia-induced hypotension, including type of intravenous fluid (crystalloid or colloid), timing of fluid administration (before or after initiation of spinal anaesthesia), and choice of vasopressor (ephedrine or phenylephrine)[17].

The aim of fluid infusion is to neutralize the hypovolemia induced by spinal anesthesia, and for this purpose, various fluids infusion protocols, including crystalloids and colloids, have been used for preloading before spinal anesthesia for cesarean section. Many studies have been reported the effects of volume preload, using various fluids, with different volumes and speeds for treatment or prevention of hypotension induced by spinal anesthesia [18-20].

The aim of this study is to compare the effect of crystalloids and colloids in managing hypotension after spinal anaesthesia in LSCS without using any vasoconstrictor or ionotropics:

MATERIAL & METHODS

The present study was conducted in the Tertiary care LD Hospital which is one of the associated Hospital of Govt, Medical collage Srinagar from 2016 to 2017 for 70 full term pregnant women aged between 20 to 30 years for elective lower segment caesarean section belonging to ASA-I and II class. Parturients were randomly allocated equally to one of (CR Group) crystalloid or (CL Group) colloid groups.

After getting approval from Institutional Ethical Committee, written informed consent was obtained from all the patients before surgery. Patients with any moderate to severe systemic disorders, patients unwilling to accept regional anesthesia, patients with any contraindication for spinal anesthesia, were excluded from the study.

After arrival in the operating room and intravenous (IV) access, was secured then 500 ml of ringer solution was infused within 10-15 min before the initiation of the spinal block, similarly in the colloid group 500 ml of 6% Hydroxyethyl starch solution was infused to the patients. Spinal anesthesia was performed in the sitting position with a 25 gauge whitacre needle, using a midline approach at L4-5 interspace. Once free flow of CSF had been recognized the intrathecal anesthetic solution (12 mg of 0.5% bupivacaine) was injected over 15 s, aspirating CSF at the end of injection to confirm needle position. After intrathecal injection, the patients were turned in supine position with left uterine displacement. Surgery was started when a sensory block up to T5 dermatome was obtained.

All patients were then placed supine and administered oxygen via facemask. During the procedure an electrocardiogram, the heart rate and pulse oximetry were monitored continuously. Non-invasive blood pressure was taken before the conduct of spinal anaesthesia and every 5 minutes after the intrathecal injection until the end of surgery. Hypotension was defined as a decrease in the mean arterial blood pressure, more than 20% from baseline within a 5 min interval. Hypotension was treated with either fluid boluses or aliquots of intravenous mephatermin 6 mg since the efficacy of mephatermin) was recognized in earlier studies. Bradycardia was defined as heart rate less than 50 beats min^{-1} and was treated with i.v. injection of atropine 0.5–1 mg. Nausea was defined as the subjectively unpleasant sensation associated with awareness of the urge to vomit. Vomiting was defined as the forceful expulsion of gastric contents from the mouth. The quality of anaesthesia was assessed by testing severity of intra operative pain using Numerical VAS, where VAS 0 meant no pain and VAS 10 worst pain imaginable. VAS was evaluated every 5 min from the time of skin incision until the end of surgery. The use of VAS had previously been explained to each patient before surgery. VAS 1–3 was considered as mild pain, VAS 4–6 as moderate, VAS 7, 8 as severe and VAS 9, 10 as unbearable pain. Five minutes thereafter, the VAS was assessed. The height of sensory block was also noted. The level of sensory block was determined by the loss of pinprick sensation and was performed using a 22 G hypodermic needle. Sensory block level was tested every 5 minutes during the first 15-20 minutes after the intrathecal injection. The surgeon started all operations 20 minutes after intrathecal injection in every patient. No sensory testing was performed during surgery.

STATISTICAL ANALYSIS

Statistical test were performed using SPSS 11 for Windows. Results are reported as absolute value, mean ± SD. Continuous variables were analyzed using Student's T test. Nominal or ordinal variables were analyzed by Chi square test and Fisher exact test or Mann-Whitney U test. $P< 0.05$ was considered statistically significant.

RESULTS

Demographic characteristics and baseline variables in the two groups were comparable. There was no statistically significant difference between two groups with regard to age, ASA class, weight, height and duration of surgery table 1.

Table-1: Comparison of Demographics between Two Groups

VARIABLE	GROUP CR	GROUP CL	P value
Age (years)	25.55±5.90	26.80±6.30	0.70
WEIGHT	61.50±8.87	62.50±10.99	0.82
HEIGHT	166.3±4.6	168.4±5.5	0.876
ASAI/II	28/7	29/6	0.754
DURATION OF SURGERY	40.45±13.37	42.11±14.82	0.78

Table-2: Intra Operative Systolic blood pressure

Time	Group	Mean	SD	P-value	Remarks
Baseline	CR	119.55	4.651		
	CL	120.75	3.193	0.38	Not Sig
After Block	CR	119.05	3.193		
	CL	119.65	2.033	0.225	Not Sig
5 min after Block	CR	105.25	1.05		
	CL	119.75	3.15	0.016	Sig
30 min after Block	CR	90.02	1.00		
	CL	119.15	3.00	0.004	Sig
60 min after Block	CR	85.60	0.75		
	CL	120.67	3.10	0.012	Sig
After Surgery	CR	115.35	1.35		
	CL	120.00	3.36	0.20	NS

The baseline values of mean systolic blood pressure were comparable between the groups with no statistical significance. But mean systolic blood pressure values shows statically significant difference during intra operative period between the groups. The mean systolic blood pressure was found to be lower in patients of Group CR as compared to Group CL with p value of < 0.05 as shown in table: 2.

Table-3: Intra Operative Diastolic blood pressure

Time	Group	Mean	SD	P-value	Remarks
Baseline	CR	78.25	4.745		
	CL	77.85	4.271	0.336	Not Sig
After Block	CR	79.70	3.213		
	CL	78.30	2.94	0.335	Not Sig
5 min after Block	CR	62.65	2.75		
	CL	77.10	3.25	0.059	Sig
30 min after Block	CR	58.25	1.75		
	CL	78.30	3.75	0.01	Sig
60 min after Block	CR	50.20	1.20		
	CL	77.35	3.95	0.015	Sig
After Surgery	CR	69.70	3.10		
	CL	80.40	4.75	5.33	NS

The baseline values of mean diastolic blood pressure were comparable between the groups with no statistical significance. But mean diastolic blood pressure values shows statically significant difference during intra operative period between the groups the mean diastolic blood pressure was found to be lower in patients of Group CR as compared to Group CL with p value of < 0.05 as shown in table: 3.

Table-4: Intra operative operative adverse effects

Adverse effects	Group CR	%	Group CL	%	P-Vale
Hypotension	18		10		0.001 (NS)
Bradycardia	12		08		0.595 (NS)
Nausea	11		09		0.873 (NS)
Vomiting	03		1		0.804 (NS)

The intraoperative adverse effects observed among the two study groups only hypotension shows statically significant value (p=0.001). When other parameters were compared statistically, the results were found not significant with a p value of > 0.05 as shown in table: 4.

DISCUSSION

Subarachnoid block is commonly used regional anesthetic technique for patients who require surgical anesthesia for lower extremities, perineum, pelvic girdle or lower abdomen. It may be useful in patients with difficult airway or suffered from co-morbidities of severe respiratory disease. Spinal anesthesia covering the mid-thoracic level yields a contracted small intestine to provide superior

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surgical conditions in combination with profound muscle relaxation of abdominal muscles [21].

Spinal anesthesia for cesarean delivery may cause severe maternal hypotension, and a decrease in cardiac output and blood flow to the placenta [22].

Our study has shown that prophylactic prehydration with Hydroxyethyl starch was more effective than prehydration with crystalloid for preventing hypotension in healthy parturient undergoing spinal anesthesia for elective cesarean delivery. We demonstrated a higher incidence of hypotension in the crystalloid Group, 51.4% compared with 28.5% in the colloid Group (p=0.005).

Multiple studies fail to show persistent blood pressure maintenance after prophylactic crystalloid administration [23, 24]. Blood pressure and cardiac indices transiently increase, but these effects are short-lived because crystalloid solutions remain intravascular for only a limited time. Fluid preloading with crystalloid is ineffective due to its rapid redistribution [25].

A well prehydration protocol is known to augment intravascular volume, maintain stable hemodynamics parameters and improve microcirculatory organ perfusion. Many different fluid protocols have been tried by various studies to minimize the severity hypotension induced by spinal anesthesia in obstetric patients and it seems that Colloid preload provides a sustained increase in central blood volume [26, 27].

In our study, the groups were not significantly different, considering the relative frequency of nausea, vomiting, severity of nausea, and the frequency of IV administration of atropine or metoclopramide. This was in agreement with results of previous studies [28].

Malthru *et al*. found no hypotension when patients received 15 mL/kg of 5% albumin prior to spinal anesthesia for cesarean section. The control group, which received 15 mL/kg of 5% dextrose in LR, had a 29% incidence of hypotension [29].

Sharma *et al*. recently observed that patients given 500 mL of hetastarch had a 21% incidence of hypotension after spinal anesthesia with lidocaine for postpartum tubal ligation compared to a 55% incidence in patients given 1000 mL of LR [30].

Extravascular redistribution of crystalloids may be so rapid that it may be impossible to infuse them fast enough to maintain intravascular volume and avoid hypotension during spinal anesthesia. Colloid solutions contain large molecules that do not immediately redistribute throughout the extracellular fluid compartment [31].

Our study indicated that the highest decrease in SBP in all groups occurred 5 min after spinal anesthesia. This can be due to the sensitivity of the autonomous nervous system and sympathetic paralysis below the blockage site before sensory and motor paralysis. Moreover, in pregnant women, the hypotension can also be result of aortic and inferior vena cava compression in supine position after spinal anesthesia [32].

Our study had several limitations. The lack of a control group precluded determination of an absolute reduction in the incidence of hypotension. For ethical reasons, we could not include a group without prehydration.

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