Original Research Article

Influence of the timing of administration of crystalloid on maternal hypotension during low dose spinal anesthesia for elective cesarean delivery: Preload versus coload

Arpit Singhal[1*], Ashima Gupta[2], S.P. Chittora[3]

[1]2nd year PG Resident, [3]Senior Professor and HOD
Department of Anesthesiology, Jhalawar Medical College and Asso. Hospitals, Jhalawar. Rajasthan, India
[2]3rd year PG Resident, Department of Anesthesiology, SMS Medical College and Asso. Hospital, Jaipur, Rajasthan, India
[*]Corresponding author email: **drarpitsinghal87@gmail.com**

International Archives of Integrated Medicine, Vol. 6, Issue 5, May, 2019.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 13-04-2019 **Accepted on:** 18-04-2019
Source of support: Nil **Conflict of interest:** None declared.
How to cite this article: Arpit Singhal, Ashima Gupta, S.P. Chittora. Influence of the timing of administration of crystalloid on maternal hypotension during low dose spinal anesthesia for elective cesarean delivery: Preload versus coload. IAIM, 2019; 6(5): 16-21.

Abstract

Background: Spinal induced maternal hypotension is a common problem during cesarean delivery. Timing of infusion of crystalloid may be important because of its short stay in intravascular space.
Aim: This study was conducted to compare effectiveness of preloading and co-loading with crystalloid in prevention of spinal anesthesia induced maternal hypotension during caesarean section.
Material and Methods: In total 62 parturients were randomized to two groups. Preload group (Group P) received 15 ml/kg of Ringer Lactate solution over 20 min before giving low dose (2 ml, 0.5% hyperbaric Bupivacaine) spinal anesthesia and coload group (Group C) were given same volume of Ringer Lactate solution as fast as possible after CSF tapping and Bupivacaine injected. Non-invasive BP measurements were recorded. The incidence of hypotension and dose of inj. Mephentermine were checked. Blood pressure, heart rate, nausea and neonatal outcome were assessed.
Results: The incidence of hypotension, blood pressure drop and dose of Mephentermine was lower in the coload group compared to the preload group (significant $p<0.05$). The incidence of nausea was also lower in the coload group. No significant differences in neonatal outcome.

Conclusion: In case of using crystalloids (ringer lactate) for cesarean delivery, coload is more effective than preload for the prevention of maternal hypotension after spinal anesthesia for caesarean delivery.

Key words

Cesarean section, Co-loading, Preloading , Hypotension, Spinal anesthesia.

Introduction

Spinal anesthesia is frequently used for cesarean delivery as it is a rapid, safe, simple and reliable technique of anesthesia for parturients. A higher incidence of hypotension is one of disadvantages of this technique. Maternal hypotension becomes intensified by a deficit of intravascular volume adding to sympathetic blockade during spinal anesthesia. Traditionally, preload of crystalloid fluids is used to prevent hypotension in spinal anesthesia, but the efficacy has been questioned. The most accepted explanation for the limited value of crystalloid fluid preloading is the rapid distribution of administrated fluids in the extravascular space. Therefore the timing of infusion may be the main key to prevent hypotension because the volume expanding effect is maximal at the time of administration. Coload might be physiologically more appropriate because the maximal effect can be achieved during the time of the block. This might increase intravascular volume expansion during vasodilatation from the sympathetic blockade and limit fluid redistribution and excretion.

Aim and objectives

The aim of this prospective randomized controlled study was to assess effectiveness of preloading or co-loading with crystalloid in prevention of spinal anesthesia induced maternal hypotension during elective caesarean section.

Objectives of study:

- To compare systolic blood pressure between two groups.
- To compare mean arterial pressure between two groups.
- To compare incidence of hypotension between two groups.
- To compare incidence of nausea between two groups.
- To compare incidence of vomiting between two groups.
- To compare use of Mephentermine between two groups.
- To compare APGAR score between two groups at 1 min and 5 min.

Materials and methods

Present study was done at Department of Anesthesiology, Jhalawar Medical College and Associated Hospitals, Jhalawar, Rajasthan. Study design was hospital based randomized controlled comparative study design.

Sample size

It was determined by power analysis based on pilot data (desired power = 0.8, alpha = 0.05, hypotension incidence 80% and significant if 50% decrease in incidence) and a minimum of 28 parturients per group was required**.** So for study purpose we took 31 parturients in each group.

This study was conducted after written informed consent of patients and attenders.

A total of 62 ASA grade II parturients scheduled for cesarean delivery under spinal anesthesia were divided equally (31 in each group) into two groups.

Group P (preload group) received 15 ml/kg of Ringer lactate solution over 20 minutes before spinal anesthesia.

Group C (coload group) received 15 ml/kg of Ringer Lactate solution as fast as possible just after spinal anesthesia.

Inclusion criteria

- Patients with ASA grade II,
- Patients with gestational age >37 weeks,

- Patients willing to give written and informed consent.

Exclusion criteria

- Multiple gestation,
- Height <150 cm,
- Fetal distress,
- PIH, preeclampsia, eclampsia,
- Known cardiovascular disease,
- Diabetes, any complicated pregnancies.

Method

Venous access was taken with 18 Gauge intravenous cannula on forearm and all patients received injection Ranitidine 50 mg intravenously and injection Metoclopramide 10 mg intravenously. The standard monitoring including non-invasive blood pressure measurement, and pulse oximetry was applied and preoperation readings were recorded.

The preload group received infusion of 15 ml/kg of Ringer lactate solution 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 as fast as possible, but it was initiated just after intrathecal administration of local anesthetic solution for spinal anesthesia.

Spinal anesthesia was conducted in the sitting position in both groups. A 25-gauge Quinke's spinal needle was inserted at the L 3–L4 intervertebral space. After appearance of clear cerebrospinal fluid, 0.5% hyperbaric bupivacaine 10 mg were injected. Parturients were then immediately placed in the supine position with a 15 degree left lateral tilt. Parameters like SBP, MAP, Pulse rate, SpO_2 were recorded in both groups at two-minute intervals from the start of the regional block for the first 20 minutes, and then at five-minute intervals until the completion of surgery.

At least two further readings were taken three minutes apart after completion of surgery, and if injection mephentermine was still required, readings were continued until at least 10 minutes had passed without vasopressor. If surgery was concluded in less than 30 minutes, readings were continued each three minutes until at least 30 minutes or until no further vasopressor was required.

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.

Nausea and vomiting were evaluated until baby birth. Just after delivery of baby all patients received 20 IU of inj. oxytocin IV and no further oxytocin was given intra-operatively. APGAR scores were recorded at 1 min and 5 min after delivery to assess fetal outcome.

Statistical analysis

The incidence of hypotension and nausea were evaluated with Chi-square test and ratio-scale data were analyzed and compared by student t-test.

Results

One parturient was excluded from preload group due to PPH (atonic uterus) and one parturient was excluded from coload group due to inadequate spinal anesthesia. So in result each group contains 30 parturients as per **Table – 1 to 4**.

The incidence of hypotension was significantly lower in the coload group compared to the preload group, that was, more parturients in the preload group needed treatment with mephentermine (66.6 % *vs.* 40%, $P = 0.038$). Comparable amount of Mephentermine was administered to parturients of preload group compared to the coload group (5 ± 2.73 mg *vs.* 3.2 ± 2.22 mg, $P = 0.007$). The incidence of nausea was also greater in the preload group (40% *vs.* 1.33%, $P = 0.019$).

Discussion

This study found that, in the pre-delivery period when the parturient is most at risk for

hypotension after spinal anesthesia, patients receiving a rapid crystalloid infusion immediately after the induction of anesthesia (coload) required significantly less mephentermine than those receiving a conventional pre-load. It means the incidence of hypotension was lower in co-load group compare to preload group. This result is in consistent with the study done by Mojica, et al. [1] and Kamenik, et al. [2]. The effectiveness of coloading can be explained by timing of hemodynamic events occur after spinal anesthesia. The sympathetic blockade after spinal anesthesia causes arterial and venodilatation resulting in hypotension [3].

Table - 1: Parturient characteristics including age, weight, height and pre operation vitals were comparable.

	Preload	**Coload**	**p-value**
Age (years)	22.67±1.86	22.8±1.84	0.237
Weight (kg)	72.5±8.0	71.2±7.2	0.510
Height (cm)	160.4±3.8	161.7±3.1	0.151
Preoperative SBP	116±13	113±8	0.286
Preoperative MAP	78±10	77±9	0.685
Pulse rate	76±10	76±11	0.915

Table - 2: Intraoperative findings.

	Preload	**Coload**	**P-value**
Lowest SBP	82±13	88±12	0.093 (NS)
Change in SBP	34± 13	25±10	0.002 (S)
Lowest MBP	49±10	57±12	0.023 (S)
Change in MBP	29±11	20±9	0.011 (S)
PR at lowest BP	95±21	79± 14	0.023 (S)

Table - 3: Incidence of hypotension, nausea, vomiting and vasopressor requirement compared.

	Preload	**Coload**	**p-value**
Incidence of hypotension	20/30	12/30	0.038
Incidence of nausea	12	4	0.019
Incidence of vomiting	0	0	-
Mephentermine dose(mg)	5±2.73	3.2±2.22	0.007

Table - 4: Neonatal outcome compared using APGAR score.

	Preload	**Coload**	**p-value**
Apgar score at 1 min	9(5-9)	9(5-9)	0.96
Apgar score at 5 min	10(9-10)	10(9-10)	0.82

Sympathetic nerve blockade is completed within the first 10 minutes after administration of bupivacaine in subarachnoid space. There are high chances of hemodynamic changes like hypotension and bradycardia in this period [4, 5]. Giving the fluid at the same time keeps the loading fluid in intravascular space. So there is less chances of hypotension.

The physiological objective during spinal anaesthesia for caesarean section is the maintenance of cardiac output, and more specifically uteroplacental blood flow, although

blood pressure is usually used as a surrogate index of cardiac output [6].

American Society of Anesthesiologists (ASA) clinical practice guideline recommendation concerning spinal anesthesia for cesarean delivery states: "Although fluid preloading reduces the frequency of maternal hypotension, initiation of spinal anesthesia should not be delayed to administer fixed volume of intravenous fluid" [7]. So with rapid turnover of cases coloading would be a more efficient method to prevent spinal induced hypotension than preload. So valuable time need not be wasted in preloading the parturients as preloading alone is not effective for the prevention of maternal hypotension during a caesarean section under spinal anesthesia.

Preloading before commencement of spinal anesthesia may be effective but with considerable risk of volume overload. But coloading makes available extra fluid in intravascular space during period of the highest risk of hemodynamic changes due to spinal anesthesia [8]. So it leads to timely compensatory changes in cardiovascular system and limits fluid redistribution and excretion with reduced risk of fluid overload. A judicious combination of fluid loading and vasopressor therapy appears the most logical method of achieving this objective.

Our study also revealed that incidence of nausea was also less in co-load group of patients making patients more comfortable.

Our study also revealed that despite 40-70% incidence of hypotension, neonatal outcome in terms of Apgar score was similar in both preload as well as coload group and the difference was not statistically significant at 1 min and 5 min.

Conclusion

An equivalent volume of crystalloid administered rapidly, immediately after the performance of spinal anesthesia for elective caesarean section, is associated with a lower pre-delivery requirement for the vasopressor mephentermine than a conventional preload. The technique of coloading did not appear to disadvantage the neonate.

References

1. Mojica JL, Melendez HJ, Bantista LE. The timing of intravascular crystalloid administration and incidence of cardiovascular side effects during spinal anesthesia: the result from a randomized controlled trial. Anesth Analg., 2002; 94: 432-437.
2. Kamenik M, Paver Erzen V. The effect of lactated Ringer's solution infusion on cardiac output changes after spinal anaesthesia. Anesth Analg., 2001; 92: 710-714.
3. M. Van De Velde. Spinal anaesthesia in obstetric patients: Prevention and treatment of hypotension. Acta Anaesth Belg., 2006; 57: 383-6.
4. Somboonviboon W, Kyokong O, Charuluxananan S, Narasethakamol A. Incidence and risk factors of hypotension and bradycardia after spinal anaesthesia for caesarean section. J Med Assoc Thai, 2008; 91: 181–187.
5. Cook PR, Malmaqvist LA, Bengtsson et al. Vagal and sympathetic activity during spinal anaesthesia. Acta anaesthesiology scand, 1990; 34: 271-5.
6. Dyer RA, Farina Z, Joubert IA, Du Toit P, Meyer M, Torr G, Wells K, James MF. Crystalloid preload versus rapid crystalloid administration after induction of spinal anaesthesia (coload) for elective caesarean section. Anaesth Intensive Care, 2004; 32: 351–7.
7. American society of anaesthesiologists task force on obstetric Anaesthesia: Practice guidelines for obstetrics anaesthesia: an updated report by the American society of anaesthesiologist. Anaesthesiology. 2007; 106(4): 843-863.

8. Monica Maria, Sandra Bliacheriene, Claudia R C, et al. Preload during spinal anaesthesia for caesarean section. Comparison between crystalloid and colloid solution. Rev Bras Anesthesiology, 2004; 54(6): 781-787.