



# Prevention of Hypotension During Spinal Anesthesia for Caesarean Section: Preload with Crystalloids or Hydroxyethyl Starch

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## ABSTRACT

Prevention of hypotension during spinal anesthesia for cesarean section avoids maternal and fetal side effects. The aim of this study is to compare the effects of prehydration with crystalloid and prehydration with Hydroxyethyl starch on maternal blood pressure and neonatal outcome during cesarean section under spinal anesthesia. We enrolled 72 full term women weighting between 50 and 85 Kg, classified as ASA I, scheduled for elective caesarean section under spinal anesthesia. Participants were randomly allocated equally to one of crystalloid or Hydroxyethyl starch (Voluven) groups. After arrival in the operating room and intravenous (IV) access, 500 ml of ringer solution was infused within 10-15 min before the initiation of the spinal block in the crystalloid group, but in the Voluven group, 500 ml of 6% Hydroxyethyl starch solution was infused to the patients. Hypotension occurred in 47.2% of patients in crystalloid group and 25% of patients in Voluven group and the statistical difference between two groups was meaningful. ( $P = 0.008$ ). The incidence of nausea was %41.6 (15 patients) in crystalloid group vs %22.2 (8 patients) in Voluven group. Apgar scores in newborns in both groups were above 8. As conclusion, prophylactic prehydration with Hydroxyethyl starch was more effective than prehydration with crystalloid in the prevention of hypotension during spinal anesthesia for elective caesarean section.

## KEY WORDS

Spinal anesthesia; Hydroxyethyl starch; Crystalloid; Hypotension.

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## INTRODUCTION

Spinal anesthesia is often selected for cesarean delivery due to its rapid, reliable, and profound sensory and motor blockade. Spinal block causes peripheral vasodilation and venous pooling, which may result in

maternal hypotension. Hypotension and bradycardia are common side effects of spinal anesthesia. The incidence of hypotension in the supine pregnant patient after spinal anesthesia may be as high as 90% (1).



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 (2-4).

The aim of this study is to compare the effects of prehydration with crystalloid with prehydration with Hydroxyethyl starch on maternal blood pressure and neonatal outcome during cesarean section under spinal anesthesia.

## METHODS

The present prospectively designed study was approved by the ethics and clinical studies committee of Tehran University of Medical Sciences and informed and signed consent was obtained from all the patients who were enrolled in the study.

We enrolled 72 full term women in Arash Hospital, weighting between 50 and 85 Kg, classified as ASA I, scheduled for elective caesarean section under spinal anesthesia. Parturient who had obstetric complications or evidence of fetal compromise were excluded. All patients were fasted overnight and received premedication with ranitidine 150 mg orally the night before and 2 h prior to surgery.

Participants were randomly allocated equally to one of crystalloid or Voluven groups. After arrival in the operating room and intravenous (IV) access, 500 ml of ringer solution was infused within 10-15 min before the initiation of the spinal block, but in the Voluven 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.

Baseline maternal heart rate and arterial blood pressure were measured by an automatic non-invasive monitor and recorded before the induction, every 2 minutes before delivery, and every 5 minutes until discharge from recovery room. Hypotention (defined by a decrease in systolic blood pressure to less than 90 mm Hg or less than 20 mm Hg from baseline value was treated IV ephedrine 5 mg and incremented doses as required and additional ringer solution. Maternal bradycardia (defined as heart rate less than 60 beats/min) was treated with IV atropine 0.5 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.

If a nausea who was not related to hypotention occurred, or after intervention for hemodynamics parameters correction, midazolam 2 mg IV was administered for patient satisfaction. The height of block was recorded as the highest dermatome with loss of pinprick sensation at 20 min post spinal.

Times of skin incision, delivery of baby and completion of surgery were recorded. The surgical technique was uniform for all patients. Apgar scores were obtained at 1 and 5 min.

Statistical test were performed using SPSS 11 for Windows. Results are reported as absolute value, mean  $\pm$  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

No significant differences were detected in maternal demographic data between the groups (Table 1). Intraoperative data are shown in Table 2 and 3. Anesthesia levels were similar in the two groups.

Hypotension occurred in 47.2% of patients in crystalloid group and 22.2% of patients in Voluven group and the statistical difference between two groups was meaningful. ( $p=0.008$ ) No patient received more than one dose of ephedrine (5 mg) for treatment of the hypotension. There were no significant difference between the mean systolic pressure between groups ( $109.39 \pm 8.92$  in crystalloid group vs  $116.20 \pm 9.72$  in



Voluven group). The incidence of nausea was %41.6 (15 patients) in crystalloid group vs %22.2 (8 patients) in Voluven group ( $p=0.12$ ). No severe hypotension and bradycardia and occurred among the patients in our study.

Neonatal outcome was similar in the two groups and all the neonates have Apgar scores 8 at one and five minutes.

## DISCUSSION

Spinal anesthesia for cesarean delivery may cause severe maternal hypotension, and a decrease in cardiac output and blood flow to the placenta (5).

The current 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, 47.2% compared with 22.2% in the Voluven group ( $p=0.008$ ).

Multiple studies fail to show persistent blood pressure maintenance after prophylactic crystalloid administration (6,7). 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 (8).

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 (9,10).

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 (11).

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 (12).

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 (13,14).

Neonatal outcome was good in both groups in our study, and it can be due to a rapid treatment of hypotension with intravenous ephedrine, and also due to the rapid treatment of hypotension in our study, the incidence of nausea in both groups was low.

## CONCLUSION

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.

## DISCLOSURE

Conflicts of Interest: None declared.

**Table 1.** Characteristics of patients receiving prehydration with Crystalloid or Voluven infusion.<sup>a</sup>

	Crystalloid	Voluven	p-value
<b>Age (years)</b>	28 ±5.4	27 ± 3.9	0.06
<b>Weight (kg)</b>	78.4 ± 9.8	86.5 ± 8.5	0.4
<b>Height (cm)</b>	170±8.8	171 ± 6.9	0.8
<b>Gestational age</b>	38.2 ±0.8	38.5 ±0.6	<b>0.9</b>

<sup>a</sup>There was no significant differences between the groups.

**Table 2.** Intraoperative characteristics of patients in crystalloid or Voluven group.



	Crystalloid	Voluven	p-value
SBP <sup>b</sup> 1-10 min	97.89±9.84	105.61 ±8.16	<b>0.2</b>
SBP <sup>b</sup> 11-60 min	109.39±8.92	116.20± 9.72	<b>0.6</b>
Heart Rate before OP	92.22 ±10.75	88.39 ±6.89	<b>0.01</b>
Heart Rate along OP <sup>c</sup>	115.75 ±21.34	104.34 ±13.56	<b>0.008</b>
Level of sensory block	T4± 1	T4± 1	1.0

<sup>a</sup>P< 0.05; <sup>b</sup>SBP: Systolic blood pressure; <sup>c</sup>OP: Operation

**Table 3.** Intraoperative adverse effects among patients in crystalloid or Voluven group.

	Crystalloid N (%)	Voluven N (%)	P value
Hypotension	17 (47.2)	9 (25)	<b>0.008<sup>a</sup></b>
Nausea	<b>15 (41.6)</b>	<b>8 (22.2)</b>	<b>0.12</b>

<sup>a</sup> P< 0.05

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