

The Rate and Severity of Headache after Caesarean Section under Spinal Anaesthesia are decreased by Hypertonic Solutions: A Randomized Placebo-Controlled Clinical Trial

Maryam Khooshideh¹, Ali Shahriari² and Sama Bitarafan^{3*}

¹Department of Obstetrics and Gynaecology, Arash Hospital, Tehran University of Medical Sciences, Tehran, Iran

²Department of Anesthesiology, Roozbeh Hospital, Tehran University of Medical Sciences, Tehran, Iran

³Iranian Center of Neurological Research, Department of Neurology, Tehran University of Medical Sciences, Tehran, Iran

Abstract

Aim: To determine the frequency and severity of post-dural puncture headache (PDPH) in women undergoing spinal anaesthesia for caesarean section who received an infusion of Voluven or Ringer before the procedure.

Methods: We enrolled 240 full term women scheduled for elective caesarean section in this study. Participants were randomly allocated equally to Ringer (A) and Voluven (B) groups. After arrival in the operating room 500 ml of ringer solution was infused within 10-15 min before spinal block in the Ringer group, but in the Voluven group 500 ml of 6% Hydroxyethyl starch solution was infused to the patients. The frequency and severity of headache were compared between two groups.

Results: The frequency of PDPH was higher in patients in Ringer group compared to Voluven group at first day ($P=0.01$), but there were no significant differences between two groups in second ($p=0.23$) and third days ($p=0.30$). The severity of headache in Ringer group was significantly more than patients in Voluven group in every three days significantly. Hypotension occurred in 95 patients in Ringer Group (79.17%) and in 76 patients in Voluven Group (%63.33) ($P=0.007$). The frequency of nausea and vomiting was seen in 27 patients in Ringer group (22.5%) vs. in 18 patients in Voluven group (15%) ($p=0.10$).

Conclusion: Hydration with hypertonic solutions (Voluven) before caesarean section under spinal anaesthesia can decrease the rate and severity of PDPH compared with hydration with Ringer solution.

Keywords: Spinal anaesthesia; Hypertonic solutions; Voluven; Ringer; Post dural puncture headache; PDPH

Introduction

Post dural puncture headache remains a major concern after spinal anaesthesia, with a prevalence of 0.5-24% [1,2]. The pregnant women are at risk for the development of this headache because of female gender and young age. PDPH is occurred probably due to reduction in brain pressure caused by the leakage of cerebrospinal fluid (CSF) [3]. A 30-60% efficacy of a blood patch as the golden standard for treatment of PDPH confirms the theory of CSF leakage for the etiology of the post spinal headache [4].

Some scientists postulated that PDPH is caused by traction on pain sensitive structures within the cranial cavity. Twenty patients had MRI performed after lumbar puncture. Very large reductions in intracranial CSF volume were related to PDPH. There was no change in position of intracranial structures, suggesting that the traction theory does not explain the etiology of the headache [5].

Some researchers reported although finer needles have been used in recent years, the incidence of a PDPH has not decreased significantly [6]. So, some other pathophysiology for PDPH was proposed. Another hypothesis for the cause of PDPH is cerebral venous dilation. The Monro Kellie doctrine states that the sum of the volume of the brain, CSF and intracranial blood is kept constant; loss of CSF leads to an increase in the blood volume due to venodilatation. This venodilatation might be the cause of headache [7].

Rizvi et al. [8] used mannitol infusions to treat PDPH successfully for years with much success. If a post-operative patient complains of a headache that is characteristic of PDPH, 20% mannitol (100 ml) is given over 30 min intravenously and is followed by 100 ml every 12 h. Mannitol acts by the following mechanism: Acute increases in blood osmolality will decrease the brain water content, thereby decreasing

brain bulk and intracranial pressure and increasing the intracranial compliance. We assumed that if we can prevent the increase of brain water content by infusion of hypertonic solutions, we can decrease the rate of PDPH after spinal anaesthesia. The aim of this study is to compare the effects of hydration with isotonic and hypertonic solutions on the rate and severity of PDPH after caesarean section under spinal anaesthesia.

Methods and Materials

The present study was approved by the ethics and clinical studies committee. We enrolled 240 full term singleton, cephalic pregnancy women ≥ 38 week gestational age that were between the 18-38 years old. They were scheduled for elective caesarean section under spinal anaesthesia in Arash Hospital in 2014. 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 prior to surgery.

Baseline maternal heart rate and arterial blood pressure were measured by an automatic non-invasive monitor and recorded before

***Corresponding author:** Sama Bitarafan, MD and PhD, Iranian Centre of Neurological Research, Department of Neurology, Tehran University of Medical Sciences, Keshavarz Blvd, Tehran, Iran, Tel: +982166948899; Fax: +982166581558; E-mail: Bitarafan@sina.tums.ac.ir

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the induction, every 2 min before delivery, and every 5 min until discharge from recovery room. Participants were randomly allocated equally to one of Ringer or Voluven groups. After arrival in the operating room 500 ml of ringer solution was infused within 10-15 min before the initiation of the spinal block in the Ringer group, but in the Voluven group 500 ml of 6% Hydroxyethyl starch solution was infused to the patients. Spinal anaesthesia 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 (12.5 mg of 0.5% heavy bupivacaine) was injected over 10s, 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.

Hypotension (defined by a decrease in systolic blood pressure to less than 90 mm Hg or less than 20 mm Hg from baseline). Nausea and vomiting were recorded in the time of surgery.

The surgical technique was uniform for all patients. A nurse who was unaware of the group location of the patients asked the patients for feeling post-surgical headache and recorded severity with visual analogue scale (VAS) of the patients who suffered from headache patients until 3 day.

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

Demographic and Intraoperative data are illustrated in Table 1. No significant differences were detected in maternal demographic data between the groups. The mean age of group A was 25.31 ± 6.41 and the mean age of group B was 25.51 ± 7.75 . The mean gestational age of group A was 39.32 ± 1.23 and the mean gestational age of group B was 39.56 ± 1.68 .

The frequencies of PDPH in two groups after surgery to 72 h and severity of PDPH in patients were illustrated in Table 2. The frequencies of PDPH was higher in Ringer group compared with the patients in Voluven group at first day ($P=0.01$), but in second ($P=0.23$) and third days ($P=0.30$) no significant differences was seen between two groups.

The severity of headache in Ringer group was significantly more than patients in Voluven group in every three days (Table 2).

Hypotension occurred in 95 patients (79.2%) in Ringer group and 76 patients (63.3%) in Voluven group and the statistical difference between two groups was meaningful ($P=0.007$).

The incidence of nausea and vomiting was 27 (22.5%) among the patients in Ringer Group vs. 18 (15%) in Voluven Group ($p=0.10$).

Discussion

The current study has shown that prophylactic prehydration with 500 ml of hypertonic solutions (Hydroxyethyl starch) was more effective than prehydration with crystalloid for preventing hypotension in healthy parturient undergoing spinal anaesthesia for elective caesarean delivery.

In this study, we found a small decrease in the incidence of headache in the Voluven Group compared with the incidence of headache in the Ringer Group. This difference reflects the incidence of hypotension in two groups.

Three mechanisms can be postulated for the lower incidence of headache in the Voluven Group.

First; the lower incidence of the hypotension is the reason. Hypotension can cause veno-dilation in cerebral space and this venodilatation may be directly the cause of headache. Some other symptoms can accompany this situation as nausea, vomiting, visual disturbances, and hearing alteration [7,9,10].

Second: This hypotension can anticipated by an increase in cerebral blood flow when the blood pressure is returned to normal [11] The hyper perfusion syndrome was shown to be the cause of headache in multiple fields of medicine, for example after electroconvulsive therapy [12], after carotid end arterectomy [13] and seizure [14].

The third possible mechanism is that the use of hypertonic solutions in small doses can have a positive effect for prevention of brain swelling and cerebral edema and by this mechanism they prevent the increase of intracranial pressure, and so a lower incidence of headache can occur or they can decrease the severity of headache; in our study the severity of headache was decreased among the patients in Voluven group [15].

Rizvi et al. used infusion of mannitol to manage the headache after spinal anaesthesia. Mannitol acts by increasing in blood osmolality and these phenomena in turn decrease the brain water content. So when we reduce with this method the brain bulk the intracranial pressure and the severity of the headache will be decreased [8,15].

	Group A n=120	Group B n=120	P value
Age (year)	25.31 \pm 6.41	25.51 \pm 7.75	0.8
Gestational age (week)	39.32 \pm 1.23	39.56 \pm 1.68	0.2
Frequency of hypotension	95 (79.2%)	76 (63.3%)	0.007
Frequency of Nausea or vomiting	27 (22.5%)	18 (15%)	0.10
Frequency of Headache	38 (31.7%)	22 (18.3%)	0.01

Values given as mean \pm SD (standard deviation), or number (percentage) unless otherwise indicate

Table 1: Baseline and demographic characteristics.

Frequency	Group A n=120	Group B n=120	P value	Severity	Group A n=120	Group B n=120	P value
Day 1	38 (31.7%)	22 (18.3%)	0.01	Day 1	5.21 \pm 2.71	3.63 \pm 2.64	<0.001
Day 2	12 (10%)	7 (5.8%)	0.23	Day 2	2.12 \pm 1.54	1.74 \pm 0.15	0.007
Day 3	6 (5%)	3 (2.5%)	0.30	Day 3	2.04 \pm 1.56	1.23 \pm 0.34	<0.001

Values given as mean \pm SD or number (percentage) unless otherwise indicated

Table 2: The frequency and severity of headache after spinal anesthesia.

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