RESEARCH ARTICLE

The Effect of Trendelenburg Posture on Sensory Block Level in Spinal Anesthesia with Intrathecal Hyperbaric Bupivacaine for Hernia Repair

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Background: Obtaining a good sensory and motor block is the goal of performing spinal anesthesia for surgeries. The aim of this study is to compare the effect of trendelenburg position on sensory block level after spinal anesthesia with intrathecal hyperbaric bupivacine.

Methods: We enrolled 80 men, classified as ASA I, scheduled for elective hernia repair under spinal anesthesia. Participants were randomly allocated equally to one of the two groups, horizontal or trendelenburg position. Spinal anesthesia was performed in the sitting position using 15 mg of 0.5% hyperbaric bupivacaine. Then the patients were turned to supine position. In trendelenburg position group, a 20 degree head tilt position was performed for 40 seconds, then the patients were returned to horizontal position and 30 mg ephedrine was administered intramuscularly. Sensory block level and incidence of hypotension were recorded in the two groups.

Results: There were significant effects of trendelenburg position on sensory block heights during the study period (10.61 ± 0.32segments blocked above the injection point versus 7.24 ± 0.51 in horizontal group). No episodes of severe hypotension were seen among the patients. Six patients in horizontal group experienced intraoperative discomfort or pain, versus no patient in Trendelenburg group. (p=0001).

Conclusion: A higher level of sensory block can be obtained with performing a short time head down position after intrathecal injection.

Keywords: spinal anesthesia; bupivacaine; trendelenburg position; sensory block level

Obtaining a good sensory and motor block is the goal of performing spinal anesthesia for surgeries. The level of sensory block, after intrathecal injection of local anesthetics, was affected by some factors, such age, height, density and baricity of local anesthetics, positioning, dosage, technique of injection, patient characteristics and direction of bevel of needles [1-4]. Hyperbaric bupivacaine is now most popular in practice than equal doses of plain bupivacaine [5-7], and it seems that intrathecal hyperbaric bupivacaine had a more rapid onset of sensory blockade than isobaric bupivacaine [8]. Also the advantage of using hyperbaric local anesthetic solutions is flexibility of controlling the level with posture [9], however the time needed in order to obtain a favorable height of anesthesia, by performing a trendelenburg position it is still controversial. Some authors declared that the level of analgesia when using hyperbaric solutions seems not to be affected by posture [10], and some others found a higher level of sensory block using trendelenburg position after intrathecal injection of hyperbaric bupivacaine [11]. We found no study evaluating the effect of trendelenburg position immediately after intrathecal injection. The aim of this study is to compare the effect of 40 sec trendelenburg position on sensory block level after spinal anesthesia with intrathecal hyperbaric bupivacine.

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 80 men, classified as ASA I, between 20 to 50 years, weighing 60 - 90 Kg, scheduled for elective hernia repair under spinal anesthesia in our hospital. Participants were randomly allocated equally to one of horizontal or trendelenburg groups with block randomizing method. Ringer solution 0.5 L was infused within 10-15 min before the initiation of the spinal block. Spinal anesthesia was

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performed in the sitting position with a 25 gauge Whitacre needle, using a midline approach at L4-5 interspace. Once free flow of cerebro-spinal-fluid had been recognized the intrathecal anesthetic solution (15 mg of 0.5% hyperbaric bupivacaine "Braun, France") was injected over 5 seconds. After intrathecal injection, the patients were turned in supine position. In trendelenburg position group, a 20 degree head down tilt was performed for 40 seconds, unless the sensory block reached T10 sooner than this time, and then the patients were returned to horizontal position, and 30 mg ephedrine intramuscularly was administrated for prevention of inadvertently hypotension caused by extensive sympathic bloc in trendelenburg position. The height of the block was recorded as the highest dermatome with loss of pinprick sensation at 2, 3, 5, 15, min post spinal. Surgery was started when a sensory block up to T10 dermatome was obtained.

Baseline heart rate and arterial blood pressure were measured by an automatic non-invasive monitor and recorded before the spinal block, every 2 minutes in operating room, and every 5 minutes until discharge from recovery room. Hypotension, defined as a decrease in systolic blood pressure to less than 90 mmHg or less than 30 mm Hg from baseline value was treated by ephedrine 5 mg, and incremented doses as required and additional ringer solution. Bradycardia, defined as heart rate less than 50 beats/min, was treated with atropine 0.5 mg. The incidence of nausea and vomiting was recorded in both groups.

If discomfort of patients was noted, midazolam and fentanyl were administrated and in cases of severe pain, general anesthesia was provided. If nausea occurred, after intervention for hemodynamic parameters correction, ondansetrone was administered for patient satisfaction. After the regression of sensory block to T10 and the ability of patients to bend their knees, the patients were permitted to leave the recovery room. The sample size estimates were based on detecting a difference of 2 dermatomes among groups at 85% power, and 40 patients were enrolled in each group.

Statistical test were performed using SPSS 13 for Windows. Results are reported as absolute value, mean ± SD. Continuous variables were analyzed using Student's T test. The Chi square test was used for categorical data. Nominal or ordinal variables were analyzed by Fisher exact test or Mann-Whitney U test. $P< 0.05$ was considered statistically significant.

Results

No significant differences were detected in demographic data between the groups (Table 1). Results for block characteristics, intraoperative supplementation, incidence hypotension, nausea and vomiting and intraoperative pain are shown (Table 2). All patients achieved sensory blockade of T10 or higher. The mean spread of sensory blockade with hyperbaric bupivacaine in the trendelenburg position group above the injection point was 10.61 ± 0.32 segments (T7± 1.23), compared with 7.24 ± 0.51segments in the horizontal position group (T10± 1.61) (P value= 0.03). No patient reported breathing discomfort or upper extremity motor block as a result of these blocks in both groups. Six patients in horizontal group experienced intraoperative discomfort or pain, requiring IV supplementation, versus no patient in trendelenburg group. (p=0001). We found no episodes of severe hypotension, bradycardia among two groups. No additional ephedrine was needed among patients in both groups.

Discussion

This study showed that patients undergoing hernia repair with trendelenburg position after intrathecal injection of hyperbaric bupivacine, experienced a higher sensory block level at 20 minutes after spinal anesthesia. We think that this finding is arguable, particularly because the cephalad extent of sensory blockade was T7 or higher in all patients in trendelenburg position group. The influence of posture immediately after intrathecal injection of the local anesthethic is important. Studies in the non-obstetric population have found the spread of hyperbaric bupivacaine to be higher than isobaric bupivacaine, because the influence of gravity causes the hyperbaric solutions to push downward into the lowest point of the thoracic curve (L3-4) [12- 16].

Some studies evaluated the effects of sitting position on extension of sensory block after intrathecal injection of hypobaric bupivacine, and conclude that these patients develop greater cephalad extents of sensory block than those in a lateral position during intrathecal injection [17]. Hallworth compared the effect of posture and baricity on the spread of intrathecal bupivacaine for elective cesarean delivery, and found higher level of analgesia with hypobaric intrathecal bupivacaine. He found that lower baricity produces a higher cephalad spread of local anesthetic in patients in sitting position [17].

The overall differences in maximal spread only differed by one dermatome, with the hyperbaric solution achieving a median maximum sensory level to T3 compared with T2 for the isobaric and hypobaric solutions [17]. We think that using hypobaric intrathecal bupivacaine with trendelenburg position can be dangerous and we did not try this method. Hallworth et al after keeping their patients in sitting position found a higher level of sensory block with hypobaric bupivacaine compared with hyperbaric bupivacaine. The overall differences in their study in maximal spread only differed by one dermatome, with the hyperbaric solution achieving a median maximum sensory level to T3 compared with T2 for the isobaric and hypobaric solutions. Hallworth in their study experienced a greater incidence of hypotension among patients with higher level of analgesia, but in our study, due to prophylactic injection of ephedrine we didn't find it [18].

Also Loubert et al [19] in their study found that in parturient undergoing cesarean delivery by keeping the patient in the upright position for 5 minutes after the intrathecal injection of hypobaric bupivacaine resulted in a higher sensory block level at 25 minutes and a higher rate of successful sensory block (minimum T4 level) than when isobaric or hyperbaric bupivacaine were used. Tecklenburg-Weier et al [20]. kept the patients in the supine position for 30 min, then changing them to the Trendelenburg position or the lithotomy position, each for 20 min. Local anesthetics used were 3 ml bupivacaine 0.5%. The mean spread of sensory blockade with isobaric bupivacaine was 16.95 segments (T6). After the 20 degrees trendelenburg position the spread of blockade increased by 0.85 segments. With hyperbaric bupivacaine the mean spread of sensory blockade after 30 min in the supine position was 17.3 segments (T5/6). After the trendelenburg position there was no increase in sensory blockade [20].

Table 1- The comparison of demographic data in two groups

	Trendelenburg (n=40)	Horizontal (n=40)	P value
Age (years)	34.8 ± 12.23	39.0 ± 19.86	0.55
Weight (Kg)	71.65 ± 16.68	68.87 ± 23.73	0.77
Height (cm)	164.45 ± 18.54	169.32 ± 20.39	0.65

Table 2- Outcomes of spinal anesthesia in two groups

	Group T (n=40)	Group H (n=40)	P value
Number of dermatomes blocked above the injection point	10.61 ± 0.32	7.24 ± 0.51	0.03 *
Mean arterial pressure (mm Hg) 5 min after spinal injection	97.67 ± 1.15	101.69 ± 2.18	0.37
Intraoperative pain (n)	0	6	0.00 *
Nausea and vomiting (n)	0	0	1.00

Group T: Trendelenburg position group; Group H: Horizontal position group; * P< 0.05: statistically significant.

The results of our study are in contrast with the results of Sinclair'study [10] who did not find a statistically significant difference in the mean spread of local anesthetic among patients in tilted head-down group compared with horizontal group, and concluded that the trendelenberg position is not necessary to ensure spread of local anesthetic solution into the mid thoracic region, but confirmed that the sensory block was higher in patients tilted head-down. It can be due to low sample size of their study. Kim kept their patients in Trendelenburg position in addition or not with the hip flexion for 5 minutes to obtain a higher sensory block level. He found the level of sensory block three dermatomes higher in patients in Trendelenburg position in addition with the hip flexion than in patients in Trendelenburg position without the hip flexion [21].

The level of sensory block in our study was not so high that we expect. We think that the glucose %5 accumulates in the lower part of thoracic column, and this accumulation prevents the spread of bupivacaine to more cephaled parts of spinal column [22-26]. In conclusion, we demonstrated that patients undergoing spinal anesthesia who were maintained 45 seconds in the trendelenburg position immediately after intrathecal injection of hyperbaric bupivacine, experienced a higher sensory block level during the operation.

References

1. Russell IF. Effect of posture during the induction of sub arachnoid analgesia for Caesarean section: right v. left lateral. Br J Anaesth. 1987; 59(3):342-6.
2. Russell IF. Posture and isobaric subarachnoid anesthesia. Anaesthesia. 1984; 39(9):865-7.
3. Santos A, Pedersen H, Finster M, Endström M. Hyperbaric bupivacaine for spinal anesthesia in cesarean section. Anesth Analg. 1984; 63(11):1009-13.
4. Richardson MG, Collins HV, Wissler RN. Intrathecal hypobaric versus hyperbaric bupivacaine with morphine for cesarean section. Anesth Analg. 1998; 87(2):336-40.
5. Van Gessel EF, Forster A, Schweizer A, Gamulin Z. Comparison of hypobaric, hyperbaric, and isobaric solutions of bupivacaine during continuous spinal anesthesia. Anesth Analg. 1991; 72(6):779-84.
6. Inglis A, Daniel M, McGrady E. Maternal position during induction of spinal anaesthesia for caesarean section: A comparison of right lateral and sitting positions. Anaesthesia. 1995; 50(4):363-5.
7. Yun EM, Marx GF, Santos AC. The effects of maternal position during induction of combined spinal-epidural anesthesia for cesarean delivery. Anesth Analg. 1998; 87(3):614-8.
8. Sia AT, Tan KH, Sng BL, Lim Y, Chan ES, Siddiqui FJ. Use of hyperbaric versus isobaric bupivacaine for spinal anaesthesia for caesarean section. Cochrane Database Syst Rev. 2013; 5:CD005143.
9. Lowson SM, Brown J, Wilkins CJ. Influence of the lum bar interspace chosen for injection on the spread of hyper baric 0.5% bupivacaine. Br J Anaesth. 1991; 66(4):465-8.
10. Sinclair CJ, Scott DB, Edström HH. Effect of the trendelenberg position on spinal anaesthesia with hyperbaric bupivacaine. Br J Anaesth. 1982; 54(5):497-500.
11. Tecklenburg-Weier E, Quest F, Nolte H, Meyer J. The effect of patient positioning on the spread of sensory blockade in hyperbaric and isobaric spinal anesthesia using bupivacaine. Reg Anaesth. 1990; 13(7):163-7.
12. Thage B, Callesen T. Bupivacaine in spinal anesthesia. The spread of analgesia--dependence on baricity, positioning, dosage, technique of injection and patient characteristics. Ugeskr Laeger. 1993; 155(39):3104-8.
13. Greene NM. Distribution of local anesthetic solutions within the subarachnoid space. Anesth Analg. 1985; 64(7):715-30.
14. Pitkanen M, Rosenberg PH. Local anaesthetics and additives for spinal anaesthesia: Characteristics and factors influencing the spread and duration of the block. Best Pract Res Clin Anaesthesiol. 2003; 17(3):305-22.
15. Bannister J, McClure JH, Wildsmith JA. Effect of glucose concentration on the intrathecal spread of 0.5% bupivacaine. Br J Anaesth. 1990; 64(2):232-4.
16. Stienstra R, Greene NM. Factors affecting the subarachnoid spread of local anesthetic solutions. Reg Anesth. 1991; 16(1):1-6.
17. Richardson MG, Thakur R, Abramowicz JS, Wissler RN. Maternal posture influences the extent of sensory block produced by intrathecal dextrose-free bupivacaine with fentanyl for labor analgesia. Anesth Analg. 1996; 83(6):1229-33.
18. Hallworth SP, Fernando R, Columb MO, Stocks GM. The effect of posture and baricity on the spread of intrathecal bupivacaine for elective cesarean delivery. Anesth Analg. 2005; 100(4):1159-65.
19. Loubert C, Hallworth S, Fernando R, Columb M, Patel N, Sarang K, et al. Does the baricity of bupivacaine influence intrathecal spread in the prolonged sitting position before elective cesarean delivery? A prospective randomized controlled study. Anesth Analg. 2011; 113(4):811-7.
20. Tecklenburg-Weier E, Quest F, Nolte H, Meyer J. The effect of patient positioning on the spread of sensory blockade in hyperbaric and isobaric spinal anesthesia using bupivacaine. Reg Anaesth. 1990; 13(7):163-7.
21. Kim JT, Shim JK, Kim SH, Jung CW, Bahk JH. Trendelenburg position with hip flexion as a rescue strategy to increase spinal anaesthetic level after spinal block. Br J Anaesth. 2007; 98(3):396-400.
22. Ali Hassan HI. Comparison between two different selective spinal anesthesia techniques in ambulatory knee arthroscopy as fast-track anesthesia. Anesth Essays Res. 2015; 9(1):21-7.
23. Heng Sia AT, Tan KH, Sng BL, Lim Y, Chan ES, Siddiqui FJ. Hyperbaric versus plain bupivacaine for spinal anesthesia for cesarean delivery. Anesth Analg. 2015; 120(1):132-40.
24. Shahriari A, Khooshideh M. Intrathecal fentanyl added to lidocaine

for Cesarean delivery under spinal anesthesia-a randomised clinical trial. Middle East J Anaesthesiol. 2007; 19(2):397-406.
25. Cantürk M, Kılcı O, Ornek D, Ozdogan L, Pala Y, Sen O, et al. Ropivacaine for unilateral spinal anesthesia; hyperbaric or hypobaric? Rev Bras Anestesiol. 2012; 62(3):298-311.
26. Shahriari A, Khooshideh M, Heidari MH. A Proposed Management of Accidental Intrathecal Injection of a Wrong Drug: Spinal Washing. J Appl Environ Biol Sci. 2014; 4(8) 292-295.