International Journal of Research in Medical Sciences
Shyam R et al. Int J Res Med Sci. 2016 Dec;4(12):5283-5287
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20164195

Original Research Article

Effect of epidural volume extension with colloid on dose requirement for intrathecal spinal block: a double blind prospective study

Radhey Shyam, Ajay Kumar Chaudhary*, Prithvi K. Singh, Gaurav Jain, Dinesh Singh, Girish Chandra, Vinod K. Bhatia

Department of Anaesthesia, King George's Medical University, Lucknow, Uttar Pradesh, India

Received: 29 September 2016
Accepted: 26 October 2016

***Correspondence:**
Dr. Ajay Kumar Chaudhary,
E-mail: ajaychaudhary62@yahoo.com

ABSTRACT

Background: Epidural volume extension (EVE) is a modification of combined- spinal epidural anaesthesia (CSEA) in which fluid is injected in epidural space after the intrathecal block. Fluid in epidural space compress subarachnoid space and causes cephalic spread of intrathecal drug to increase block height. Purpose of study is to determine efficacy of EVE on dose requirement of intrathecal bupivacaine when colloid was used for EVE.
Methods: Sixty patients of ASA physical status I or II, scheduled for elective caesarean sections were recruited and randomized into two groups (30 each group). Group 1: CSEA in which spinal block is followed by 10 ml Colloid (HES 6%) in epidural space; Group 2: CSEA but no fluid in epidural space. Onset of sensory block and hemodynamic variables were measured at 5 min. intervals up to 40 minutes then at 10 min. intervals till end of surgery. Ineffective block was top- up by epidural 0.5% bupivacaine in incremental doses.
Results: Median effective dose of intrathecal bupivacaine was significantly lower, 4.0 mg (95% CI 4.40-5.60) in group 1 versus 7.0 mg (95% CI 6.93-7.61) in group 2. Only 11 patients required ephedrine in group 1 versus 20 in group 2. Requirement of ephedrine was significantly lower 2.20 (±2.94) mg in group 1 versus 4.0 (±2.88) mg groups 2. Changes in haemodynamic variables from baseline were significantly lower in group 1 than those in group 2.
Conclusions: EVE with colloid was effective in lowering dose requirement of spinal bupivacaine while patients hemodynamically were more stable.

Keywords: Bupivacaine, Colloid, Epidural, Fentanyl, Haemodynamic, Spinal

INTRODUCTION

Combined spinal- epidural anesthesia (CSEA) is gaining popularity as preferred technique for caeserean sections and orthopaedic surgeries as it has rapid onset through spinal component and extension of aneasthesia and post-operative pain relief through epidural component while avoiding disadvantage of both.[1-3]

Epidural volume extension (EVE) is a modification of CSEA in which fluid is injected in epidural space through epidural catheter after intrathecal spinal block. The epidural space with colloids, which compress the subarachnoid space, causes cephalic spread of intrathecal local anaesthetic to increase block height and speed of onset (Volume Effect).[1,4]

In contrast EVE with local anaesthetic causes leaks from epidural space to subarachnoid puncture and also perineural or transdural spread of the extradural solution to enhance intensity and block duration besides volume effect.[5-7] In this study, we aimed to evaluate the efficacy of epidural volume extension (EVE) with colloid on dose requirement of intrathecal bupivacaine with fentanyl to

enhance the block height and improved the haemodynamic profile.

METHODS

This prospective study included sixty patients with ASA physical Status I or II, more than 37 weeks of gestation, with a singleton uncomplicated pregnancy were enrolled. This study was approved by the Institutional ethics committee and an informed, written consent was obtained from each individual. History with pregnancy induced hypertension, in active labor, requiring emergency caesarean section, any contraindication to regional anesthesia and obese patients with more than 100 kg were excluded from study. The anesthetist who performed the procedure was not present with the patients for rest of the duration for assessing the block height, hemodynamic profile and any requirement of an epidural top-up before 60 min extent. Subjects were randomized in two groups using random number table:

Group1: Patients receiving combined spinal-epidural anesthesia (CSEA) with epidural volume extension (EVE) by hydroxyl ethyl starch 6% w/v 10 ml through the epidural needle or catheter.

Group 2: Patients receiving combined spinal-epidural anesthesia (CSEA) without epidural volume extension

An up-down sequential allocation technique was used to allocate bupivacaine dose to each patient with the first patient in each group receiving 10 mg hyperbaric bupivacaine with 25 µg fentanyl. The combined spinal-epidural block was performed with a kit containing 27-gauge pencil point spinal needle and an 18G Tuohy epidural need in the left lateral position at the L2-3 or L3-4 interspace using single space needle through needle technique in which spinal needle was inserted via Tuohy needle and the study solution was injected over 15–20s without barbotage. After that spinal needle was withdrawn and a 20-G multiorificed catheter was placed 5 cm into the epidural space and the Tuohy needle was removed. Depending on group allocation, in EVE group 10 ml of 6% hydroxyl ethyl starch was injected in epidural space via epidural needle or catheter and patients were turned into the supine position with left lateral tilt within 3 min of spinal injection.

Standard monitoring with electrocardiogram, noninvasive blood pressure and pulse oximetry was done. Baseline heart rate (HR) and blood pressure (BP), both systolic and diastolic, were recorded. All participants received ringer lactate solution 500 ml IV as a preload before procedure. After withdrawal of the spinal needle, heart rate and blood pressure was recorded at 5min intervals till 40 min after giving anesthesia and then at 10 min intervals till the end of surgery. Hypotension was defined as a systolic blood pressure (SBP) ≤100 mm Hg or a drop ≥20% from baseline and was treated with ephedrine 6 mg boluses. Heart rate ≤55/min or drop ≥25% from baseline value was recorded as bradycardia and treated with IV boluses of atropine 0.6 mg.

A median effective dose is defined as one that resulted in a sensory block up to fourth thoracic dermatome (T4) within 20 min of the intrathecal injection, with no requirement for an extradural top-up within 60 min. An ineffective intrathecal dose or whenever the patient experienced discomfort, a top-up of bupivacaine 0.5% w/v was administered via the epidural catheter using incremental doses. Sensory block height measured by assessing touch sensation at 5 min. intervals

Statistical analysis

The collected data were analyzed by using statistical software SPSS 16.0. Data was presented as mean (SD), median and percentage. For parametric quantitative variables student's t-test and for nonparametric quantitative variables the mann–whitney U-test was used. For qualitative variables chi-square test was used. The P-value ≤0.05 was considered as significant.

RESULTS

The demographic variables as mean age, mean height, mean weight and mean gestational age were shown in Table 1. The demographic profile was not significantly different among the groups (p>0.05). The median effective dose of intrathecal bupivacaine was 4.0 (95% CI: 4.40-5.60) in group 1 and 7.0 (95% CI: 6.93-7.61) in group 2. The median effective dose for hyperbaric bupivacaine 0.5% w/v with 25 µg fentanyl was significantly higher (p <0.001) in group 2 (Table 2; Figure 1 and 2).

Table 1: Distribution of patients according to their demographic variables.

	Group 1 (N=30)	Group 2 (N=30)	'P' Value
Age (Mean ± SD) Years	28.70±2.79	27.80±3.46	0.30
Height (Mean ± SD) cm	154.90±9.03	153.80±10.40	0.70
Weight (Mean ± SD) kg	70.07±5.31	71.40±5.82	0.40
Gestational age (Mean ± SD) weeks	37.70±0.74	37.94±0.86	0.30

Table 2: Comparison of median effective dose of bupivacaine in two groups.

	Group1	Group 2	'p' Value
Median Dose	4	7	<0.001(signifi-cant)
Interquartile range	1	1	-

*Significant value

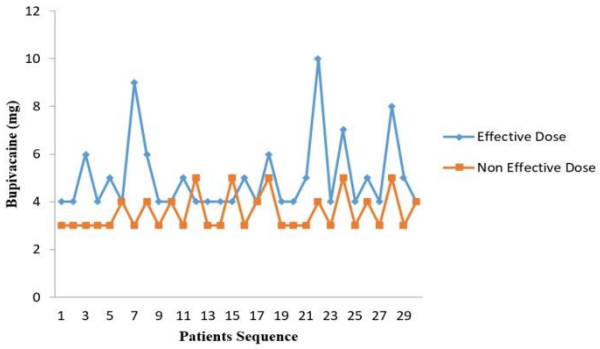

Figure 1: Sequence of effective/ineffective doses of bupivacaine for group 1 in total number of cases.

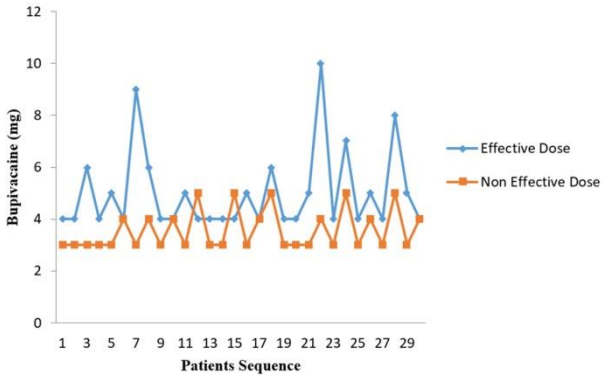

Figure 2: Sequence of effective/ineffective doses of bupivacaine for group 2 in total number of cases.

Ephedrine was required in 11(36.6%) and 20 (73.2%) patients of group 1 and group 2 respectively (n=30). Statistically this difference was significant (p <0.05). The dose requirement of ephedrine mean±(SD) was 2.20±(2.94) mg in group 1 versus 4.00±(2.88) in group 2. This difference was highly significant (p<0.01) i.e epidural volume extension (EVE) caused hemodynamically more stability than that without EVE (Table 3).

Table 3: Comparison of ephedrine usage in both groups.

	Group 1	Group 2	P Value	t
No. of patients	11	20	0.0198*	2.397
Dose (Mean±S.D.)	2.20± (2.94)	4.00±(2.88)	<0.01*	3.08

*Significant value

Table 4: Comparison of haemodynamic changes from baseline in both groups at different time intervals (n=30).

	Heart Rate			Systolic Blood Pressure		
Time (min)	Group1 (Mean±S.D.)	Group 2 (Mean±S.D.)	'p' Value	Group1 (Mean±S.D)	Group2 (Mean±S.D.)	'p' Value
5	0.5±5.15	3.6±3.05	<0.01	-2.4±8.4	-10.6±5.4	<0.001*
10	1.9±7.98	5.6±3.63	<0.05	-2.2±9.4	-14.8±4.4	<0.001*
15	2±8.04	7.2±4.83	<0.001	-4.0±12.3	-14.8±4.6	<0.001*
20	1.5±5.9	7.1±4.8	<0.001	-3.8±11.9	-15.9±4.8	<0.001*
25	0.5±5.95	4.65±3.6	<0.01	-2.2±11.1	-16.2±4.6	<0.001*
30	0.4±2.9	5.2±3.4	<0.001	-2.4±8.42	-10.5±5.36	<0.001*
35	0.9±4.4	1.0±3.9	NS	-2.4±6.9	-2.8±8.2	NS
40	1.1±4.8	0.2±2.84	NS	-2.1±10.52	-2.6±8.46	NS
50	0.5±2.8	0.30±2.92	NS	-1.9±10.6	-1.9±6.82	NS
60	0.5±2.9	0.8±2.88	NS	-1.9±10.6	-1.9±6.84	NS
70	0.1±1.8	1.2±3.44	NS	-1.7±10.8	-1.8±7.80	NS

-ve sign shows decrease from baseline, *Significant value.

The increase in heart rate from baseline was significantly lower in group 1 than that in group 2 for first 30 minutes (p <0.001). Thereafter heart rate started to settle down and changes from baseline became non-significant. Statistically the decrease in systolic blood pressure (SBP) was significantly lower in group 1 versus in group 2 for

first 30 minutes (p<0.001). Analyzing the haemodynamic variables, it is clear that in first thirty minutes, decrease in systolic blood pressure and increase in heart rate from baseline was statistically significantly lower in group 1 than that in group 2. After 30 min, the changes were not significant between both groups throughout surgery. Thus it is cleared that the patients in group 1 is haemodynamically more stable than those in group 2 (Table 4).

DISCUSSION

In present study, we had used the single space, needle through needle technique for performing combined spinal epidural anesthesia (CSEA) whereby a long spinal needle is introduced through an extradural needle. Previously various studies had used this technique safely and several reports had appeared in support and since then technique had gained sufficient popularity.[1-3]

In our study we had used 10ml of colloid (6% HES) for epidural volume extension. Safety and efficacy of colloid use in epidural space has been demonstrated in various previous studies.[8-11] Lander et al reported that the epidurally administered colloid (Dextran 40) had no neurotoxic effects as compared to epidural blood patch (EBP).[8] Another study demonstrated that injection of the epidural colloid increased the epidural pressure and immediately relieved headache. Because of its viscosity, reabsorption of the colloid from the epidural space was delayed, leading to a greater and longer compression.[9] Souron et al found that the epidural colloid had a high success rate, no adverse effect.[10]

We found that median effective dose of intrathecal hyperbaric bupivacaine 0.5% w/v with 25µg fentanyl was significantly lower in group 1 [4.0 mg (95% CI 4.40-5.60)] as compared with group 2 [7.0 mg (95% CI 6.93-7.61)]. Several mechanism were responsible for spinal block enhancement with epidural top up. As the continuing spread of the initial subarachnoid injection by diffusion through the sleeves of duramater that cover the spinal roots as they pass through it; leakage of extradural bupivacaine into the subarachnoid space via the hole created by the subarachnoid puncture; or perineural or transdural spread of the extradural solution.[5-7]

Increased volume within the extradural space causing a decrease in CSF volume in the caudal subarachnoid space and cephalad shift of local anesthetic within the CSF (Volume effect).[4] This volume effect is also confirmed by various other studies. A study had reported dual mechanism for the extension of sensory blockade induced by an epidural top up with a local anesthetic, initially volume effect and subsequent the local anesthetic itself according to time.[12]

A Myelographic study also suggested the volume effect of epidural top up of saline after 10 minute of spinal block. Study demonstrated that the contrast medium in the subarachnoid space was displaced in a cephalad direction after the lumber epidural injection of saline and that the diameter of the subarachonoid space narrowed due to the volume effect.[13] It was suggested that volume effect is time dependent and is seen when epidural top up is done soon after spinal injection. This volume effect is abolished when patients are left seated for 5 minutes after spinal injection.[14]

Other studies had contradicted this time dependency they found that raised sensory level can be found even epidural saline injection was given 20 minutes and 10 minutes after spinal block respectably.[15] Eileen et al showed that lower dose of 5 mg of intrathecal hyperbaric 0.5% bupivacaine with fentanyl 10µg followed by epidural volume extension (EVE) with 6 ml of 0.9% saline provide similar quality of anesthesia as that provided by higher dose of 9 mg of intrathecal hyperbaric 0.5% bupivacaine with fentanyl 10µg without EVE while allowing faster motor recovery of the lower limb.[16]

As many previous studies supported the dose lowering effect of EVE of our study but Beagle et al who found that EVE has no significant or reliable dose lowering effect on intrathecal dose of bupivaciane.[17] This could be a result of small sample size chosen in this study (30 cases in each group) with only 50% achieving effective dose.[17] It is also possible that the epidural injection of 7 ml was insufficient to cause compartmental compression. They thought this is unlikely as other studies had demonstrated the effect with lower dose of EVE only 5 ml and 6 ml EVE.[13,16] To avoid these bias we had selected a dose of 10 ml and colloid (6% HES) in place of crystalloid. As previous studies showed that colloid has more viscosity, absorbed slowly so may be more effective than crystalloid as EVE for enhancing spinal block.

In present study, the significant difference was found in heart rate and systolic blood pressure between group 1 and group 2 for first 30 min, with significant hemodynamic stability achieved in group 1 as compared to group 2. Ephedrine usage was significantly less in group 1 as compared to group 2 which is unsurprising on account of hemodynamic stability in group 1. These findings are supported by many previous studies. A study had demonstrated that small-dose spinal anesthesia (6.5 mg hyperbaric bupivacaine combined with sufentanil) better preserves maternal hemodynamic stability with equally effective anesthesia that is of shorter duration.[18]

Teoh et al demonstrated significantly lower incidence of maternal hypotension with the use of ultra-low dose combined spinal-epidural anesthesia with intrathecal bupivacaine 3.75 mg for cesarean delivery.[19] He concluded that it has a good role in high-risk patients in whom maintenance of stable hemodynamics is imperative. It was found that small dose of spinal bupivacaine when dissolved in large volume, it got diluted. This dilute small-dose spinal bupivacaine is

associated with notable hemodynamic stability that seems unaffected by the addition of fentanyl.[20]

CONCLUSION

In conclusion, we found that the epidural volume extension (EVE) with colloid was significantly reduced the dose requirements of intrathecal bupivacaine with fentanyl. In addition, epidural volume extension (EVE) was also enhancing the block height and improved the haemodynamic profile. So, it is very useful to get adequate anaesthesia in haemodynamically compromised patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Loubert C, O'Brien PJ, Fernando R, Walton N, Philip S, Addei T, et al. Epidural volume extension in combined spinal epidural anaesthesia for elective caesarean section: a randomised controlled trial. Anaesthesia. 2011;66:341-7.
2. Blanshard HJ, Cook TM. Use of combined spinal-epidural by obstetric anaesthetists. Anaesthesia. 2004;59:922-3.
3. Dureja GP, Madan R, Kaul HL. Combined spinal epidural anaesthesia. In: Regional anaesthesia and pain management (current perspectives) B. I. Churchill Livingstone Pvt. Ltd. 2000;139-45.
4. Blumgart CH, Ryall D, Dennison B, Thompson-Hill LM. Mechanism of extension of spinal anesthesia by extradural injection of local anaesthetic. Br. J. Anaesth. 1992;69:457-60.
5. Bromage PR. Mechanism of action of extradural anesthesia. Br. J. Anaesth. 1975;47:199-212.
6. Rawal N. Single segment combined subarachnoid and epidural block for cesarean section. Can Anaesth Soc J. 1986;33:254-5.
7. Carrie LES. Epidural versus combined spinal epidural block for cesarean section (Letter). Acta Anaesthesiol Scand. 1988;32:595-6.
8. Lander CJ, Korbon GA. Histopathologic consequences of epidural blood patch and epidurally administered Dextran 40. Anesthesiology Suppl. 1988;69:A410.
9. Salvador L, Carrero E, Castillo J, Villalonga A, Nalda MA. Prevention of post dural puncture headache with epidural-administered dextran 40. Reg Anesth. 1992;17:357-8.
10. Souron V, Hamza J. Treatment of Postdural Puncture Headaches with Colloid Solutions: An Alternative to Epidural Blood Patch. Anesth Analg. 1999;89:1333.
11. Chiron B, Laffon M, Ferrandière M, Pittet J. Postdural puncture headache in a patient with sickle cell disease: use of an epidural colloid patch. Can J Anaesth. 2003;50:812-4.
12. Stienstra R, Dahan A, Alhadi BZ, van Kleef JW, Burm AG. Mechanism of action of an epidural top-up in combined spinal-epidural anesthesia. Anesth Analg. 1996;83:382-6.
13. Takiguchi T, Okane T, Egwa H, Okubo Y, Saito K, Kitajima T. The effect of epidural saline injection on analgesic level during combined spinal and epidural anesthesia assessed clinically and myelographically. Anesth Analg. 1997;85:1097-100.
14. Mardirosoff C, Dumont L, Lemedioni P, Pauwels P, Massaut J. Sensory block extension during combined spinal and epidural anesthesia. Reg Anaesth Pain Med. 1998;23:92-5.
15. Choi DH, Park NK, Cho HS, Hahm TS, Chung IS. Effects of epidural injection on spinal block during combined spinal and epidural anesthesia for cesarean delivery. Reg Anaesth Pain Med. 2000;25:591-5.
16. Eileen Lew, Thomas E. Combined spinal-epidural anesthesia using epidural volume extension (EVE) leads to faster motor recovery after elective cesarean delivery. Anesth Analg. 2004;98:810-4.
17. Beale N, Evans B, Plaat F, Columb MO, Lyons G, Stocks GM Stocks. Effect of epidural volume extension on dose requirement of intrathecal hyperbaric bupivacaine at Caesarean section. Br J Anaesth. 2005;95:500-3.
18. Van de Velde M, Van Schoubroeck D, Jani J, Teunkens A, Missant C, Deprest J. Combined spinal-epidural anesthesia for cesarean delivery: dose-dependent effects of hyperbaric bupivacaine on maternal hemodynamics. Anesth Analg. 2006;103:187-90.
19. Teoh WH, Thomas E, Tan HM. Ultra-low dose combined spinal-epidural anesthesia with intrathecal bupivacaine 3.75 mg for cesarean delivery: a randomized controlled trial. Int J Obstet Anesth. 2006;15:273-8.
20. David BB, Miller G, Gavriel R, Gurevitch A. Low dose bupivacaine-fentanyl spinal anesthesia for cesarean delivery. Reg Anaesth Pain Med. 2000;25:235-9.

Cite this article as: Shyam R, Chaudhary AK, Singh PK, Jain G, Singh D, Chandra G, et al. Effect of epidural volume extension with colloid on dose requirement for intrathecal spinal block: a double blind prospective study. Int J Res Med Sci 2016;4: 5283-7.