Epidural Volume Extension In Combined Spinal Epidural Anaesthesia For Rapid Motor Recovery After Elective Caesarean SectionA Comparative Study

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Citation

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Abstract

Background: Epidural volume extension with saline solution can contribute to enhancement of a small dose intrathecal local anaesthetic. The resultant substantial reduction in local anaesthetic dose produces a sufficient effective block, decreased side effect and less motor blockade. The aim of this study was to evaluate the sensory and motor block characteristics of 10ml epidural saline after intrathecal small dose local anaesthetic and opioid. Setting and Design: This prospective, randomized, double-blind study was conducted in a operation room setting of a university hospital. One hundred and five women (25-40 years) of ASA 1 and 11 physical status electively undergoing caesarean section under regional anaesthesia were investigated.Method and Material: After hospital Ethics Committee approval and written informed consent, 105 women were allocated randomly, into three groups (n=35), received 7mg of spinal hyperbaric 0.5% Bupivacaine (groupB7), 7mg of spinal hyperbaric 0.5% Bupivacaine followed by 10ml of Normal Saline through the epidural catheter, 5 minutes thereafter (group B7-EVE) and 10mg of spinal hyperbaric 0.5% Bupivacaine without epidural volume extension (groupB10). All women also received 25mcg of Fentanyl intrathecally. The patients were assessed at 2.5 minutes interval for sensory block level to loss of pain from pin prick and for motor block using modified Bromage scale. We also recorded visual analogue scale, peak sensory block height, highest Modified Bromage scale, motor block recovery, incidences of side effects and ephedrine dose requirement.Result: Demographic data, duration of surgery, VAS, incidence of maternal side effects and ephedrine dose requirement were similar in all the groups. There was no difference in the peak sensory block heights between the groups during the study. The motor score was significantly lower in the group B7-EVE (grade-1 vs grade-3 in groupB7and groupB10, P=0.014). This was associated with a significantly faster motor recovery to Modified Bromage 0 in group B7-EVE (61-80mts vs 121-140mts in group B7 and 141-160mts in groupB10, P=0.0001).Conclusion: This study demonstrates a benefit in using epidural volume extension with 10ml normal saline, as a part of a combined spinal epidural technique by providing a more rapid motor recovery of the lower limbs after elective caesarean section.

INTRODUCTION

The combined spinal epidural anaesthesia technique (CSE) has gained increasing interest in obstetric units. [1] It combines the reliability of spinal block and the flexibility of epidural block. Now a days the sequential CSE technique used, in which a small dose intrathecal local anaesthetic and opioids are used to produce limited block, that can be extended with epidurally administered saline. [2] It may be due to compression of the subarachnoid space by epidural volume extension (EVE), facilitating spread of the intrathecal local anaesthetic. [3] The saline extends the block height and does not prolong the block duration. The advantage of EVE technique is that a small dose spinal block may provide an adequate level of anaesthesia while allowing faster motor recovery of lower limbs. [4]

.The present study was designed to evaluate the effect of using epidural volume extension (EVE) while performing CSEA to provide anaesthesia for caesarean section while allowing faster motor recovery of the lower limbs.

METHOD AND MATERIALS

After hospital Ethics Committee approval and written informed consent, 105 patients (25-40 year) of ASA physical status I and II, scheduled for elective caesarean section, were considered for single spinal anaesthesia or a technique with epidural volume extension (EVE). They were allocated

randomly into three groups of 35 each. Group allocation was achieved by a computer generated randomised list. Exclusion criteria included patients with contraindication to regional anaesthesia, hypertensive disorders, bleeding disorders, gestational age less then 36weeks, age less then 16 years and emergent caesarean deliveries.

Preanaesthetic check up was carried out the day before operation. Vertebral column was inspected for any local sepsis and anatomical disorder. The purpose, protocol of study, use of a 0-10cm visual analogue scale (0-No pain at all to 10- Worst pain) and modified Bromage score was explained to patients.

Patients were kept fasting for 6 hours prior to surgery and premedicated with oral Ranitidine 150 mg at night and oral Metoclopramide 10 mg and Ranitidine 150 mg two hours prior to surgery. The anaesthetist conducting the study was blinded to the study drug which was prepared by another anaesthetist as per instruction.

On arrival in the operation theatre, standard monitoring was applied with NIBP, RR, SPO2 and ECG. Baseline mean arterial blood pressure (MAP) and heart rate were also recorded (Nihon-kohden, PVM-2701). An 18 G intravenous canula was secured and all patients were preloaded with 500 ml of Ringer Lactate before induction of the allocated regional anaesthetic technique.

Grouping of cases was in the following manner:-

Group B10: received 10 mg of hyperbaric 0.5% Bupivacaine and 25 mcg Fentanyl intrathecally.

Group B7: received 7 mg of hyperbaric 0.5% Bupivacaine and 25 mcg Fentanyl intrathecally.

Group B7-EVE: received 7 mg of hyperbaric 0.5% Bupivacaine and 25 mcg Fentanyl intrathecally and 10 ml of Normal Saline in epidural space after 5 minutes of intrathecal drug injection.

The procedure was carried out in sitting position at the L3-L4 or L4-L5 interspace. Patients in the group B10 were given study drug over 10 seconds through a 26-gauge Whitacre spinal needle after free flow of cerebrospinal fluid (CSF) was obtained. The point at which the spinal needle was removed, marked the completion of spinal anaesthesia.

All the patients in the B7 and B7-EVE group received CSE, an 16-gauge Tuohy needle (combined spinal epidural needle) (portex) was introduced, at the L3-L4or L4-L5 interspace and epidural space was identified by a loss of resistance to saline. Using the needle-through-needle technique, 26-gauge Whitacre spinal needle was inserted via the Tuohy needle and after CSF was obtained study drug was injected over 10 seconds. After withdrawal of spinal needle, a 16-gauge epidural catheter (portex) was placed, 4cm into the epidural space, in all the patients of these two groups. Five minutes from completion of the intrathecal injection, patients in groupB7-EVE, received 10 ml of Normal Saline, injected through epidural catheter and marked the completion of anaesthesia in this group.

At the end of each regional technique, immediately patients were turned supine with left uterine displacement, using a wedge pillow under the right hip. Supplemental oxygen was given through a mask. Monitoring of HR, MAP, systolic blood pressure (SBP), level of sensory block to loss of pain from pinprick induced by 25G hypodermic needle and the modified Bromage motor score were noted, every 2.5 minutes interval, for 30 minutes, and then every 5 minutes interval, till the end of surgery, by an observer, who was unaware of the technique.

Modified Bromage scale was as follow [4]

Score 0- Able to move hip, knee and ankle

Score 1- Unable to move hip, able to move knee and ankle

Score 2- Unable to move hip and knee, able to move ankle

Score 3- Unable to move hip, knee and ankle

Surgery was allowed, as soon as the sensory block height reached the fifth thoracic dermatome (T5) or 10 minutes had elapsed. Intraoperative VAS was assessed and repeated, whenever pain or discomfort was experienced. If VAS was >3, analgesia was supplemented with epidural boluses of 5ml of 0.5% Bupivacaine (in CSE group) or Intravenous Fentanyl 25µg boluses (for all groups). If these failed to reduce the pain to less then VAS of 3, general anaesthesia was given to patients.

Hypotension was taken as a systolic blood pressure less then 90mmHg or a reduction in MAP of more than 20% from baseline, and bradycardia as HR less then 60. Hypotension was treated with fluids and IV bolus of 6mg ephedrine. Intraoperatively, crystalloid solution like Ringer's lactate or Normal saline used. The presence of intraoperative nausea, vomiting and shivering were noted and treated. Antiemetic

drugs- IV Ondansetron 4-8 mg and Metoclopramide 10 mg were used. The baby's Apgar scores at 1 min and 5 min were noted. At the end of surgery, patients of the CSE group had their epidural catheter removed before being transported to the recovery room.

At the recovery room, all the patients were monitored every 15 minutes, with respect to sensory and motor block profile, by testing for sensory loss to pinprick, getting the patients to perform straight leg raise, knee bends and time to first request for postoperative IM Diclofenac sodium 75 mg injection by trained staff nurse blinded to the type of regional technique. Patients were monitored for complications like hypotension, respiratory depression, post spinal headache, vomiting, nausea, pruritus and shivering up to 24 hrs postoperatively. Occurrence of urinary retention could not be assessed as the patients for caesarean section are routinely catheterised for 24 hours postoperatively in our institution.

During first 4hrs, the patients were kept in recovery room, thereafter, they were sent to the ward and Diclofenac sodium 75 mg intramuscular was given on demand.

Statistical analysis

The data was compiled and continuous variables were analysed using Student's 't' test. Scores were analysed using the Mann-Whitney U test and X^2 test. 'P' value of <0.05 was considered significant and P >0.05 was insignificant.

OBSERVATIONS

All enrolled patients completed the study. There was no inadvertent dural puncture or block failure or technical difficulty in any patient. Patients in the three groups were comparable in terms of demographic data and duration of surgery (P>0.05) [Table 1]. The modified Bromage motor score was significantly lower in patients of group B7-EVE (P<0.05), with majority of patients retaining the ability to bend their knee when asked [Table 2]. The surgeon enjoyed adequate muscle relaxation for performing the surgery and patients were comfortable. This was associated with a significantly shorter duration of motor block of 61-80min. (P=0.001) [Figure1]. There was no statistically significant difference between B7 and B10 groups with regard to motor block [Table 2].

In the comparison of sensory block, there was no difference in the peak sensory block height and VAS (P>0.05) [Table 2]. However, the initial sensory block level was higher in the spinal group, although the maximum levels were the same (T2).

The incidence of maternal adverse effects was similar among the groups [Table 3]. There was no statistically significant difference in ephedrine requirement between groups (P=0.442) [Table 4].

There was no difference between the groups regarding sensory block duration and time interval to the first request for postoperative analgesia. None of the patients developed pruritus, shivering or postspinal headache. The Apgar score of the newborns and maternal satisfaction was comparable in all the groups.

Figure 1

Table 1: Demographic and other data

	Group B10	Group B7	Group B7-EVE
Age (Years)	24.2±3.21	25.1±3.26	23.8±2.06
Weight (Kg)	65.77±5.29	67.66±5.21	66.21±4.02
Height (cm)	155.5±4.80	155.7±5.32	155.3±4.01
Duration of Surgery(min)	43±14	45±12	50±15

Data expressed as mean ± SD

Figure 2

Table 2: Comparison of sensory and motor block characteristics

	Group B10	Group B7	Group B7-EVE	P-value
Visual Analogue Scale	0	0	0	NS
Peak Sensory Level	T2(C8-T4)	T2(C8-T4)	T2 (C8-T4)	NS
Modified Bromage Motor Score	3(0-3)	3(0-3)	1(0-3)	0.014
Grade 3 Bromage Score	32(91%)	31(88%)	0(0%)	0.017

Data expressed as median (range) or number (proportion)
NS-non significant

Figure 3

Table 3: Maternal side effects

	Group B10	Group B7	Group B7 EVE	P value
Nausea	10 (28%)	11(31%)	5 (14%)	0.252
Vomiting	8 (23%)	8 (23%)	5 (14%)	0.300
Hypotension	15(43%)	10 (28%)	7 (20%)	0.455

Data expressed as mean (SD) or number (proportion)

Figure 4

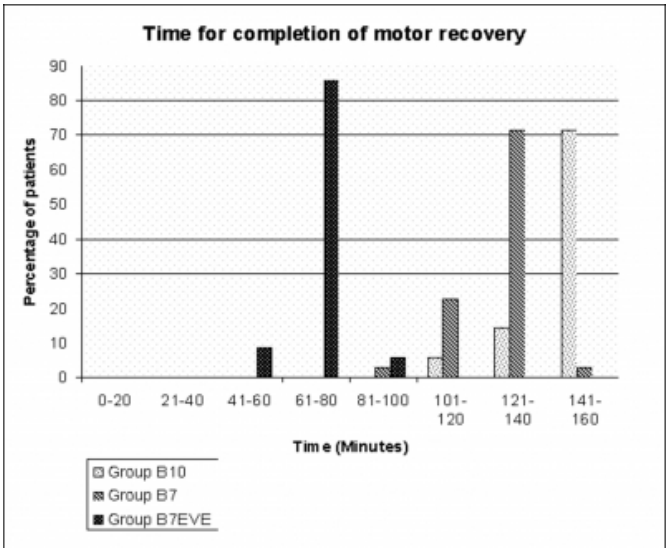
Table 4: Comparison of ephedrine requirement.

	Group B10	Group B7	Group B7-EVE	P-value
Ephedrine used, Dose(mg)	10.0±2.2	12.0±1.8	8.0±2.1	0.442

Data expressed as mean±SD
P<0.05-Significant, p>0.05-Insignificant

Figure 5

Figure 1. Time for completion of motor recovery in three groups



DISCUSSION

Epidural volume extension (EVE) with normal saline, following spinal anaesthesia, using low dose of local anaesthetic, in combined spinal epidural technique has been shown to provide adequate anaesthesia as well as rapid motor recovery, in comparison to spinal anaesthesia alone. [5] Various studies have documented the use of EVE, where it has been performed using 6, [4]5, [6]and 10ml [7] saline. The volume of saline to be given for EVE was chosen to be 10 ml in the present study, to avoid any bias from lower volume of the same. We defined “adequate anaesthesia” as the achievement of anaesthesia level at T5 dermatome, that is associated with a pain free caesarean delivery. Conventional doses of local anaesthetic used in single-shot spinal anaesthesia, often produce rapid onset of dense block that lasts beyond the duration of surgery and is associated with residual motor blockade leading to delay in ambulation.

We hypothesise that by means of “volume effect,” the saline in epidural space may actually accelerate the spread of a fraction of the spinal hyperbaric Bupivacaine towards the sacral segments. Upon, assuming the wedged supine position, it is possible that a greater amount of Bupivacaine than that in patients in the non EVE group may have been ‘trapped’ in the sacral region of the dural sac, owing to the natural curvature of the spine. As the sacral roots do not contribute the motor function of the lower limb, this may explain a low modified Bromage score and rapid motor recovery in EVE group. The results of the present study are consistent with the evidence from the other trials.

Loubert and collegues randomised 90 pregnant patients undergoing elective caesarean section into three groups of 30 each, to receive 7.5 mg of hyperbaric 0.5% Bupivacaine 7.5mg(B7.5), 7.5mg of hyperbaric Bupivacaine, followed by EVE with 5ml of saline in the epidural space (B7.5-EVE) or 10mg of hyperbaric 0.5% Bupivacaine (B10). They found that median motor scores as well as bromage scores were higher in group B10 as compared to B7.5-EVE, although it was similar to group B7.5. The maternal side effects and ephedrine requirement and neonatal outcome were similar in all the groups. [6]They concluded that EVE has no benefit in parturients, undergoing caesarean section. However, the median motor scores were definitely less in the B7.5-EVE group, as compared to the other groups, which is consistent with our study. Also in their trial use of 5 ml of saline for EVE might not have been enough to be counteracted by gravity and thus was unable to provide desired sensory level. In contrast, 10 ml of saline has been used in our study which was probably enough to cause cephalad spread of the drug, thus leading to desired level of sensory block with same dose of intrathecal drug.

The results of the present study are also consistent with the randomised control trial done by Lew et al, who compared combined spinal epidural anaesthesia (hyperbaric 0.5% Bupivacaine 5mg followed by 6ml saline for EVE) to spinal anaesthesia (hyperbaric 0.5% Bupivacaine 9mg) in 62 parturients(n=31 in each group) posted for elective caesarean section and evaluated them in terms of sensory/motor profile and haemodynamic stability. [4] They observed that patients in the EVE group had faster motor recovery to modified Bromage scale 0 as compared to those receiving spinal anaesthesia alone.

Gokce et al demonstrated that epidural injection of 10ml saline, soon after the administration of intrathecal Bupivacaine, resulted in an increased cephelad extent of the sensory block, suggesting that the extension of sensory blockade may be caused by epidural volume effect. [8]

A study done by Kucukguclu et al observed that CSE anaesthesia with plain Bupivacaine resulted in higher sensory block than with hyperbaric Bupivacaine, but EVE did not affect the sensory block height. [9]

Leeda et al reported that women have a smaller increase in peak sensory block level than men after an epidural loading dose following an epidural top-up with 10 ml of either

0.75% Ropivacaine or normal saline, suggesting differences in the two genders with the same volume of epidural top-up solutions. [10]

In contrast our study failed to demonstrate the cephald spread of the sensory block and sensory block height achieved was similar in all the patients. The possible explanation for the same may be that all the neuroaxial blocks were administered in the sitting position in the present study. In the sitting position baricity is a determinant factor of local anaesthetic spread with in cerebrospinal fluid. [11, 12] Gravity might have counteracted the rostral spread of the hyperbaric Bupivacaine, thus affecting the EVE induced elevation of sensory block height in our study.

Beale N et al and Loubert et al have also reported that EVE failed to increase the level of sensory block. [13, 6] Loubert et al reported higher failure rate among the study groups. [6] This may be because they did not use intrathecal opioids in conjunction with the local anaesthetic in their study. Use of opioids have a dose sparing effect on the local anaesthetic and provide excellent analgesia while allowing early ambulation of the patient by sparing sympathetic and motor nerves.[14] In our study no block failure was encountered as opioids were used with the local anaesthetic.

The deliberate use of a small intrathecal dose has been shown to reduce hypotension and motor block, and to provide good cardiovascular stability. [15] Doganci et al. concluded that epidural saline after single-shot anesthesia had no influence on the motor block period.[16] It may be possible because they used 10mg,large intrathecal dose of Bupivacaine as compared to 7.5 mg of Bupivacaine in thepresent study.

This study demonstrated a relatively reduced incidence of hypotension, nausea and vomiting in any of the groups. The possible explanation for this is the similar sensory block level among the study groups. Alternately this might be a result of adequate uterine displacement by putting wedge under the right hip in our study. The autonomic block is usually higher than the sensory block in spinal anaesthesia contributing to the degree of hypotension. Therefore block height is an important risk factor for hypotension. [17] However, reduced incidence of maternal hypotension has been reported by Mendonca et al attributing it due to the left lateral position of parturient during caesarean section, but in this position surgery access is difficult in the said position. [18]

Respiratory depression though seen with intrathecal Fentanyl, was not observed in any of our patients because intrathecal Fentanyl is not likely to cause respiratory depression at doses≤25mcg. [19]

The limitation of the present study was that the volume of saline used for identification of the epidural space by loss of resistance method, was not measured and added to the volume given for EVE. However it was consistently below 1ml and we believe that it had a negligible effect on local anaesthetic spread with in the dural sac. Second limitation, that we did not use epidural catheter for postoperative analgesia because of inadequate monitoring facilities in postnatal wards.

Conclusion- In conclusion the use of epidural volume extension following spinal anaesthesia using small dose of local anaesthetic in combined spinal epidural anaesthesia provides adequate anaesthesia for the surgery and also allow rapid motor recovery of the lower limbs in women undergoing elective caesarean section. The faster motor recovery may reduce length of post anaesthesia care unit stay and prompts early ambulation of the patient ambulatory. It is cost effective for the patient as well as the institution.

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