Original article

The Effect of epidural volume extension on spinal block with plain Bupivacaine for caesarean delivery

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Abstract:

Introduction: The purpose of our study was to study the effect of epidural volume extension on spinal block and its sensory and motor characterstics with plain bupivacaine for caesarean delivery.

Methodology: It was a prospective, randomized and double blind study conducted on 80 ASA grade I & II parturients. These parturients were divided into 4 groups of 20 each. Group I and III received 2 ml and 1.5 ml plain bupivacaine intrathecally respectively whereas group II and IV received 15 ml of normal saline through epidural catheter after receiving 2 ml and 1.5 ml plain bupivacaine intrathecally. We observed sensory and motor characteristics in each group.

Results: Maximum sensory block level was found statistically significant and higher (P< .05) in group II than I and group IV than III. Time of regression of sensory block to L1 was found to be statistically significant and increased in group II than I and group IV than III (P< .05). There was no significant difference found between all four groups in terms of onset of sensory block and onset of motor block. Therefore volume of plain bupivacaine should be decreased with epidural volume extension.

Conclusion: Spinal block with Epidural volume extension of 15 ml in caesarean delivery causes increase in sensory block level, increase in time to regression of sensory block to L1 and decrease in MAP in comparison to single shot spinal.

Keywords: epidural volume extension, bupivacaine, caesarean section

Introduction

Regional anaesthesia is a safe and widely used technique since it is devoid of use of many anaesthetic drugs and their metabolism and excretion as in general anaesthesia. In various co-morbidities, it is always beneficial to have less stress of metabolism and impact of various anesthetic drugs.

Spinal or Subarachnoid block is most common technique of anaesthesia in caesarean delivery. The most common drug used in subarachnoid block is bupivacaine. Bupivacaine can be used either as isobaric or hyperbaric solution. The combined spinal–epidural (CSE) technique includes an initial subarachnoid injection followed by epidural catheter placement and administration of epidural medications delivered for variable extended periods. The benefit of CSE technique is that it provides reliable block of single shot spinal with the extra benefits of epidural anesthesia and analgesia. The combined spinal-epidural with epidural volume extension technique of providing regional anaesthesia for caesarean delivery is now going to be increasingly popular. Epidural volume extension is further modification and ugradation of combined spinal-epidural technique. In

this after subarachnoid injection of drugs and placement of epidural catheter in the same intervertebral space, some volume of normal saline is injected through epidural catheter. The effect of epidural volume extension on dose of bupivacaine and other characteristics of subarachnoid block in caesarean delivery is very important concern for the anesthesiologists.

The present study is therefore undertaken to study the effect of epidural volume extension on spinal block and its sensory and motor characterstics with plain bupivacaine for caesarean delivery.

Material and methods

After approval from the ethical committee, the study was performed at S.R.N. Hospital (Associated to M.L.N. Medical College) Allahabad and Dr. Ram Manohar Lohia Institute of Medical Sciences Lucknow over a period of one year. The study was conducted on 80 ASA grade 1 or 2 parturients, 18 years of age or above. The technique was explained to patients and written informed consent was taken from all parturients.

Selection criteria: 18 years of age or above**,** ASA grade I or II**,** single live fetus**,** gestation age 37 weeks or above, body weight within normal range of BMI, height 150-170 cm and uncomplicated pregnancy scheduled for elective caesarean section.

Exclusion criteria: Patient refusal**,** bupivacaine allergy**,** parturients weighing more than 90 kg.**,** parturients having preeclampsia, placenta praevia and other peripartum haemorhhagic conditions, emergency caesarean section, **c**oagulation abnormality**,** local site infection, spinal abnormality and hemodynamic instability

Allocation of Groups:

Parturients were allocated randomly by computer generated tables to one of four groups comprising of 20 parturients each to receive either single shot spinal or combined spinal epidural with epidural volume extension.

After randomization, patients were allocated among the following groups-

- **Group I**: Parturients of this group received intrathecal 2ml of 0.5% bupivacaine (Isobaric)
- **Group II:** Parturients of this group received intrathecal 2ml of 0.5% bupivacaine (Isobaric) + 15 ml normal saline through epidural catheter.
- **Group III:** Parturients of this group received intrathecal 1.5ml of 0.5% bupivacaine (Isobaric)
- **Group IV:** Parturients of this group received intrathecal 1.5ml of 0.5% bupivacaine (Isobaric) + 15 ml normal saline through epidural catheter.

The parturients and the observer doctor both were not aware of the study characteristics. Group I and III are single shot spinal groups and Group II and IV are Epidural volume extension (EVE) groups. After shifting the patient to the operation room, intravenous line was started. Standard monitoring of vital signs was instituted, that include Pulse oximetry , Automated noninvasive blood pressure, ECG, Respiratory rate, and Heart rate. All patients were prehydrated with 10ml/kg of lactated Ringer's solution over 10-15 minutes before induction of the allocated regional anesthetic technique.

The regional anesthesia was performed with the patient in the right lateral position at L_{3-4} or L_{4-5} interspace using a midline approach. Group I and Group III received 2 ml and 1.5 ml isobaric bupivacaine respectively. In Group II and Group IV, epidural catheter is laced 5 ml inside the epidural

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space after injecting isobaric plain bupivacaine 2 ml and 1.5 ml respectively. After 5 minutes of intrathecal injection, 15 ml of 0.9% saline was injected in group II & group IV through the catheter over 30 secs.

At the end of each regional technique (taken as time 0 min), an observer who was unaware of the technique received by each patient recorded the HR, systolic blood pressure (SBP) and MAP and S_PO_2 .

Level of sensory block to loss of pain is assessed by pinprick induced by a 25-gauge hypodermic needle.

Motor block was assessed by Modified Bromage Scale scored as below

0. No motor block
1. Being unable to move hip
2. Being unable to move knee
3. Being unable to move ankle
4. Being unable to move toes

While assessing motor block score 1 and score 2 could not be assessed during because of inconvenience during the surgery. These parameters were assessed every 2.5 minutes till there was no change in three consecutive readings or 30 minutes had passed. Surgery was allowed to start as soon as the sensory block height reached T5 level or 10 min had elapsed. At the time of surgical incision, the visual analog pain score (VAS) was assessed on a 10-point scale and repeated intraoperatively whenever pain or discomfort was experienced. On the VAS scoring 0 means no pain, 2 equal to minimal pain, 4 means uncomfortable pain, 6 means dreadful pain, 8 means horrible pain and 10 means agonizing pain. If Hypotension occurred (defined as Systolic blood pressure < 100 mm Hg or reduction in MAP of more than 20% from baseline) was treated with boluses doses of 6 mg ephedrine. Side effects like intraoperative nausea, vomiting, pruritus, and shivering were also noted and treated appropriately epidural catheters removed before being transported to the recovery room.

At the recovery room, all patients were monitored by trained nurses blinded as to the type of anesthetic technique administered. The time intervals for sensory recovery to the first lumber dermatome (L1) and motor recovery to modified Bromage score 0 were ascertained by testing for sensory loss to pinprick and getting the patients to perform straight leg raise and knee bends respectively every 15 min.

All the data were tabulated and comparison was drawn between the groups. A computerized Analysis of data was performed using “MS Excel”, and Tests of statistical significance were performed. For Quantitative numerical variables ‘t’ test and ‘ANOVA’ tests of significance were applied. A ‘P’ value of < .05 was considered significant.

Observations and Results:

Demographic Data:

Table1. Comparison of Age (years) in different groups

	Group I	Group II	Group III	GroupI V
Number of cases	20	20	20	20
Mean (Age in years)	24.6	24.9	24.1	23.65
S.D.±	3.067	3.878	3.669	3.731

Since the P value of ANOVA test is >0.05, so age distribution of patients in all groups are similar and there is no significant statistical difference.

Height and weight distribution of the patients in all groups were similar and no statistical difference was found.

Table 2: Analysis of Maximum Sensory Block level in Group I, II, III &IV

Spinal Segment	Group I	Group II	Group III	Group IV
T1	-	14	-	-
T2	-	5	-	-
T3	-	1	-	12
T4	2	-	-	7
T5	13	-	-	1
T6	5	-	2	-
T7	-	-	14	-
T8	-	-	4	-
Total	20	20	20	20

The mode of Maximum Sensory Block Level is T_5 in Group I, T_1 in Group II, T_7 in Group III and T_3 in Group IV. After performing student't' test between group I & II, it is found to be statistically significant (P< .05). After performing student 't' test between group III & IV, it is found to be statistically significant.(P <.05)

Table 3: Analysis of Onset of Sensory Block level (Min) in Group I, II, III & IV

	Group I	Group II	Group III	Group IV
Number of cases	20	20	20	20
Mean(Min)	27.55	29.65	27.15	29.45
S.D.±	3.410	4.888	4.404	3.966

The P value of student test between group I & II is .112, so there is no significant difference in onset of block in above groups. The P value of student test between group IV & V is .097, so there is no significant difference in onset of block in above groups.

Table 4: Analysis of Regression from Maximum Sensory block to L1 (Min) of Group I , II, III & IV

	Group I	Group II	Group III	Group IV
Number of cases	20	20	20	20
Mean	122.25	167.3	95.3	124.75
S.D.±	11.336	9.403	8.602	7.853

P value is .00 between group I & II, so there is significant difference found in time for regression of sensory block to L1 between these groups.

Table 5: Analysis of Onset of Motor Block (Min) of Group I , II, III & IV

	Group I	Group II	Group III	Group IV
Number of cases	20	20	20	20
Mean	10.95	10.15	11.7	10.65
S.D.±	2.064	2.158	2.430	2.033

P value is .130 between group I & II , so there is no significant difference found in onset of motor block and P value is .146 between group IV & V , so there is no significant difference found in onset of motor block between these groups.

Table 6: Analysis of Lowest Mean Arterial Pressure (mm. Hg.) of Group I, II, III & IV

	Group I	Group II	Group III	Group IV
Number of cases	20	20	20	20
Mean	75.25	64.85	84.10	73.65
S.D.±	2.971	2.924	3.370	3.065

On the basis of our study , following observations were drawn :

- Epidural volume extension if applied with isobaric bupivacaine in spinal anaesthesia for caesarean delivery raised the sensory block level and increased the time of regression of maximum sensory block to L1 ,using 15ml normal saline in epidural volume extension in comparison to spinal anaesthesia using same dose of isobaric bupivacaine
- 2 ml of isobaric 0.5% bupivacaine in spinal block was found to provide sensory block of T_5, which was adequate for caesarean section. Epidural volume extension of 15ml in spinal block with 2 ml isobaric bupivacaine was found more than adequate for caesarean section.
- 1.5 ml of isobaric 0.5% bupivacaine in spinal block was found to provide sensory block of T_7 in most patients,which was not adequate in some patients(20%) for caesarean section. Epidural volume extension of 15ml or 20 ml in spinal block with 1.5 ml isobaric bupivacaine was found to provide sensory level of T_3, which was found adequate for caesarean section.
- There was no significant difference found in onset of sensory block , motor block profile and hemodynamic parameters except mean arterial pressure , which was decreased when used 15 ml of normal saline in epidural volume extension

Discussion

In our study comparison of the Epidural Volume Extension (EVE) technique with single-shot spinal anesthesia for cesarean delivery in terms of its sensory and motor block profile and hemodynamic vital parameters like mean blood pressure and S_PO_2 was done.

The groups were similar in respect to Age, Sex, Height and Weight. By including only ASA I and II patients, it was tried to eliminate any systemic problems confounding our results.

In our study we had assessed the sensory block level every 2.5 minutes till three consecutive readings became equal for each group. The maximum sensory level in group II was T_1 that was higher in comparison to group I. In the same way, the maximum level was found T_7 in group III and 4 levels higher that is T_3 in group IV. It concludes that epidural volume distension by compression of subarachnoid space increases the level of sensory block. There was significant increase in sensory block level found in the group of epidural volume extension with 15 ml normal saline in comparison to single shot spinal group.

Takiguchi et al [3](1997) demonstrated clinical and myelographic extension of sensory block with 5 and 10 ml saline 0.9% w/v.

Kim AR et al [6] (2005) tested the effect of combined spinal epidural with epidural volume extension on

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caesarean section. The study showed that CSE with EVE provided adequate anesthesia for elective cesarean delivery at only 70% of the bupivacine dose and allowed a more rapid motor recovery of the lower limbs, which might have a beneficial impact on PACU stay.

Doganci N. et al [18](2010) also supported the findings of our study. After performing the study it was seen that the sensory block level is 4 segments higher in epidural volume extension group of 15ml and 20 ml as compared to epidural volume extension group of 0 ml.

Tyagi A. et al [14](2008) concluded in his addition of epidural volume extension to plain bupivacaine group PBE versus group PB, resulted in a significant decrease in ED50 and increase in maximum sensory level(T6 vs T8, respectively, P _ 0.05).

In our study in group III where 1.5 ml isobaric bupivacaine was used, had sensory block level of T7. In some cases(20%) the level was found insufficient for caesarean section. For analgesia, fentanyl 25 ug was given, after delivery of the baby. With epidural volume extension of 15ml or 20ml, this level went up to T3 , which was found satisfactory for caesarean section.

Eileen Lew et a l [5] (2004) also supported the hypothesis. In his study he concluded that combined spinal epidural with epidural volume extension provided adequate anaesthesia for caesarean delivery with only 55% of bupivacaine dose.

The time to reach maximum sensory block level that is **onset of sensory block** was assessed. No significant difference is found in onset of sensory block and onset of motor block between single shot spinal group and EVE group. While significant difference was found in regression of sensory block to L1 between two type of groups.

Doganci N. et al [18] (2010) conducted a study on ceiling effect of epidural volume extension . In his study , he allocated five groups of 0 , 5, 10 , 15 ,20 ml saline epidural volume extension groups and found no difference in onset of sensory block among these five groups. He also concluded that the time to regression to the L1 level was significantly longer with 15 and 20mL treatment groups compared to the 0, 5 and 10mL groups . The onset and duration of motor block was found same in all groups.

Eileen Lew et al[5] (2004), studied the effect of epidural volume extension on motor recovery compared to single shot spinal anaesthesia. In each group then time for regression of sensory level to L1 was noted. They found no significant difference between single shot spinal and epidural volume extension group. They also found that there was no significant difference found in lowest systolic blood pressure between single shot spinal and epidural volume extension group.

The reason behind it was that in this study, only 5 mg of hyperbaric bupivacaine was used in comparison to 9 mg in single shot spinal group. The sensory level achieved by both groups was also same, therefore to regression time to L1. 6 ml saline used in EVE group helped to raise the level of sensory block equal to single shot spinal group by compressing the subarachnoid space.

When we use low dose of isobaric bupivacaine with EVE in caesarean section, low incidence of side effects were found , because most of the side effects were found due to bupivacaine.

Conclusion

Spinal block with Epidural volume extension of 15 ml in caesarean delivery causes increase in sensory block level, increase in time to regression of sensory block to L1 and decrease in MAP in comparison to

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single shot spinal. 1.5 ml of plain (isobaric) bupivacaine with 15 ml of epidural volume extension is sufficient for caesarean delivery. Therefore epidural volume extension technique is recommended for caesarean section with benefit of decreased incidence of side effects.

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