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Original Research Article

# EPIDURAL VOLUME EXTENSION IN COMBINED SPINAL EPIDURAL ANAESTHESIA IN PREGNANT PATIENTS COMING FOR ELECTIVE CAESAREAN SECTION WITH ROUTINE SPINAL ANAESTHESIA - A COMPARATIVE STUDY

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## Abstract

**Background:** Vaginal deliveries are common, and recent cases have seen an increase in the number of caesarean deliveries. Anaesthesia is crucial in obstetric surgeries, with regional and epidural techniques being popular. Combined Spinal Epidural (CSE) anaesthesia has minimal adverse effects. This study aimed to evaluate the effects of epidural volume extension with normal saline and intrathecal hyperbaric bupivacaine combined with the spinal epidural technique. **Materials and Methods:** This prospective, randomised, controlled study was conducted over three months involving 60 parturients at the Institute of Obstetrics and Gynecology, Madras Medical College. Sixty parturients were divided into two groups; Group E received 5 mg of 0.5% hyperbaric bupivacaine plus 25mcg of fentanyl intrathecally, followed by epidural volume extension with 6mL of normal saline through the epidural catheter. Parturients in group C received 10 mg of 0.5% hyperbaric bupivacaine plus 25mcg of fentanyl intrathecally. **Result:** The difference between the two groups' age, weight, and height was insignificant ($p>0.05$). Systolic blood pressures after the 20th minute of initiation of spinal blockade were significantly higher in Group E than in Group C until the 40th minute (P values for the 20th, 25th, 30th and 40th min, respectively, 0.001, <0.001, 0.002, 0.012). Ephedrine consumption was significantly higher in Group C ($p=0.042$). Motor blockade regressed sooner in group E than in group C ($p<0.001$). The other monitored parameters were similar in both groups. **Conclusion:** This study found that combined spinal epidural anaesthesia with normal saline resulted in stable anaesthesia, reduced motor blockade duration, and no adverse effects in elective caesarean sections.

## INTRODUCTION

Pregnancy is the most vital period in every woman's life, in which delivery is the critical period for risking the life of both the mother and foetus. Pain during delivery continues to be a nightmare for every pregnant woman. Generally, in the very old days, almost all parturients undergo normal vaginal delivery. Vaginal delivery is beneficial to the mother in many ways (decreased maternal morbidity, earlier resumption of routine work, and less blood loss).[1,2] Recently, the incidence of caesarean delivery has increased significantly. There are some conditions or situations during which allowing pregnant women to undergo normal vaginal delivery may be life-threatening to either the mother or the foetus. The most common conditions are foetal distress, failure to progress in the second stage of labour, malpresentation, uterine anomalies, and cephalopelvic disproportion.[3,4] In these situations, caesarean section plays a major role in the safe confinement of the mother. The word caesarean section means 'cutting the uterus and expelling the baby through the incision'. Surgery cannot be planned without anaesthesia; obstetric anaesthesia differs from anaesthesia for non-obstetric surgeries.[5] In pregnant women, anaesthesiologists are responsible for taking care of two lives simultaneously throughout the procedure. Special considerations are taken even when planning the modalities of


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anaesthesia, preoperative assessment, and intraoperative monitoring. Hence, regional anaesthesia has gained more popularity in obstetrics than general anaesthesia.[6,7] Spinal anaesthesia is routinely practised among regional techniques; however, other techniques have evolved because of their definite duration and adverse effects. Epidural anaesthesia can prolong the duration of operative anaesthesia with fewer adverse effects; however, it may result in patchy blockade or catheter-related problems. Combined Spinal Epidural (CSE) anaesthesia provides the advantages of both techniques with minimal adverse effects, as the drug dosage used here would be nearly 50% less than that used for routine spinal anaesthesia.[8-10]

This study was based on the principle of Epidural Volume Extension (EVE), a CSE modification. Here, a small volume of normal saline was used epidurally to rapidly increase the level of sensory blockade with a low dose of intrathecal bupivacaine. Normal saline produces a mechanical compression effect intrathecally, causing a more cephalad spread of the drug administered, resulting in adequate surgical anaesthesia with fewer complications.

**Aim**

This study aimed to evaluate the effects of epidural volume extension with normal saline and intrathecal hyperbaric bupivacaine in combination with the spinal epidural technique for parturients planned for elective caesarean section to achieve adequate anaesthesia.

## MATERIALS AND METHODS

This prospective, randomised, controlled study was conducted over three months involving 60 parturients with ASA physical status I and II who were scheduled for elective caesarean section at the Institute of Obstetrics and Gynecology, Madras Medical College, Chennai. The study received approval from the institutional ethics committee before its initiation.

**Inclusion Criteria**

Individuals aged 18–35 years with American Society of Anesthesiologists (ASA) classification I or II, who underwent elective lower segment caesarean section, and who provided written informed consent were included.

**Exclusion Criteria**

Patients under the age of 16 years, those with pregnancy-induced hypertension, individuals with a gestational age of <36 weeks, patients in active labour or other emergencies, and those with contraindications for regional anaesthesia were excluded. Patients who satisfied the inclusion criteria were included in the study after the procedure, and the nature of the study was explained. Written informed consent was obtained from all participants. Parturients were divided into two groups. Parturients in Group E received 5 mg of 0.5% hyperbaric bupivacaine plus 25mcg of fentanyl intrathecally, followed by epidural volume extension with 6mL of normal saline through the epidural catheter. Parturients in group C received 10 mg of 0.5% hyperbaric bupivacaine plus 25mcg of fentanyl intrathecally.

Examinations included general condition, height, weight, vital parameters such as BP, PR, and SpO2, and systemic examinations such as CVS, RS, CNS, abdomen, and spine. An airway assessment was also performed. Investigations were recorded, including complete blood count, haemoglobin concentration, renal function test, urea, serum creatinine, serum electrolytes, random blood sugar, urine routine, bleeding time, clotting time, blood grouping and typing, and electrocardiography.

The parturients were placed on a horizontal operating table, painted with betadine and chlorhexidine solutions, and wiped clean. L3-L4 interspace was identified and infiltrated with a local anaesthetic. A combined spinal epidural technique was planned using an 18G epidural needle and a 27 G spinal needle. After the free flow of the CSF, 0.5% hyperbaric bupivacaine was injected. An epidural catheter was threaded into the same interspace, and the epidural space and tip were placed 5 cm cephalad. The parturients were turned on their backs in the supine position, and a wedge was placed under the gluteal region. In group E, 6 ml of 0.9% normal saline was administered through the epidural catheter at the 5th minute of spinal blockade administration. Parturients were administered 6 litres of oxygen through Hudson's face mask until delivery.

Systolic and diastolic blood pressure, pulse rate, and SpO2 were recorded every 5 minutes for the first 30 minutes and then every 10 minutes for up to 2 hours intraoperatively and postoperatively. Hypotension was defined as a decrease in systolic blood pressure >20% from the baseline values. A heart rate <60 beats/min was defined as bradycardia. Parturients who developed hypotension were managed with bolus fluid administration and intravenous injection of ephedrine (6 mg). Parturients who developed bradycardia were treated intravenously with Inj Atropine. Sensory blockade was assessed every 15 minutes from the 5th minute of the initiation of spinal blockade using the loss of pinprick sensation in both groups. Motor blockade was assessed using the Bromage scale. Apart from hypotension, other intraoperative complications, such as nausea, vomiting, and breakthrough pain, were measured and compared between the groups. In case of breakthrough pain, analgesic supplementation was given with Inj pentazocine 0.5 mg/kg IV. If it does not subside, conversion to general anaesthesia should be considered.

**Statistical Analysis**

Statistical analysis was performed using SPSS software version 17.0; if the P value was 0.000 to 0.010, it implied high significance. If the P-value is 0.011–0.050, it implies significance. If the P-value is 0.051–1.000, this implies that it is insignificant.


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## RESULTS

The difference between the two groups' age, weight, and height was insignificant, with a p-value of >0.05 [Table 1]. The baseline systolic blood pressure in both groups was comparable. There was no statistically significant difference between the two groups (p=0.137). The systolic blood pressure between the two groups at the 5th, 10th, and 15th minutes after administering the allotted number of drugs for groups C and E was comparable. The p-values at the 5th, 10th, and 15th minutes were 0.896, 0.299, and 0.287, respectively. Hence, the difference in systolic blood pressure between the two groups was not statistically significant up to the 15th minute after the initiation of blockade.

Group C had significantly lower systolic blood pressure than Group E from the 20th to the 40th minute after the initiation of blockade (P values: 0.001, <0.001, 0.002, 0.012). However, no significant differences were observed in systolic blood pressure between the two groups after the 40th min (p = 0.062, 0.063, and 0.063 at the 50th, 60th, and 90th min, respectively). The diastolic blood pressure did not show statistically significant differences between the groups throughout the study [Table 2].

Of the 60 parturients, ephedrine consumption (6 mg) was higher in group C (n=12) than in group E (n=5). Hence, with a p-value of 0.042, a significant difference in ephedrine consumption was observed between the two groups. Ephedrine is required to treat hypotension in more patients in group C than in those in group E.

The pulse rates between the two groups at various intervals during the study did not differ significantly and were comparable. The duration of surgery was similar in both groups. The neonatal scores were not significantly different between the two groups (p=0.087) [Table 3].

**Table 1: Demographic data of the study groups**

| | Mean±Std | | P value |
|---|---|---|---|
| | Group C | Group E | |
| Age | 25.73 ± 2.612 | 24.8 ±3.112 | 0.213 |
| Weight | 66.87 ±7.333 | 64.97 ± 9.076 | 0.376 |
| Height | 159.9 ± 5.598 | 157.67 ± 6.315 | 0.153 |

**Table 2: Comparison of systolic blood pressure and diastolic blood pressure at various intervals between the groups**

| | Group C | Group E | P value |
|---|---|---|---|
| SBP baseline | 124.17 ±4.857 | 120.80 ±11.238 | 0.137 |
| SBP.5 | 114.87 ±5.532 | 114.57 ±11.212 | 0.896 |
| SBP.10 | 108.50± 5.619 | 106.07± 11.414 | 0.299 |
| SBP.15 | 102.37± 6.145 | 104.83± 10.980 | 0.287 |
| SBP.20 | 97.03± 7.228 | 104.47± 9.612 | 0.001 |
| SBP.25 | 93.70± 8.318 | 103.90± 10.571 | 0 |
| SBP.30 | 97.30± 7.382 | 103.80± 7.980 | 0.002 |
| SBP.40 | 101.70± 7.363 | 107.07± 8.670 | 0.012 |
| SBP.50 | 105.17± 6.968 | 108.83± 7.914 | 0.062 |
| SBP.60 | 108.03± 4.923 | 111.37± 8.294 | 0.063 |
| SBP.90 | 110.60± 3.490 | 113.37± 7.175 | 0.063 |
| DBP baseline | 76.47± 5.419 | 76.83 ±10.373 | 0.864 |
| DBP.5 | 72.2± 5.258 | 69.40± 7.766 | 0.1 |
| DBP.10 | 67.73± 5.152 | 65.43± 11.563 | 0.324 |
| DBP.15 | 64.57± 4.911 | 61.60± 10.656 | 0.171 |
| DBP.20 | 61.07± 4.593 | 61.43± 10.183 | 0.858 |
| DBP.25 | 58.97± 4.716 | 58.53± 10.037 | 0.831 |
| DBP.30 | 59.63± 3.518 | 58.07± 9.645 | 0.407 |
| DBP.40 | 60.50± 3.712 | 61.13± 9.906 | 0.744 |
| DBP.50 | 63.30± 3.771 | 65.57±11.196 | 0.298 |
| DBP.60 | 65.50±3.730 | 65.70± 9.392 | 0.914 |
| DBP.90 | 65.63±3.709 | 67.63±7.641 | 0.202 |

**Table 3: Comparison of ephedrine consumption and neonatal scores between the groups**

| | Group C | Group E | P value |
|---|---|---|---|
| Ephedrine Consumption | 18(41.9, 60) | 25(58.1, 83.3) | 0.043 |
| | 12(70.6, 40) | 5(29.4, 16.7) | |
| Neonatal Scores | 7(36.8, 23.3) | 12(63.2, 40.0) | 0.087 |
| | 17(50, 56.7) | 17(50, 56.7) | |
| | 6(85.7, 20) | 1(14.3, 3.3) | |

**Table 4: Comparison of duration and time of first analgesic requirement after surgery between the groups**

| | Mean±Std | | P value |
|---|---|---|---|
| | Group C | Group E | |
| Duration | 60.67 ± 4.498 | 58.17 ±7.130 | 0.111 |
| Time of 1st Analgesic Requirement after Surgery | 155.17± 6.884 | 149.67± 15.309 | 0.078 |


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**Table 5: Comparison of sensory blockade at various intervals after blockade between the groups**

| | Group C | | | | | | | Group E | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB 5th | SB 15th | SB 30th | SB 45th | SB 60th | SB 90th | SB 120th | SB 5th | SB 15th | SB 30th | sb 45th | SB 60th | SB 90th | SB 120th |
| T4 | 30 | 30 | 18 | 0 | | | | 26 | 30 | 28 | 12 | | | |
| T5 | | | 10 | 6 | | | | | | 0 | 6 | | | |
| T6 | 0 | | 2 | 14 | 2 | | | 4 | | 2 | 11 | 6 | | |
| T7 | | | | 9 | 8 | | | | | | 1 | 11 | | |
| T8 | | | | 1 | 11 | | | | | | 0 | 8 | | |
| T9 | | | | | 9 | | | | | | | 5 | | |
| T8 | | | | | | 2 | | | | | | | 0 | |
| T9 | | | | | | 6 | | | | | | | 4 | |
| T10 | | | | | | 8 | 2 | | | | | | 8 | 0 |
| T11 | | | | | | 14 | 5 | | | | | | 8 | 0 |
| T12 | | | | | | 0 | 10 | | | | | | 10 | 3 |
| L1 | | | | | | | 13 | | | | | | | 9 |
| L2 | | | | | | | 0 | | | | | | | 9 |
| L3 | | | | | | | 0 | | | | | | | 9 |

**Table 6: Comparison of motor blockade scoring from 5th min to 120th min between the groups**

| | Group c | | | | Group E | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 | 3 | 2 | 1 | 4 | 3 | 2 | 1 |
| MB 5TH | 30 | | | | 30 | | | |
| MB 15TH | 30 | | | | 30 | | | |
| MB 30TH | 30 | | | | 20 | 10 | | |
| MB 45TH | 13 | 17 | | | 5 | 25 | | |
| MB 60TH | 1 | 29 | | | | 13 | 17 | |
| MB 90TH | | 29 | 1 | | | 1 | 16 | 13 |
| MB 120TH | | 18 | 12 | | | | 2 | 28 |

The duration of surgery and time to 1st analgesic requirement after surgery was not significantly different between the two groups (p=0.111 and p=0.078, respectively) [Table 4].

The maximal sensory blockade (T4) levels achieved in both groups were similar. The time maximal sensory blockade was achieved (5-10 mins) in both groups was also insignificant. Groups C and E experienced regression of sensory blockade below T8, 60 min post-procedure. However, more parturients in Group E had sensory levels regressing below T8 than those in Group C. Overall, the maximal level of sensory blockade was achieved, the time it took to reach the maximal level, and the progressive regression of sensory blockade levels at various intervals were not significantly different between the two groups [Table 5].

At the 30th minute, group E started regressing in motor blockade level, while group C maintained maximal blockade; a significant difference was observed (P value <0.001). From the 45th minute, group C showed motor blockade regression, but group E exhibited faster motor recovery, with a statistically significant difference (P value = 0.009). By the 120th minute, nearly all parturients in group E (n=28) had reached the lowest motor blockade score, whereas none in group C had reached a score of 1. The differences in motor blockade regression between the two groups were highly significant (P value <0.001**)** [Table 6].

## DISCUSSION

In this study, pregnant women's age, height, and weight were comparable. The duration of the procedure, time from spinal blockade to supine positioning, and duration of surgery were identical between the two groups. Baseline systolic and diastolic blood pressure values, pulse rate, and SpO2 were similar between the groups. Before the procedure, all patients were preloaded with 500 ml of normal saline for 15 min. The parturients in Group C received 10 mg of hyperbaric bupivacaine 0.5% along with 25mcg fentanyl intrathecally without any epidural volume extension. The parturients in Group E received only 5 mg of hyperbaric bupivacaine 0.5% along with 25mcg fentanyl intrathecally with 6 ml of normal saline administered through the epidural catheter as epidural volume extension.

Choi et al. stated that hypotension is lower in low-dose combined spinal-epidural anaesthesia than in single-shot spinal anaesthesia.[10] In our study, there was also a lower incidence of hypotension in parturients who received EVE in CSE than in parturients who received only intrathecal local anaesthetic, which supports our study's findings. Similarly, a study conducted by Gokce et al. that evaluated the effectiveness of epidural top-up with saline in patients undergoing TURP did not find any difference in the incidence of hypotension.[11] A study conducted by Loubert et al. also reported similar findings.[12]


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In our study, the incidence of hypotension was greater intraoperatively in group C, which received a routine dose of intrathecal bupivacaine, than in group E, which received a low dose of intrathecal bupivacaine along with epidural volume extension, which contradicts the findings from the studies mentioned earlier. Our study did not observe any difference in the maximal level of sensory blockade achieved, quality of blockade, and the degree of muscle relaxation, and none of the patients complained of breakthrough pain intraoperatively requiring analgesic supplementation. Parturients received EVE in the lateral position and received a similar level of sensory blockade as those who received only spinal anaesthesia, even with a reduced dose of the drug intrathecally. In a study by Gokce et al., two groups of patients posted for TURP were administered 10 mg of 0.5% bupivacaine intrathecally, with group one additionally receiving 10 ml of saline epidurally. While group two received no epidural injections.[11]

In a study conducted by Tyagi et al. on patients undergoing lower limb surgeries with inadequate sensory blockade, the administration of epidural saline of 7 ml increased the level of sensory blockade.[13] Higushi et al. also studied the influence of patient positioning over the lumbosacral CSF volume in determining the sensory block height, and it was found that the lumbosacral volume of CSF is the primary determinant of block height.[14] Lew et al. conducted a study comparing two groups of parturients: group one received 9 mg of 0.5% bupivacaine intrathecally, and group two received 5 mg of 0.5% bupivacaine intrathecally along with 6 ml of normal saline. The results showed that the level of sensory blockade was achieved, and the quality of blockade was similar in both groups. Still, group two participants showed a more rapid recovery of motor blockade than group one.[15] This result correlates with the results of our study, where group E parturients received similar doses as in the study above and were found to have faster motor recovery than the parturients in group C.

Other similar studies conducted by Choi et al., in which along with spinal bupivacaine of 6 mg, 10 ml of 0.25% bupivacaine was administered epidurally, and another group receiving 9 mg of spinal bupivacaine found faster motor recovery in the first group of pregnant women.[10] Loubert et al. also reported similar results in their study of epidural volume extension with normal saline compared with single-shot spinal bupivacaine administered to term parturients planned for caesarean section.[12]

In our study, ephedrine consumption correlated well with hypotension incidence. Parturients in group C had a higher incidence of hypotension, with 12 subjects involved in the study receiving a mean dose of 6 mg ephedrine IV. Parturients in group E had a minimal incidence of hypotension compared to group C, in which only five subjects involved in the study received 6 mg of ephedrine IV. These results were supported by the results obtained from a study by Choi et al., in which patients in the group receiving only spinal anaesthesia had a higher incidence of hypotension, thereby having increased ephedrine consumption than patients who received low-dose combined spinal epidural anaesthesia.[10] Loubert et al. compared the neonatal scores between three groups who received an intrathecal injection of 0.5% bupivacaine (7.5 mg) in the first two groups, and the third group received 10 mg of 0.5% bupivacaine. The second group received 5 ml of epidural normal saline in addition to the spinal cord. Neonatal Apgar scores were similar among the three groups.[12] This finding supports the results of our study in which the difference in neonatal scores between the two groups was insignificant.

Variables such as nausea, vomiting, and breakthrough pain were not observed in any of the patients during the intraoperative period. Analgesic supplementation was not required by any of the parturients intraoperatively. The degree of motor blockade was achieved, and the quality of muscle relaxation was similar in both groups. These results correlate with the study conducted by Loubert et al., where all these parameters were compared between the three groups involved, and no difference was found.[12] Results of the study conducted by Choi et al. also found that the degree of motor blockade and muscle relaxation were similar among the group, thus supporting the results of our study.[10]

The time of the first analgesic requirement indirectly measures the time taken for complete regression of the sensory blockade level and when the patients started to perceive surgical pain postoperatively. Our study showed no significant difference regarding the first analgesic requirement between the two groups. These results were supported by a study conducted by Lew et al., who found that the time taken for regression of sensory blockade between the two groups was similar.[15]

## CONCLUSION

Our study concluded that epidural volume extension with normal saline in combined spinal epidural anaesthesia provides haemodynamically stable anaesthesia with a reduced duration of motor blockade without compromising the duration and quality of anaesthesia and with no adverse foetal effects for elective caesarean section. These benefits are obtainable with a reduced dose of intrathecal local anaesthetic.

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