

# The Influence of Epidural Volume Extension on Spinal Block with Hyperbaric Bupivacaine for Elective Lower Limb Orthopaedic Surgical Procedures

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**Abstract:** ***Background:** Epidural Volume Extension (EVE) has been studied as a modification to the combined spinal epidural (CSE) technique to enhance the effectiveness of spinal anesthesia. The addition of EVE aims to improve sensory blockade levels while reducing the dose of intrathecal anesthetic. This study investigates the influence of EVE on spinal block with hyperbaric bupivacaine in elective lower limb orthopedic surgical procedures. **Objective:** The primary aim of this study was to determine if the use of EVE could achieve a higher sensory block and more stable hemodynamic parameters in comparison to traditional CSE without EVE. **Methods:** A prospective, randomized, comparative study was conducted with 60 patients scheduled for elective lower limb orthopedic surgeries. Patients were divided into two groups: Group I (CSE with EVE) and Group II (CSE without EVE). Both groups received 10 mg injection hyperbaric bupivacaine intrathecally, with Group I additionally receiving 10 mL of saline via an epidural catheter for volume extension. Sensory and motor block characteristics were assessed along with hemodynamic parameters. **Results:** The results showed that Group I had a faster onset of sensory block, a higher level of sensory blockade, and a more stable hemodynamic profile than Group II. The two-segment regression time and motor recovery time were significantly prolonged in the EVE group. Complications were minimal and comparable between the groups. **Conclusion:** The use of EVE in conjunction with CSE enhances the sensory block, reduces the required intrathecal dose of anesthetic, and provides better hemodynamic stability in patients undergoing lower limb orthopedic surgeries. EVE is a viable option for optimizing anesthetic management in such procedures.*

**Keywords:** Epidural Volume Extension, Combined Spinal Epidural, Hyperbaric Bupivacaine, Sensory Block, Hemodynamic Stability, Lower Limb Surgery

## 1. Introduction

Among the numerous anesthetic techniques available, regional anesthesia, particularly spinal and epidural anesthesia, has become a popular choice for many surgical procedures, especially in orthopedic surgeries of the lower limb. This method offers significant advantages, including superior pain management, reduced need for systemic analgesics, and better postoperative outcomes. In recent years, a combined approach known as combined spinal-epidural (CSE) anesthesia has gained favor due to its potential to enhance the effectiveness of the block while allowing for postoperative analgesia. The CSE technique incorporates the benefits of spinal anesthesia—characterized by its rapid onset and profound block—and epidural anesthesia, which allows for the extension of the block duration and level, along with postoperative pain relief. Despite its popularity, the CSE technique is not without limitations, especially when it comes to balancing the sensory block height, the motor blockade, and the hemodynamic stability. To address these challenges, a modification of the CSE technique, called as epidural

volume extension (EVE), has been introduced. In order to maximise sensory block and reduce amount of intrathecal local anaesthetic, this method entails injecting a tiny amount of saline or local anaesthetic into the epidural region after spinal injection. This modification improves the safety and effectiveness of the procedure.[3]

## 2. Aim and Objectives:

### Aim

The aim of our study is to find out if there is any “influence of epidural volume extension on spinal block with hyperbaric bupivacaine for elective lower limb orthopedic surgical procedures.”

### Objectives

#### Primary Objectives:

- 1) Maximal level of sensory block achieved
- 2) Degree of motor blockade
- 3) Time for need of epidural drug
- 4) Changes in hemodynamic parameters

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**Secondary Objectives:**

- 1) Complications, if any. (nausea, vomiting)

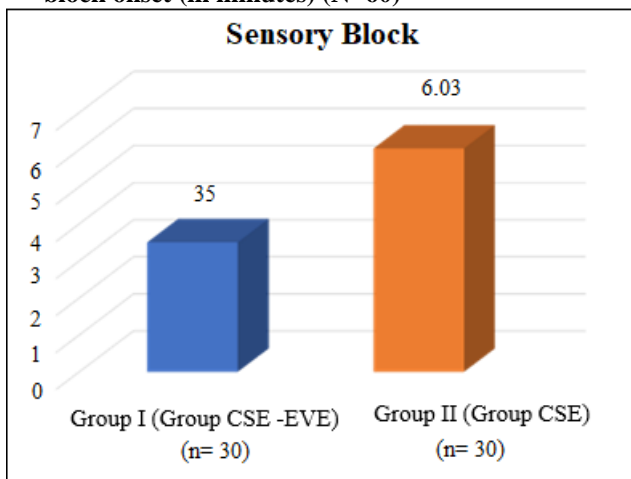
**3. Material and Methods**

The proposed study titled “The influence of Epidural Volume Extension on Spinal block with Hyperbaric Bupivacaine for Elective Lower Limb Orthopedic Surgical Procedure.” was carried out in Swaroop Rani Nehru Hospital associated with Moti Lal Nehru Medical College, Prayagraj after taking approval from Institutional Ethical Committee and obtaining written and informed consent from all patients. Using computer generated random number table, patients were allocated to one of the two groups. Group I received 10mg Hyperbaric Bupivacaine intrathecally by Combined spinal epidural anaesthesia and subsequently 10ml saline via epidural volume extension and Group II received Combined spinal epidural anaesthesia with 10mg Hyperbaric Bupivacaine without epidural volume extension. After a detailed preanaesthetic evaluation, an IV line was secured and monitors were attached. Under aseptic conditions a single space technique for combined spinal epidural anaesthesia was used at L3-L4 intervertebral space using 18G Tuohy needle and 25G Sprotte tip needle using needle through needle technique. Injection 0.5% hyperbaric bupivacaine 10 mg was given intrathecally with 10 ml of normal saline injected in epidural space. Patient lied supine with no table tilt.

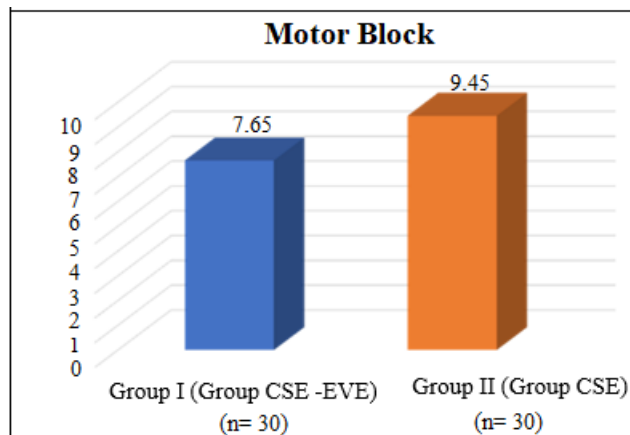
The level and time to achieve maximum sensory and motor block was noted along with the hemodynamic parameters and need for epidural top-up.

**4. Result**

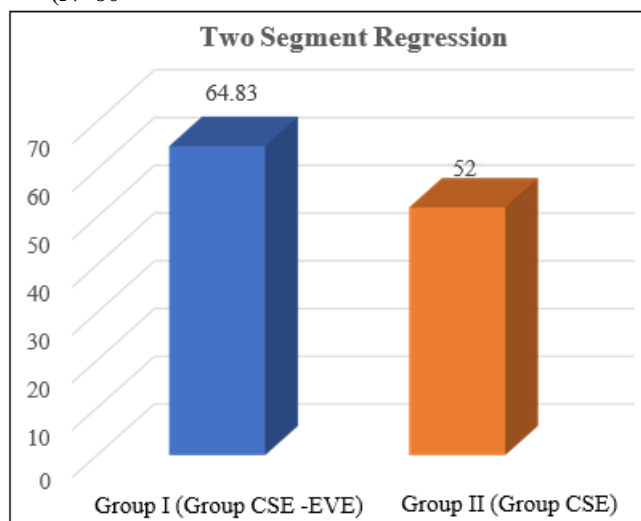
- a) Distribution of participants with respect to Sensory block onset (in minutes) (N=60)



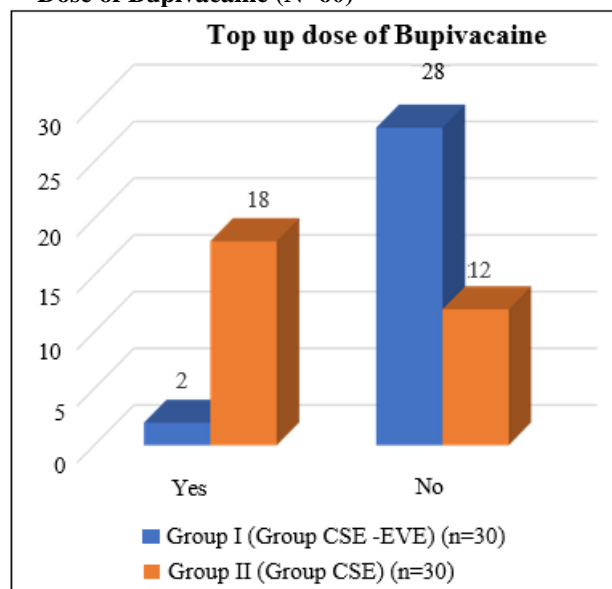
- b) Distribution of participants with respect to Motor block onset (in minutes) (N=60)



- c) Distribution of participants with respect to Two-segment regression time of sensory block (in min.) (N=60)



- d) Distribution of participants with respect to Top up Dose of Bupivacaine (N=60)



**5. Discussion**

- a) Sensory block onset

In the present study, it was evident that the sensory block onset was faster in group I (3.50±0.509 minutes) compared

to group II ( $6.03 \pm 0.778$  minutes). All these differences are highly significant from the perspective of statistical analysis ( $P < 0.00001$ ).

Along the similar lines in a study conducted by Naaz et al. [1] it was discovered that Group E, which received EVE (CSEA with EVE of normal saline), experienced a quicker onset of sensory compared to Group NE, who received combined spinal-epidural alone ( $p < 0.001$ ). In their study, Hakim et al. [2] observed that patients who received epidural volume extension experienced an earlier onset of sensory block. These findings were consistent with the present research.

#### b) Motor block onset

Present study found that the mean duration of onset of motor block was  $7.65 \pm 0.483$  min in group I and  $9.45 \pm 0.504$  min in group II indicating that the onset of motor block was quicker in group I. These differences were found to be statistically significant ( $P < 0.00001$ ).

In line with the present study, Hakim et al. [2] observed that patients who received epidural volume extension experienced an earlier onset of motor block.

#### c) Two-segment regression

The mean duration of the Two-segment regression period of sensory block was  $64.83 \pm 2.707$  min in group I and  $52.00 \pm 4.597$  min in group II. This suggests that regression occurred faster in group II, and all of these differences were statistically significant ( $P < 0.00001$ ).

However, a study conducted by Naaz S et al. [1] found that Group E experienced a faster time to two-segment sensory regression compared to Group NE.

In their study, Hakim et al. [2] discovered that the time it took for the sensory block to regress to the T12 level was significantly different between the two groups being studied. The SCSE group had a greater time of  $133.36 \pm 15.35$  compared to the EVE group with a time of  $120.43 \pm 17.39$ .

## 6. Conclusions

According to the findings of the study, it is suggested that the application of epidural volume extension to intrathecal hyperbaric bupivacaine has clinical benefits. This includes a faster onset of sensory and motor block, a longer duration of sensory block, a longer period of sensory regression, an increased level of block, and a reduced need for additional doses when combined with CSE. Therefore, EVE presents itself as a viable choice for performing neuraxial block with a reduced dosage of local anesthetic, while still achieving a comparable level of block height and ensuring hemodynamic stability.

## References

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