Section: Anaesthesiology

Original Research Article

# COMPARATIVE STUDY ON EFFICACY OF SEQUENTIAL COMBINED SPINAL EPIDURAL ANAESTHESIA VERSUS EPIDURAL VOLUME EXTENSION IN LOWER LIMB SURGERY

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## Abstract

**Background:** To overcome the problems faced in spinal or epidural anesthesia, newer techniques such as combined spinal epidural technique and epidural volume extension technique are being followed for lower limb surgeries. The aim to compare the efficacy of sequential combined spinal epidural anaesthesia versus epidural volume extension among patients undergoing lower limb surgeries. **Materials and Methods:** A prospective comparative study was conducted for a period of one year. A total of 120 study subjects were included for the study and were divided into two groups. Group A patients received sequential combined spinal epidural (SCSE) and group B patients received epidural volume extension (EVE) technique. Assessment of sensory block, motor block, hemodynamic parameters and occurrence of adverse events between these two techniques were measured and compared. **Result:** The onset of sensory block was early among patients in epidural volume extension, whereas the duration of sensory block and the time for sensory regression to T12 was much longer for SCSE group compared to EVE group. Similarly, the onset of motor block was much early and the duration of block was longer in the SCSE group compared to EVE group and the difference in the time between these two groups were found to be statistically significant. The hemodynamic parameters and the incidence of adverse events did not show significant difference between the two groups. **Conclusion:** EVE had shorter onset of anaesthesia, but SCSE provides significantly longer duration in terms of sensory and motor block, whereas the hemodynamic parameters were preserved in both the groups and the incidence of adverse events were very minimal among both these groups.

## INTRODUCTION

The two types of anaesthesia that are commonly employed for lower limb surgeries are neuraxial anaesthesia (NA) and general anaesthesia (GA). Both these techniques are widely used in the field of anaesthesia as the recovery time and the patient's level of satisfaction is more or less similar among both the techniques.[1] Spinal anaesthesia is the commonly followed neuraxial type of anaesthesia procedure in which local anaesthetic drug is completely placed in the intrathecal space (subarachnoid space). Other neuraxial techniques such as epidural and caudal anaesthesia are also performed for certain conditions.[2] Even though neuraxial techniques are widely used they too have certain limitations. Using spinal anaesthesia could cause certain adverse events such as hypotension, hypothermia, post puncture headache, transient neuralgic symptoms, urinary retention, haematological complications and infectious sequalae etc.[3] However epidural anaesthesia has better control of the level of analgesia and can be utilised for providing post-operative pain relief with the use of opioids or local anaesthetic agents. Whereas it still causes hypotension and has a slower onset of action compared to spinal anaesthesia.[4] To overcome these problems a new technique was introduced in early 1950s which is a combined spinal epidural anaesthesia. This technique comprises an initial subarachnoid injection followed by epidural catheter placement and consequent administration of epidural medications. Combined spinal epidural anaesthesia provides a rapid relief of


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pain by its rapid onset of action of the spinal drugs and subsequent dispension of medications for prolonged anaesthesia is made possible through this technique.[5,6] Other advantages of this technique includes gradual dosing, stable hemodynamics, less concentration of local anaesthetic drug getting absorbed in the blood, conversion of analgesia to anaesthesia or vice versa can be made.[7]

Epidural volume extension is another newer technique in which normal saline is injected into the epidural space after intra-thecal injection of local anaesthetic agents.[8] The mode of action in epidural volume extension technique is compression of the sub-arachnoid space by the saline in the epidural space, which ensures the cephalad spread of local anaesthetic agent within the sub-arachnoid space. Advantages of this technique includes, dose sparing effect providing the required level of anaesthesia and analgesia, hemodynamic stability and rapid motor system recovery level.[9,10] Studies have been conducted earlier to prove the efficacy of combined spinal epidural anaesthesia and epidural volume extension, but very few comparison studies between these two procedures have been conducted and in India the numbers are still less. So, the present study was aimed to compare the efficacy of sequential combined spinal epidural anaesthesia versus epidural volume extension among patients undergoing lower limb surgeries.

## MATERIALS AND METHODS

A prospective comparative study was conducted by the department of anaesthesiology, in a tertiary care hospital for a period of one year. The study was started after getting approval from the Institutional ethics committee. Patients undergoing lower limb surgeries are taken as our study population. All patients in the age group between 21 and 60 years and with ASA grade I and II are considered as inclusion criteria for our study. Patients with BMI > 35, with history of allergy to local anaesthesia and uncooperative patients were excluded from the study. A non-random quota sampling technique was followed and a total of 120 study subjects were included for the study and they were divided into two groups of 60 each. Group A patients received sequential combined spinal epidural (SCSE) in which small doses of local anaesthetic was injected in epidural space after low dose spinal anaesthesia and group B patients received epidural volume extension (EVE) in which 10 ml saline was injected in epidural space after low-dose of spinal anaesthesia. All selected patients underwent a routine pre anaesthetic assessment. Baseline hemodynamic parameters were recorded and the patients were randomly assigned to receive sequential combined spinal and epidural anaesthesia or epidural volume extension. For patients in the sequential combined spinal and epidural anaesthesia group, initially epidural space was identified with 18-G needle using a loss of resistance to air technique. Dural puncture was done using a 27-G spinal needle through the epidural needle and free flow of CSF was observed, 2 ml (10 mg) of 0.5% hyperbaric bupivacaine over 30 seconds was administered into the subarachnoid space. After removing the spinal needles, all epidural catheters (20 G) were inserted 4 to 5 cm into the epidural space. Patients were then placed in a supine position immediately after fixing the epidural catheter in position. If the desired spinal level of T10 was not achieved even after 10 minutes of subarachnoid block, then incremental epidural top-up dose with isobaric 0.5% bupivacaine 2 ml for every unblocked segment was given through epidural catheter till T10 level was reached and the same was continued during the intra-operative period. For patients in the epidural volume extension group, epidural space was identified with an 18-G epidural needle using a loss of resistance to air technique. Dural puncture was done using a 27-G spinal needle through the epidural needle and the free flow of CSF was observed, 2 ml (10 mg) of 0.5% heavy bupivacaine was given in the subarachnoid space. After removing the spinal needles, all epidural catheters (20 G) were inserted 4 to 5 cm into the epidural space. Patients were then placed in a supine position immediately after fixing the epidural catheter in position. 10 ml saline was then directly injected into the epidural space. Sensory block was assessed by pin prick method and it was tested at every 5 minutes interval. And time was noted for block to reach different dermatomal levels. Assessment of sensory block was done by assessing the onset of sensory block from the time of injecting drug to the time till the sensory block reached T10 level., time of sensory regression to T12 and the duration of sensory block. Motor block assessment was done using bromage scale initially every 5 minutes until onset of motor block and every 10 minutes after the surgery. Onset and duration of motor blockade was recorded. Hemodynamic parameters such as systolic blood pressure and heart rate were measured during pre, intra and post-operative periods at regular intervals. Occurrence of side effects such as nausea, vomiting, post dural puncture headache and back ache were recorded. All data were entered and analysed using SPSS version 24. Mean and SD were calculated for all parametric variables and percentage was derived for frequency variables. Statistical inference was derived using Student T test and Chi-square test for comparing the parametric and non-parametric variables between the two groups.

## RESULTS

This prospective randomized study was conducted with 120 patients divided into two groups of 60 each and all their data were collected recorded and analysed using appropriate statistical tests. The


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demographic variables such as age and gender were found to be almost similar in both groups and similarly the anthropometric measurements such as the mean weight and height did not show significant difference between the two groups and it proves that the groups are exactly matched even after randomization. In inclusion criteria we took the patients only with ASA grade I or II, and their distribution between the two groups was found to be more or less equal and the mean duration of surgery was 124.4 mins in group A and 125.9 mins in group B [Table 1].

After performing the spinal anaesthesia procedure, the sensory and motor block assessment was done between the two groups. It was found that the onset of sensory block was early among patients in epidural volume extension (EVE) group compared to sequential combined spinal epidural (SCSE) group and the difference in time was found to be statistically significant ($p<.05$), whereas the duration of sensory block and the time for sensory regression to T12 was much longer for SCSE group compared to EVE group and the difference was statistically significant ($p<.05$). The onset of motor block (18.8 mins Vs 20.7 mins) was much early and the duration of motor block (166.6 mins vs 144 mins) was longer among the SCSE group compared to EVE group and the difference in the time between the two groups was found to be statistically significant [Table 2].

The hemodynamic parameters such as the heart rate (HR) and systolic blood pressure (SBP) were monitored at regular intervals from the baseline up to 2 hours. It was found that both the HR and SBP did not show significant difference at any point of the time interval between the two groups [Figure 1 and 2]. The usage of ephedrine was almost similar between both the groups and the incidence of adverse events such as hypotension, bradycardia, nausea, post dural puncture headache and backache were very minimal among both the groups and there was no statistically significant difference in the occurrence of adverse events between the two groups [Table 3].

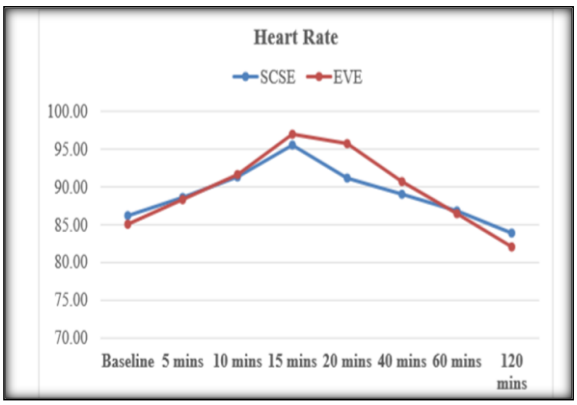


**Figure 1: Comparison of heart rate between two groups at various time intervals**

P>.05 for all time intervals

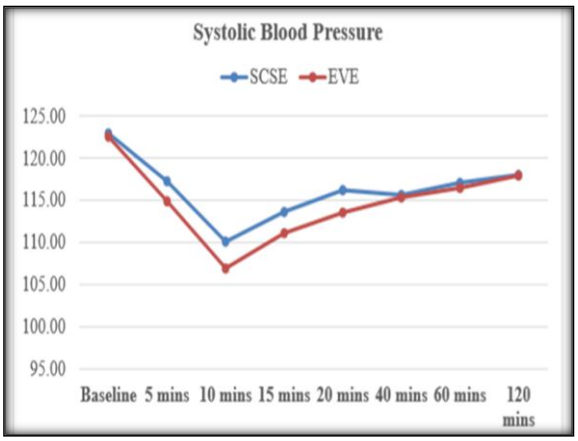


**Figure 2: Comparison of systolic BP between two groups at various time intervals**

**Table 1: Comparison of demographic, anthropometric variables, ASA status and duration of surgery between the two groups**

| Variables | | Group A (SCSE) | Group B (EVE) | P value |
|---|---|---|---|---|
| Age | (mean ± SD) | 43.67 ± 10.41 | 43.63 ± 9.46 | 0.990 |
| Gender | (M: F) | 36: 24 | 40: 20 | 0.593 |
| Weight | (mean ± SD) | 65.5 ± 6.7 | 67.6 ± 7.8 | 0.261 |
| Height | (mean ± SD) | 165.8 ± 7.8 | 166.0 ± 7.2 | 0.932 |
| ASA | Grade I (%) | 34 (56.6%) | 28 (46.6%) | 0.439 |
| | Grade II (%) | 26 (43.3%) | 32 (53.3%) | |
| Duration of surgery | (mean ± SD) | 124.4 ± 10.8 | 125.9 ± 10.6 | 0.591 |

**Table 2: Comparison of onset and duration of sensory and motor blockade between the two groups**

| Variables | Group A (SCSE) | Group B (EVE) | P value |
|---|---|---|---|
| Onset of sensory block (mean ± SD) | 15.7 ± 1.05 | 13.1 ± 1.63 | 0.001 |
| Time for sensory regression to T12 | 125.6 ± 11.4 | 112.8 ± 8.6 | 0.001 |
| Duration of sensory block | 201.2 ± 11.5 | 174.2 ± 8 | <.0001 |
| Onset of motor block | 18.8 ± 1 | 20.7 ± 1.26 | 0.001 |
| Duration of motor block | 166.6 ± 9.2 | 144 ± 8.5 | 0.001 |

**Table 3: Comparison of ephedrine consumption and the incidence of adverse events between the two groups**

| Variable | Group A (SCSE) | Group B (EVE) | P value |
|---|---|---|---|
| Ephedrine usage | 6 (10%) | 8 (13.3%) | 0.289 |


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| | | | |
|---|---|---|---|
| Hypotension | 6 (10%) | 7 (11.6%) | 0.312 |
| Bradycardia | 1 (1.6%) | 2 (3.3%) | 0.438 |
| Nausea | 2 (3.3%) | 4 (6.6%) | 0.382 |
| Post dural puncture headache | 4 (6.6%) | 2 (3.3%) | 0.382 |
| Backache | 2 (3.3%) | 3 (5%) | 0.511 |

## DISCUSSION

As of today, the concept of sequential combined spinal epidural and epidural volume extension technique is in vogue in the field of spinal anaesthesia, as these two techniques requires a low dose of local anaesthetic drug and also it maintains the hemodynamic parameters. These techniques are now widely used for elderly and high-risk patients who are more prone to develop hypotension. Previous studies had shown the efficacy and advantages of these techniques individually and in this study, we aimed to study and compare the efficacy of sequential combined spinal epidural anaesthesia versus epidural volume extension in lower limb surgery in terms of their mode of action, hemodynamic stability and adverse events.

The results of our study showed that the onset time for sensory block was significantly faster with EVE group. The SCSE group had significantly shorter mean onset time for motor block, longer duration of sensory and motor block and longer time for sensory regression to T12. Also, the usage of ephedrine was very minimal in both these groups. A similar study was done by Hakim in 2020 comparing sequential combined spinal epidural and epidural volume extension technique. The results showed that anaesthesia readiness time was considerably faster in epidural volume extension group [18.4(2.6) vs. 20.5(2.3) minutes], whereas motor block [185.33(15.49) vs. 159.25 (20.37) minutes] and sensory block [133.36 ± 15.3 vs 120.4±17.3minutes] duration was better in sequential combined spinal epidural group. Time for first request of post-operative analgesia was significantly shorter in EVE group [190.5±23.3 vs. 230.4 ± 19.1minutes] whereas the dosage of post- operative bupivacaine consumption was statistically insignificant among the two groups.[11] Another study done by Naaz et al in 2020 comparing intrathecal administration of ropivacaine and epidural volume extension. It was found that sensory level of block was higher in epidural volume extension group [T4(T2–T5 vs T6(T3-T8)] and also the time for two-segment sensory regression, time to reach maximum sensory and motor block was significantly much earlier in epidural volume extension group. The duration of analgesia was much longer and the usage of ephedrine was much lesser in epidural volume extension group compared to intrathecal group (316.5 min vs. 230.67 min) and the difference in duration was found to be statistically significant. So, it is proved that the results of our study are in line with the results of the previously conducted studies.[12]

Similarly most of the studies conducted earlier had compared spinal anaesthesia with sequential combined spinal epidural technique or spinal anaesthesia with epidural volume extension technique and in both these type of studies it was proven that the onset and duration of sensory and motor blockade were significantly better either in combined spinal epidural technique or in epidural volume extension technique compared to spinal anaesthesia.[13-16] Bhandari et al did a study comparing SCSE + EVE Vs SCSE and it was found that the highest level of sensory block, onset and duration of sensory and motor block are all in favour of SCSE + EVE group than SCSE group alone.[17]

In our study we found that there was no statistically significant difference in the hemodynamic parameters such as the heart rate and the systolic blood pressure between the two groups during the peri-operative and post-operative period. Our results are almost in par with the studies done by Loubert C etal, McNaught AF etal and Hakim, where they found that the hemodynamic parameters were well maintained and there was no much incidence of hypotension both in sequential combined spinal epidural technique and epidural volume extension technique.[18,19,11]

Whereas most of the other studies which had compared spinal anaesthesia with sequential combined spinal epidural or EVE technique had showed a significant increase in the incidence of hypotension and tachycardia among the spinal anaesthesia group compared to the other two techniques. A similar type of results was also seen with the incidence of adverse events such as nausea, post dural puncture headache and backache.[13-16,20,21] The only limitation of the present study is the sample size, which could have been still larger to further validate our results.

## CONCLUSION

The current study had proved that both SCSE and EVE was effective in preserving haemodynamic stability without producing any major adverse events and also significantly effective in producing sensory and motor block in terms of onset and duration, whereas in comparison between these two procedures EVE had shorter onset of anaesthesia, but SCSE provides significantly longer duration in terms of sensory and motor block.

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