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Original Research Article

A PROSPECTIVE STUDY UTILIZING LOW DOSAGE INTRATHECAL HYPERBARIC BUPIVACAINE TO ASSESS THE EFFICACY OF EPIDURAL VOLUME EXTENSION PAIRED WITH NORMAL SALINE IN COMBINED SPINAL EPIDURAL ANESTHESIA FOR LOWER LIMB ORTHOPEDIC OPERATIONS

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ABSTRACT

Background: To assess the effectiveness of a modest dosage of intrathecal hyperbaric bupivacaine combined with normal saline to expand the epidural volume for lower limb orthopedic surgeries, while keeping the hemodynamics unchanged.

Material and Methods: The study consisted of two cohorts, each comprising thirty patients, who were selected randomly and prospectively. These cohorts were part of a research project that encompassed a total of sixty patients scheduled for elective orthopedic procedures on their lower limbs.

Results: A small dose of hyperbaric bupivacaine (10 mg) combined with 25 micrograms of fentanyl administered intrathecally, along with the application of epidural volume extension (10 ml of normal saline), has been associated with a notable degree of sensory block, a prompt onset of both motor and sensory block, and a shortened duration of regression in two segments.

Conclusion: Research shows that a more effective and quicker block time is obtained when spinal epidural and epidural volume expansion with regular saline are combined. The much shorter maximum motor block time, which permits longer pain relief, supports this. This method also delivers a higher level of sensory block in ten minutes with a shorter mean maximum sensory block period, and it takes fewer extra doses of bupivacaine.

Keywords: Combined Spinal Epidural, Epidural Saline Expansion, Intrathecal Bupivacaine.

INTRODUCTION

First described in the context of cesarean section surgeries in 1984, the combination spinal-epidural anesthetic approach has seen a recent upsurge in popularity. Strong neurological blocking is produced by spinal anesthetic, which acts immediately and lasts for a predetermined period of time. Better titratability and fewer hemodynamic fluctuation are two benefits of epidural anesthesia. It can also provide postoperative analgesia. By injecting saline into the epidural space, the theory behind this method is to create a volume effect that will compress the spinal cord and cause the local anesthetic used for spinal anesthesia to rise.[1-3]

The majority of patients undergoing orthopedic surgery for lower extremities are elderly and present with many coexisting medical problems. Selecting appropriate localized anesthetic techniques that minimize excessive sympathectomy while preserving a safe and ideal level of nerve blocking is essential to maintaining hemodynamic stability in these individuals. Most patients requesting orthopedic surgery are older and in their middle years. Every

organ system is affected by the constant reduction in functional ability that occurs as people age. The way older people react to anesthesia and surgery varies. Because they have several serious medical conditions at the same time, it is difficult to predict how elderly individuals will react to stress and illness. These people usually experience modifications in their breathing mechanics, which lowers their gas exchange efficiency.[4-6]

Aging of the heart and autonomic nervous system causes blood pressure to fluctuate and the heart's contractile power to diminish, lowering the ejection fraction. Spinal anesthesia and general anesthesia are the two main options that might be taken into consideration. EVE has evolved as a way to deal with any unwelcome aging-related changes. It avoids the uncomfortable side effects connected to each method while offering the advantages of both regional and general anesthesia. It also acts as a backup option in the case that spinal anesthesia doesn't work. By minimizing the need to manipulate the airway and the ensuing stress reaction, which could have a detrimental effect on the patient's cardiovascular condition, it offers a clear advantage over general anesthesia. It counteracts the negative effects of positive pressure breathing on blood flow returning to the heart and the unfavorable decrease in heart muscle contraction brought on by anesthetic medications. For those with isolated left ventricular dysfunction, the mild vasodilation that follows a subarachnoid block using EVE's approach is advantageous.[7-10]

MATERIAL AND METHODS

60 patients were included in this study group after consent from patients obtained in writing and the study was approved by the Institutional Ethics Committee at Department of Anaesthesiology, Guntur Medical College, Guntur, Andhra Pradesh, India from February 2023 to Jauary 2024. Group A was administered a mix of spinal and epidural anesthesia, with the epidural volume extension being performed using 10 ml of normal saline and 10 mg of 0.5% bupivacaine. Group B was administered alone with a combination of epidural and spinal anesthesia.

Inclusion Criteria

- The age range is 40 to 70 years old.
- The height needs to be between 150 and 170 centimeters.
- The range of weight is 40 to 75 kg.
- Both genders.
- Physical statuses 1 and 2 of ASA. • Lying patients undergoing planned treatments on their lower limbs.

Exclusion Criteria

- Individuals with physical states 3 and 4 of the ASA.
- Individuals opting out of regional anesthesia.
- People whose intracranial pressure is high.
- A disorder known as intrinsic or idiopathic coagulopathy causes a spontaneous or inexplicable decrease in the blood's capacity to clot.
- Skin or soft tissue infection where the needle is supposed to be inserted.
- A significant reduction in blood volume.
- An underlying neurological disease, such as peripheral neuropathy of the lower limbs.
- Emergency surgery for orthopedic conditions.
- A supine position is not used for orthopaedic procedures.
- Operations lasting longer than three hours.
- Individuals with a history of hypersensitivity to any of the trial's prescribed drugs.

RESULTS

Table 1: The two segment regression time

Two Segment Regression Time	Group CSE - EVE	%	Group CSE	%
≤ 60 min	1	3.4	25	83.4
61-70 min	11	36.7	5	16.7
71-80 min	17	56.7	0	0.00
> 80 min	1	3.4	0	0.00
Total	30	100	30	100

Table 2: Time for maximum sensory block

Time for Maximum Sensory Block	Group CSE – EVE	%	Group CSE	%
≤ 10 min	14	46.67	0	0.00
11-12 min	16	53.34	2	6.67
13-14 min	0	0.00	22	73.34
> 14 min	0	0.00	6	20
Total	30	100	30	100

Table 3: Time for maximum motor block

Time for Maximum Motor Block	Group CSE - EVE	%	Group CSE	%
≤ 3 min	6	20	0	0.00
4-5 min	24	80	2	6.67
6-7 min	0	0.00	25	83.34
> 7 min	0	0.00	3	10

Total	30	100	30	100

Table 4: Top up dose of bupivacaine

Top up Dose of Bupivacaine	Group CSE - EVE	%	Group CSE	%
Yes	2	6.67	19	63.33
No	28	93.34	11	36.67
Total	30	100	30	100
P value Fishers Exact Test			<0.0002	

DISCUSSION

For lower limb orthopedic procedures, a combination of spinal and epidural anesthesia is the recommended and most often used approach. The sophisticated epidural volume extension approach offers a useful block profile. Spinal anesthesia alone is linked to a lesser degree of sympathectomy. This is because less severe hemodynamic impairment is caused by the use of a moderate dose of hyperbaric bupivacaine. When epidural saline was administered after a delay of more than 10 minutes, failures occurred often. Mardirosoff et al. also provided evidence for this point, demonstrating that the patient needs to be in a supine position for at least five minutes following the intrathecal injection in order for epidural volume extension to be successful.[11-13]

Twenty minutes after intrathecal injection, Trautman and associates showed that the method was useless. The much greater incidence of sensory loss up to the T5 level at the ten-minute mark lends credence to this. Group CSE - EVE experienced a significantly longer average duration of sensory block regression than group CSE, with a mean difference of 14.10 minutes (20% greater). An unpaired t-test revealed that the observed difference had a p-value of less than 0.0001, which indicates that it is highly significant. We may safely conclude from this study that a successful and long-lasting anesthesia is produced when spinal epidural is used in conjunction with epidural volume extension using normal saline. The substantially longer time it takes for the sensory block to regress by two segments is evidence for this. An unpaired t-test revealed that the observed difference has a p-value of less than 0.0001, indicating that it is highly significant. We can safely conclude from this study that a more efficient and shorter sensory block is produced by utilizing both spinal and epidural anesthesia in conjunction with normal saline for epidural volume expansion.[14-16]

The significantly shorter peak sensory block duration obtained lends credence to this. A 38% reduction in mean time was observed, with a difference of 2.43 minutes. An unpaired t-test revealed that the observed difference had a p-value of less than 0.0001, which indicates that it is highly significant. This study clearly indicates that the combination of spinal epidural and normal saline epidural volume expansion produces a more effective and brief blockage period, as indicated by a markedly shortened maximal motor block time. With a percentage difference of 62.50 score points (96% lower), the CSE - EVE group's need for extra bupivacaine dosages was much lower than that of the CSE group. Fisher's exact test indicates that the observed difference has a p-value of less than 0.0001, indicating statistical significance. We can conclude with confidence from this study that prolonged pain relief is achieved when spinal epidural therapy is used in conjunction with epidural volume extension using normal saline. This is accomplished by lowering the requirement for subsequent bupivacaine dosages, as seen by the significantly lower frequency of such doses. The subarachnoid block must be expanded with 1.5 to 3 milliliters of the epidural dose per neural segment; this is a much smaller amount than the usual epidural dose. The mechanism by which sensory blocking spreads to the T2-T4 level following an extradural injection was studied by Blumgart and his colleagues. The study participants were divided into three cohorts by the researcher. The first group was injected intrathecally with 1.6–1.8 ml of hyperbaric bupivacaine and then 10 ml of saline epidural. Ten milliliters of epidural bupivacaine were given to the second group. No more injections were given to the third group.[17-20]

CONCLUSION

We found that a low dose of intrathecal hyperbaric bupivacaine (10 mg) combined with normal saline added to the epidural volume produced a higher sensory level at the T5 dermatomal level. The anesthesia wore off in two phases, taking an average of 70 minutes, but this might be shortened by increasing the volume of the epidural with normal saline. As a result, maximum sensory obstruction was reached more quickly and lasted an average of 10.63 minutes. We conclude that the combination of 10 mg of intrathecal hyperbaric bupivacaine, 25 micrograms of fentanyl, and 10 ml of normal saline for epidural volume extension causes a rapid onset of sensory and motor block, a high degree of sensory block, a shorter time for two segments to regression, and stable blood pressure.

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