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Research Article

COMPARISON OF EPIDURAL VOLUME EXTENSION USING 2% LIGNOCAINE WITH STANDARD EPIDURAL VOLUME EXTENSION TECHNIQUE FOR HYSTERECTOMY UNDER COMBINED SPINAL EPIDURAL ANESTHESIA

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ABSTRACT

Objectives: We compared epidural volume extension (EVE) using 2% Xylocaine with standard EVE technique and studied characteristics of neuraxial block along with hemodynamic stability and recovery profile in total abdominal hysterectomy surgery under combined spinal-epidural (CSE) anesthesia.

Methods: 50 patients undergoing hysterectomy were randomly assigned into two groups. Group M (EVE with 2% 10 mL lignocaine) and Group C (EVE with 10 mL NS). Patients were anesthetized using CSE with 0.75% hyperbaric ropivacaine 2.5 mL and EVE, as per drug assigned to group. Anesthesia was maintained with epidural top-up with 2% lignocaine in 6 mL aliquot. Conscious sedation was provided. Perioperative data and recovery profile were recorded.

Results: The amount of epidural anesthesia required to maintain block was less in Group M (17.7±4.5 mL in comparison to 26.9±7.3 mL in Group C $p<0.001$). Time for first epidural top-up required was early in Group C (62.1±26.2 min) than in Group M (83.718±.3 min). Onset of motor blockade was earlier in Group M (8.4±4.8 min). Quality of anesthesia was better in Group M. Pain and recovery from neuraxial block was earlier in Group C (31.02±13 min) in comparison to 49.88±12.01 min in Group M. Safe level of block was achieved without affecting cardiorespiratory function in all patients.

Conclusion: CSE with modified EVE is a feasible technique, is associated with early onset of neuraxial block, and had longer time of two-segment regression with the need of less anesthesia drugs.

Keywords: Combined spinal-epidural anesthesia, Epidural volume extension, Hyperbaric bupivacaine, Total abdominal hysterectomy.

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INTRODUCTION

Awake infraumbilical laparotomy under regional anesthesia is a technique where abdominal surgeries are done under combined spinal and epidural (CSE) anesthesia [1]. It has gained popularity due to its rapid onset through the spinal component and extension of anesthesia with lower anesthetic dose and post-operative pain relief through epidural component in a controlled manner when avoiding the disadvantages of general anesthesia [2,3].

When safe neuraxial anesthesia is used in conjunction with epidural volume extension (EVE) utilizing 0.9% normal saline, abdominal surgery can be completed more swiftly and easily on an awake patient [4]. Further research found that this effect had limitations as enhancement of block following EVE with saline extends the block height by a mechanical volume effect (that appears to be time-dependent) and does not prolong the duration of block. Moreover, beyond 30 min or after 2-segment regression has begun, EVE with saline has no effect on block extension and may even accelerate spinal block regression [5].

To overcome this limitation, modified EVE (mEVE) with local anesthetic (LA) technique was described in which after spinal anesthesia drug administration, level of anesthesia is increased by injecting cardioprotective isobaric LA agent (2% lignocaine through epidural catheter. Because there is a preexisting area of subclinical analgesia cranial to the spinal segment coinciding with the maximal level of spinal block following the intrathecal injection, the CSE with mEVE method make sense in augmenting density of block. According to hypothesis, LA, if present in this area, can convert it into complete analgesia by blocking nerve conduction at unblocked level which is not possible in case of EVE with normal saline [6]. This extra LA agent in the epidural space improves sensory perception at and it provides the rapidity, density, and reliability of spinal anesthesia and gives flexibility to titrate the level of epidural anesthesia, vary the intensity of block, extend the duration of anesthesia, and deliver post-operative analgesia [7].

However, majority of the previous studies were done in full-term pregnant patients and pharmacodynamics and pharmacokinetics of neuraxial block changes during pregnancy.

Thus, the present study was designed to compare the quality and efficacy of two EVE techniques that are with 2% lignocaine and normal saline during CSE in awake laparotomy for elective total abdominal hysterectomy (TAH) surgery using low doses anesthesia drugs for subarachnoid block.

METHODS

After obtaining ethical committee clearance (IEC/JPR/2022/867) and written informed consent from all participants, we enrolled patients aged ≥18 years, body weight between 50 kg and 80 kg, and height between 150 cm and 170 cm who underwent elective TAH surgery from January 1st, 2022 to December 31, 2022. Patients with contraindications to neuraxial blocks, ASA/NYHA more than Grade III, uncompensated comorbidities, and pregnancy were excluded.

We calculated the sample size with this equation and with confidence level: 95%, width of confident interval: ±5.5% assuming p=35%.

where n is the required sample size; p is the magnitude of satisfaction; Zα/2 is the value (Z-statistic) at the 95% confidence level (α=0.05) which is 1.96; d is the margin of error 5% (0.05) with 10% nonresponse rate; and the final sample size was n=25.

Thorough pre-anesthetic evaluation was done and procedure of CSE was explained. All 50 patients were divided into two groups of 25 patients each according to computer-generated random number table.

Group M received CSE (2.5 mL 0.75% ropivacaine heavy along with 25 µ fentanyl as spinal anesthesia and EVE with 10 mL of 2% lignocaine in epidural space within 10 min of spinal drug injection.

Group C received CSE with 2.5 mL of 0.75% ropivacaine heavy along with 25 µ fentanyl as spinal anesthesia and EVE with 10 mL of 0.9% normal saline in epidural space within 10 min of spinal drug injection.

To ensure the double blindness, independent anesthesiologist had prepared coded syringes of epidural EVE drugs while the investigator was inserting the epidural catheter.

Resident unaware of group allocation had recorded the perioperative data.

On arrival in the operating room, ASA standard monitors were placed and intravenous line was secured with free flow. Under all aseptic precautions, in sitting position through midline approach after intravenous pre-hydration with 10 mL/kg crystalloid fluid, an 18 G epidural catheter was inserted using Tuohy needle at L1-L2/L2-L3 intervertebral space using the loss of resistance technique and fixed at 5 cm into the epidural space, followed by subarachnoid block with 2.5 mL of 0.75% of hyperbaric ropivacaine along with 25 mcg of fentanyl (total volume 3.0 mL) injected intrathecally through the L3-L4 interspace using a 25 G Quincke's needle. Patient position was changed to supine, and within 7 min of subarachnoid block, 10 mL of EVE injection was made through the epidural catheter slowly over nest 2 min, watching hemodynamics and neurological status. In Group M, EVE drug administered was 2% isobaric lignocaine, while in Group C, inject was 10 ml of 0.9% normal saline. Oxygen 4 L/min was administered through a simple face mask and 1% propofol infusion was started through peripheral line at the rate of 50–100 mcg/kg/min to maintain conscious sedation state equivalent to responding to verbal commands. Epidural top-up was done with aliquots of 6 ml of 2% isobaric lignocaine till the end of surgery every hour or when required.

The following parameters were recorded: (a) Onset of sensory blockade at T6 dermatome using a blunt 22-gauge needle tested at the mid-axillary line on both sides of the chest, (b) onset of motor block according to abdominal reflex and modified Bromage criteria, (c) time for need of epidural top-up at two segment regression of sensory block and total number of 10 mL of 2% isobaric lignocaine aliquots required till completion of surgery, (d) total dose of propofol required for maintain conscious sedation, (e) perioperative complications such as hypotension, bradycardia, shivering, respiratory depression (respiratory rate <10 breaths/min), nausea, vomiting, urinary retention, and pruritus which required pharmacological intervention were also recorded. If surgical team or patient was not comfortable during surgery, or desired level of anesthesia is not achieved, patients were converted to general anesthesia and these patients were recorded as failed cases. In post-operative recovery profile, post-operative sensory and motor block levels were assessed every 15 min until return of normal sensations. The presence and severity of pain, nausea, vomiting, and rescue analgesia requirement were assessed postoperatively up to 24 h by an investigator blinded to group allocation. All patients were assessed for pain using 10 cm Visual Analog Scale (VAS) until the first time when rescue analgesia (VAS>4) was administered in the post-operative period with epidural top-up. The data were analyzed using appropriate statistical tests.

RESULTS

Demographic data distribution is displayed in Table 1. Systolic blood pressure and heart rate monitoring up to 210 min at different time intervals are displayed in Graph 1. Table 2 explains the values of different variables recorded. All values are mean±2SD along with statistical analysis and a p value.

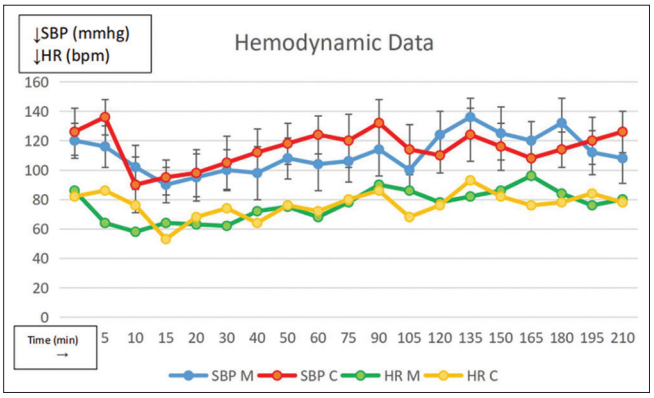
DISCUSSION

Concept of EVE was first described by Rawal *et al*. [8] in 1986 when they purposefully inject a small amount of local anesthetic in epidural space after deliberately given inadequate spinal anesthesia to achieve higher level of block in cesarean section. Mechanism of extension of spinal anesthesia by extradural injection of local anesthetic was published by Blumgart *et al*. [6] in the British Journal of Anesthesia in 1992. This technique was used to reduce spinal drug dose in high-risk cesarean section surgeries initially but with advancement in neuraxial block and invent of CSE technique with epidural catheter, previous technique EVE lost its relevance. Interest in EVE is regained when more complex abdomino-thoracic surgeries are being done under neuraxial blocks.

Several mechanisms were reported to play a role in the enhancement of spinal block by EVE with saline, including the volume effect, in which the theca is compressed by epidural saline, resulting in the squeezing of cerebrospinal fluid and more extensive spread of subarachnoid local anesthetic agent [9]. EVE with local anesthetic agents has the advantage of not only mechanical enhancement but also clinical blocking of nerve conduction at higher segment levels providing dense prolonged block.

In the present study, both groups are similar in age, weight, height, duration, and nature of surgery (Table 1).

Perioperative data as presented in Table 2 explained that patients had



Graph 1: SBP M Systolic blood pressure in Group M, SBP C Systolic blood pressure in Group C (mmhg), HR M Heart rate in Group M, HR C Heart rate in Group C (beats per minute). SBP M: systolic blood pressure Group M, SBP C: Systolic blood pressure Group C, HR M: Heart rate Group M, HR C: Heart rate Group C

Table 1: Patient characteristics

Variable	Group M (n=25) Mean±SD	Group C (n=25) Mean±SD	p-value
Age (years)	36.8±4.2	37±3.9	0.76
Weight (kg)	62.6±12.2	58.8±9.7	0.19
Height (cm)	151.74±11.32	153±9.13	0.667
ASA Group II/III	14/11	12/13	NS

Table 2: Block characteristics

Variable	Group M (n=25) Mean±SD	Group C (n=25) Mean±SD	p-value
Time to achieve T 10 level	2.9±1.7 min	2.7±1.9 min	0.69
Time to achieve T6	8.7±6.48 min	9.4±5.82 min	0.68
Onset of motor block T6	8.4±4.8 min	11.9±6.5 min	0.035
2-Segment regression time	83.7±18.3 min	62.1±26.2 min	0.001
Duration of surgery	158.6±47.91 min	162±53.32 min	0.814
Total epidural vol. Req.	17.7±4.5 mL	26.9±7.3 mL	0.001
Total 1% propofol required	45.3±17.1 mL	62.7±20.5 mL	0.002
Recovery from motor block	49.88±12.01 min	31.02±13.04 min	0.001
Post surgery visual analog scale value more than 4	48.34±14.2 min	36.49±23.8 min	0.038
Need of phenylephrine	6/25	7/25	0.001
Conversion rate to GA	Nil	Nil	
Post-operative major adverse events	Nil	Nil	
Length of stay in hospital	3.5±0.6 days	3.8±0.2 days	0.11

early onset of motor block at T6 level in Group M in comparison to Group C (8.4±4.8 min in Group M, 11.9±6.5 min in Group C, p=0.035).

The study group also had longer two-segment regression time (Group M 83.7±18.3 min, Group C 62.1±26.2 min, p=0.001) and required less supplemental epidural dose than Group C (Group C 17.7±4.5 mL, Group M 26.9±7.3 mL, p=0.001). No major hemodynamic variations were observed in any patients of either group (Graph 1).

All above data suggest superior block characteristics of mEVE group over EVE group. Vital parameters were more stable in Group M compared to Group C; this is due to higher anesthetic dose received by Group C, but at all points, hemodynamics easily maintained within physiological range with the help of mild dose phenylephrine. The requirement of vasoactive pharmacological intervention for maintenance of hemodynamics with boluses of 20 µ of phenylephrine was needed in 6 patients in Group M, while 7 patients in Group C required it, this is statistically significant difference.

In our study, all patients of both the groups had adequate level of anesthesia; however, effect differs from the enhancement of block following EVE with local anesthetic, as saline extends the block height by a mechanical volume effect (that appears to be time-dependent) and does not prolong the duration of block while local anesthetic agent deposited in epidural space as EVE fluid had drug mass effect on surrounding epidural nerves.

The maximum sensory height did not differ as the volume was smaller in both groups [10], while duration of block was longer in Group M due to dose effect of the EVE anesthetic agent administered to the epidural space which had caused the increase duration of anesthesia [11]. Drug administered during spinal anesthesia acts on nerve roots and dorsal Ganglion. It gets redistributed and washed by CSF continuously, while drug in epidural space deposited in adipose and connective tissue, lipid act as a reservoir of drug for paravertebral nerve roots. Thus, the effect lasted longer in epidural anesthesia.

Our findings are equivalent to the observations of a previous study done by Salman *et al*. [5]. In their study, they compared combined spinal-epidural anesthesia (intrathecal 0.5% levobupivacaine followed by 5 mL saline EVE or 5 mL 0.5% levobupivacaine for EVE, 5 min after performing the block) to spinal anesthesia. They observed that motor and sensory blocks had faster onset, lasted longer, and was a higher level in EVE groups. These effects were more pronounced in the group in which EVE was applied by local anesthetic [12]. We did not observe higher level with mEVE, but other findings are similar. This may be due to the fact that their study was for cesarean section surgery, which has hormonal and pressure effect on neuraxial block.

When a local anesthetic agent deposited subrachnoid space the supine position, the natural mid-thoracic region concavity of the spine limits the cephalic spread of the drug. Thus, even after injecting 10 ml. Of drug/saline in epidural space to facilitate EVE, subrachnoid block level rises in a controlled manner. We used cardio-stable agents in our study for achieving a safe level of block without affecting cardio respiratory functions. All patients remained stable with spontaneous respiration and no patient of any group required conversion to general anesthesia.

In the EVE technique, epidural volume was injected within 10 min of drug deposition in subrachnoid space. It is given within this time frame to ensure availability of a free subrachnoid drug in CSF before its fixation to spinal nerves [13]. We ensured in our study that all patients received epidural injection of 10 mL drug within 10 min of spinal block. Time for achieving block up to T6 level was not statistically different (Group M 8.7±6.48 min and Group C 9.45±82 min). Our findings were similar to observations of Tiwari *et al*. [13]. The first epidural top-up of 6 mL of 2% lignocaine was required early in the control group. We used 2% lignocaine as it is commonly used safe drug and also act as test dose for checking the appropriate position of epidural catheter. Group with mEVE required less total epidural top-up doses of 2% lignocaine. Similar conclusion was also made by Almeida *et al*. [14] in their recent study and highlighted the utility of EVE in high-risk cases to provide safe and hemodynamically stable neuraxial block with the use of lower anesthesia drug. EVE with saline or Lignocaine increased the level of sensory block same in both groups, but the quality of anesthesia was better in Group M as it was reflected by reduced amount of 1% propofol required for maintaining conscious sedation, these findings exclusive observation of this study.

Recovery from neuraxial block was earlier in Group C despite more anesthesia drug received (Group C 31.02±13.04 min vs. Group M 49.88±17.1 min). Rescue analgesia was also required earlier in group C. (Group C 36.49±23.8 min versus Group M 48.3±14.2 min), these findigs were different from previous study done by Heesen et al. [10]. Our Hypothesis is preemptive blockage of the pain pathway earlier and at multiple stages in Group M might have some pain modulating effect. Length of stay in hospital was not different, as due to surgical protocol, these patients were discharged only after 3 days of surgery.

CONCLUSION

Sufficient and rapid neuraxial block was achieved with lower dose of spinal drug in all the patients of both EVE group patients without any adverse effect in the present study. However, this block had faster onset, lasted longer, and required significantly lower doses of total epidural drug in Group M. We observed that CSE with local anesthetic agent was used for EVE provides an efficient level of anesthesia with better quality and facilitates earlier onset with delayed regression and also provides good postoperative analgesia with stable vital parameters without adverse effects. These factors may result in early mobilization and discharge of patients from hospital.

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Nil.

CONFLICT OF INTEREST

Nil.

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