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Original Research Article

Comparative Evaluation of Ultrasound Guided Bilateral Erector Spinae Block and Ultrasound Guided Caudal Block in Lumbar Spine Surgeries for Post-Operative Analgesia

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Abstract:

Background: Effective management of pain following spine surgeries is essential to enhance functional outcomes, facilitate early ambulation, expedite recovery, and avert the onset of chronic pain. Epidural analgesia is regarded by many as a fundamental component of postoperative analgesia for lumbar spine surgeries. A unique interfacial plane block that has lately gained popularity is the erector spinae plane block.

Aim and Objectives: The goal of this research was to evaluate the analgesic effect of ultrasound guide bilateral erector spinae block and ultrasound guided caudal block in lumbar spine surgeries for post-operative analgesia**.**

Material and Methods: Following the approval of institutional ethical committee, this randomized controlled study was done on 40 patients presenting for lumbar spine surgery in Sri Siddhartha Medical College and Research Institute, Tumkur, Karnataka, India. Patients were randomly assigned equally to receive either ultrasound guided caudal block (Group C) or receive bilateral ultrasound guided lumbar ESP block (Group E) after induction of general anaesthesia. Time to first analgesia request postoperatively was recorded. VAS score and VCS score was used to assess quality of postoperative analgesia. An analysis of the data was conducted using SPSS version 20. Statistical analysis was conducted on continuous and categorical data using the suitable statistical approach. A significance level of $P < 0.05$ was used to determine statistical significance.

Result: The mean time to 1st analgesia request in group E (ultrasound guided bilateral Erector spinae block) was found to be 7:28±1.00 hrs while the mean time to 1st analgesia request in group C (ultrasound guided caudal block) was found to be 4:04±1.00 hrs ($P<0.001$).

Conclusion: Ultrasound-guided bilateral erector spinae block (ESPB) has been shown to be effective for lumbar spine surgeries by extending the duration of postoperative pain relief and reducing the need for first rescue analgesia compared to patients who received an ultrasound-guided caudal block without any complications. The block's simplicity and safety contribute to its growing popularity.

Keywords: Caudal epidural block; Lumbar spine surgeries; Erector spinae block.

Introduction

Significant lumbar spine surgeries are associated with severe postoperative pain that frequently endures for a minimum of three days. Numerous studies indicate that postoperative pain reaches its zenith during the first four hours and progressively diminishes by the third day following lumbar spine surgery; hence, efficient and safe postoperative analgesic methods are crucial for rapid recovery. [1] Traditional opioid analgesic methods are linked to the known side effects of opioids, such as drowsiness, nausea, vomiting, and pruritus. [2] Many investigators support epidural block as the gold standard for perioperative pain management after lumbar spine operations. [3] Post-operative pain has been successfully managed by intraoperative catheter placement. While this tactic has its advantages, it is not without problems. Spinal surgery may lead to a rupture of the dura, increasing the danger of intrathecal administration of local anaesthetics, which might result in total spinal anaesthesia, as well as the potential for haematoma and infection. [4] By providing sensory blocking, caudal block can successfully control pain after lumbar canal stenosis treatments [5]. It

has been shown that a single dose caudal injection of bupivacaine 0.25%, given 20 minutes before surgery, is safe and effective in providing significant pain relief for up to 24 hours after surgery [6]. One drawback, though, is that this concentration is associated with some motor block, which might make it more difficult to detect any possible post-surgery motor impairment during the neurosurgical examination. In order to provide analgesia without impairing motor function, epidural analgesia throughout labour has traditionally been provided with bupivacaine 0.125%.

It was suggested in 2016 to use the erector spinae interfacial truncal plane block. [7] Several studies showed that the lumbar ESPB effectively controlled perioperative pain in cases of lumbar spine surgery, which decreased the need for analgesic medication. [8]; however, only a limited number of clinical studies have concentrated on ESP block for lumbar procedures [9].

Ropivacaine 0.25% was employed as the local anaesthetic agent in this research due to its superior safety profile and preferential action on sensory rather than motor blockage compared to bupivacaine. [10]

Aim and Objectives:

The aim of present study is to compare the analgesic effect of ultrasound guide bilateral erector spinae block and ultrasound guided caudal block in lumbar spine surgeries for post-operative analgesia.

Primary Objectives:

Evaluation and comparison of total duration of analgesia as well as time to need for first rescue analgesia.

Secondary Objectives:

Assessment of post-operative pain using Visual Analogue Scale (VAS) score and verbal categorical score (VCS), as well as any associated notable side effects.

Material and Methods

The study was done as a hospital based prospective randomized controlled study at the Department of Anaesthesiology, Sri Siddhartha Medical College and Research Centre, located in Tumkur, Karnataka, India. A total of 40 patients aged 18-65 years, belonging to ASA class I & II, scheduled for elective lumbar spine surgeries under general anaesthesia, were recruited for the research after obtaining clearance from the institutional ethics committee (Ref No.: (SSMC/MED/IEC-144/July-2022) and written informed consent from the patients.

Patients with established contraindications to regional anaesthesia, such as coagulopathy, e.g., INR > 1.5, platelet count < 100,000, infection at the needle insertion site, decompensated cardiac function, elevated intracranial pressure, demyelinating lesions, deformities of the spine, septicemia, known allergies to any research drugs, ASA classification III-IV, individuals under 18 or over 65 years of age, those requiring revision surgery, or those declining participation in the research were excluded from the research.

The sample size calculation was done by using convenient sampling method with the help of the following formula,

$$n = \{(1-\alpha/2) + (1-\beta)\}2[p1(1-p1) + p2(1-p2)] / d2$$

Considering non-response rate of 10%, the minimum sample size required was 20 in each group (total = 40).

Upon arrival in the operating room, participants were at random assigned to receive either of the two blocks using a computer-generated random number sequence and a closed opaque envelope technique.

- **Group E (n=20):** Received ultrasound guided bilateral Erector Spinae Block **[ESPB]** with 20 ml of 0.25% Ropivacaine.
- **Group C (n=20):** Received ultrasound guided Caudal Epidural Block **[CEB]** with 20 ml of 0.25% Ropivacaine.

While performing pre-anaesthetic evaluation, all the patients were taught about the visual analogue scale (VAS) for postoperative pain and the verbal categorical scale (VCS) for postoperative pain, with a scale of 0–10 indicating no pain to worst possible pain. Upon transferring the patients to the operation room, accurate measurements of all essential vital parameters were taken. Following general anaesthesia, the examined subjects were carefully positioned in a prone manner.

The block was delivered based on the study group by an experienced anaesthesiologist who was not part of the trial, and both the patient and the outcome assessor, excluding the block administrator, were blinded to the study group.

Methodology: For ESPB, a curvilinear ultrasound transducer was positioned 3 cm laterally to the L3 spinous process in order to outline the shadow of the transverse process and erector spinae muscle. A 22-gauge spinal needle was placed from cranial to caudal towards the TP, aligned with the ultrasonic transducer, in order to access the TP without passing through any muscles. After making sure the needle placement was accurate, 10 mL of 0.25% Ropivacaine was given. The same steps were taken to duplicate the procedure on the other side.

For **CEB,** Sacral horns were palpated, and ultrasonography was used to define the sacral hiatus and epidural area. Once the caudal epidural space had been identified by ultrasonography, the sacrococcygeal membrane was directly punctured out of plane using a 22-gauge spinal needle. The needle could then be seen in plane inside the epidural space when the probe was rotated 90 degrees to the longitudinal axis. After that, a 20 ml injection of 0.25% ropivacaine was given.

Patients had continuous monitoring for systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, pulse oximetry, continuous electrocardiogram (ECG), and local anaesthetic toxicity symptoms for 30 minutes following the block.

The time to the initial request for analgesia determined the primary outcome. The secondary outcome measured the incidence of any complications, such as itching, vomiting, urine retention, and respiratory depression, over the course of 24 hours following surgery in both groups. The VAS score was measured at 30 minutes, then at 1, 2, 6, 12, and 24 hours after surgery. Measurements of mean arterial blood pressure and heart rate were taken as baselines prior to surgery, during the induction of general anaesthesia, every five minutes for the duration of the procedure (up to two hours), and thirty minutes afterward. These measurements were also taken 2, 6, 12, and 24 hours following the procedure.

Statistical analysis:

The data will be inputted into an Excel spreadsheet. A descriptive statistical analysis will be conducted. Quantitative data will be reported as mean and standard deviation, whereas qualitative variables will be reported as frequency and percentages. The relationship between category variables will be examined using the Chi-square test. The data will be analyzed via SPSS software (version 20). A significance criterion of $P < 0.05$ was employed to ascertain statistical significance.

Results:

Comparable demographic variables, age, gender, BMI, ASA grades, and surgical procedures were observed in both groups. **[Table 1]**

Table 1: Demographic variables

Variables		Group E (ESPB block) (n=20)	Group C (CEB block) (n=20)	P-value
Mean age (years)		49.50±10.15	49.75±13.15	0.947 **(NS)**
Gender	Male	13	11	0.519 **(NS)**
	Female	07	09	
BMI		25.37±2.36	25.77±2.28	0.584 **(NS)**
ASA grade	I	10	13	0.337 **(NS)**
	II	10	07	
Surgical procedure	Post. decompression	19	18	0.548 **(NS)**
	TLIF	01	02	

NS- Non Significant

The mean duration of anaesthesia was significantly longer with caudal block (P=0.018). **[Figure 1]**

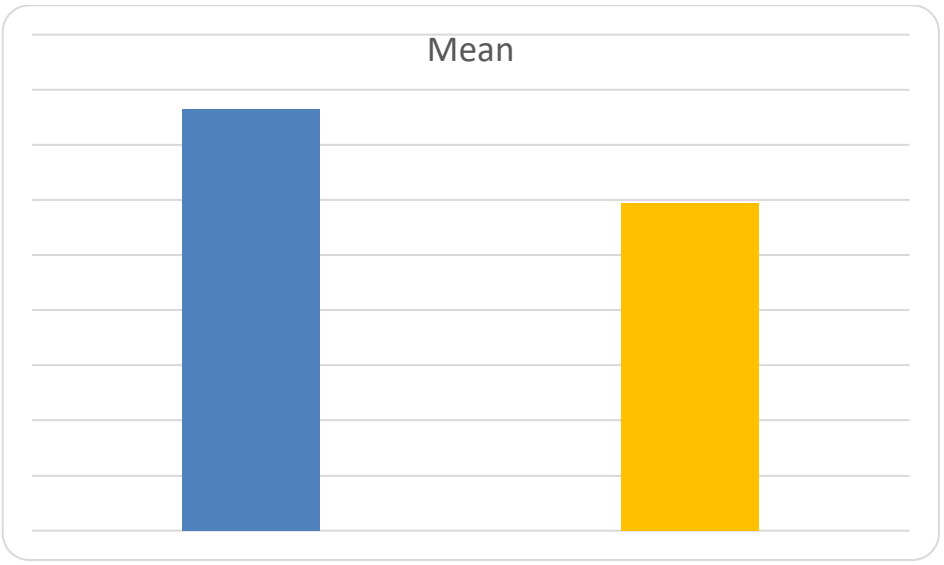

Figure 1: Mean duration of anaesthesia among groups

With a P-value of less than 0.001, the VAS score in the first 24 hours following the surgery was considerably lower in the ESPB group than in the CEB group. [Figure 2]

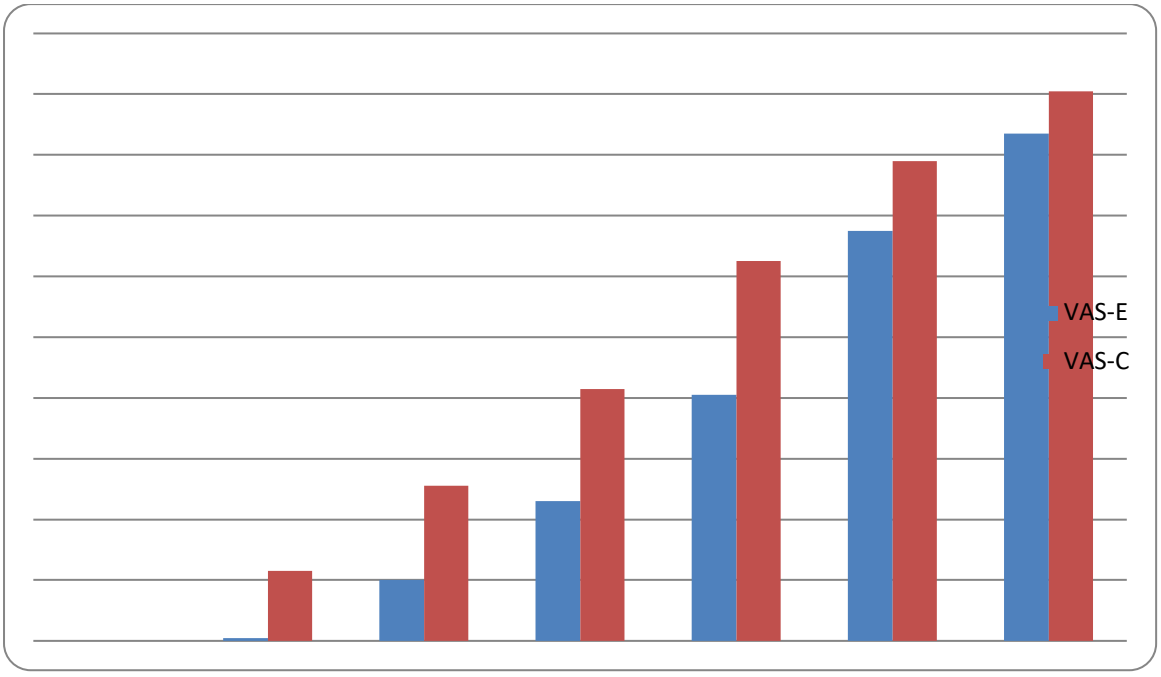

Figure 2: VAS scores at different time intervals among groups

With a P-value of less than 0.001, the VCS score in the first 24 hours following the surgery was substantially lower in the ESPB group than in the CEB group. [Figure 3]

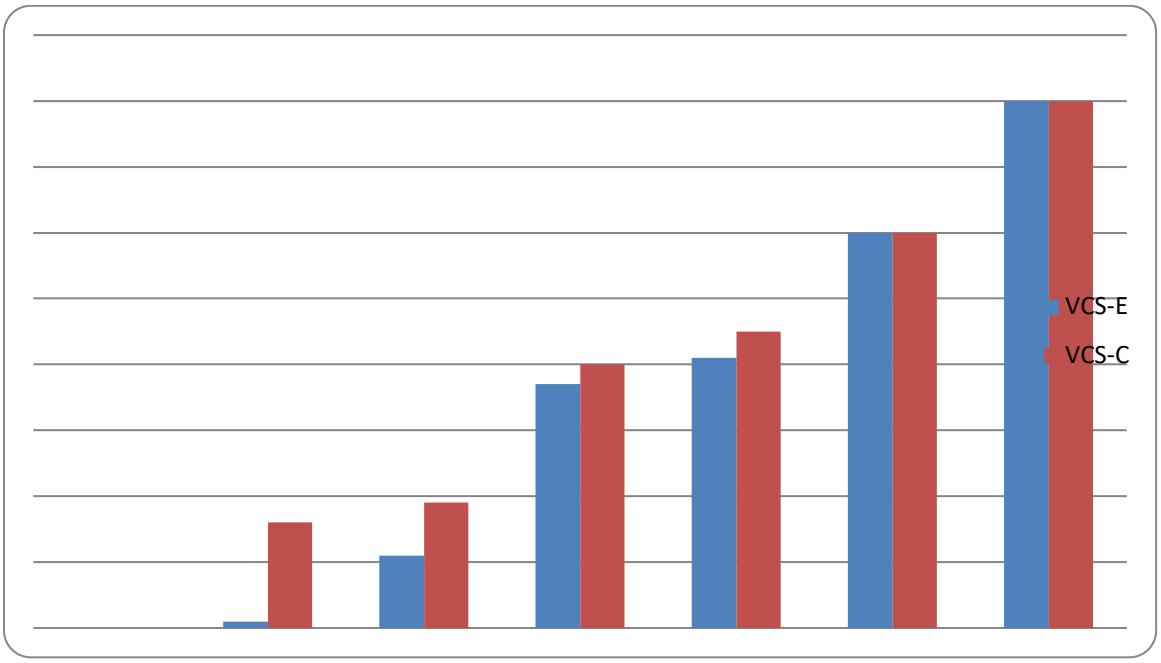

Figure 3: VCS scores at different time intervals among groups

The average time to the first analgesic request in group C (caudal epidural group) was 4.00±1.04 hours, but in group E (erector spinae plane block), it was 7.45±1.02 hours, P<0.001. [Table 2, Figure 4]

Table 2: Time to first analgesic request

Parameters	Group E (ESPB block)	Group C (CEB block)	P-value
Time to first analgesic request in hours	7.45±1.02	4.00±1.04	**<0.001 (S)**

S- Significant (p<0.05)

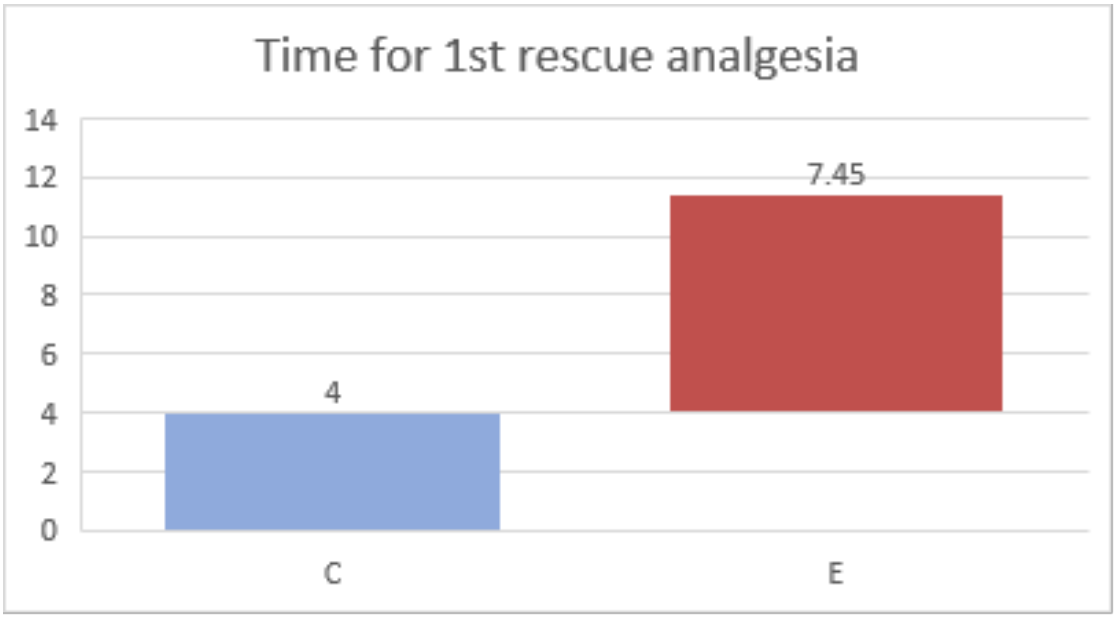

Figure 4: Time to first rescue analgesia

Intraoperative vital parameters were comparable between both the groups except mean heart rate, which was found to be more stable with the Erector spinae block group as compared to caudal epidural block. [Figure 5]

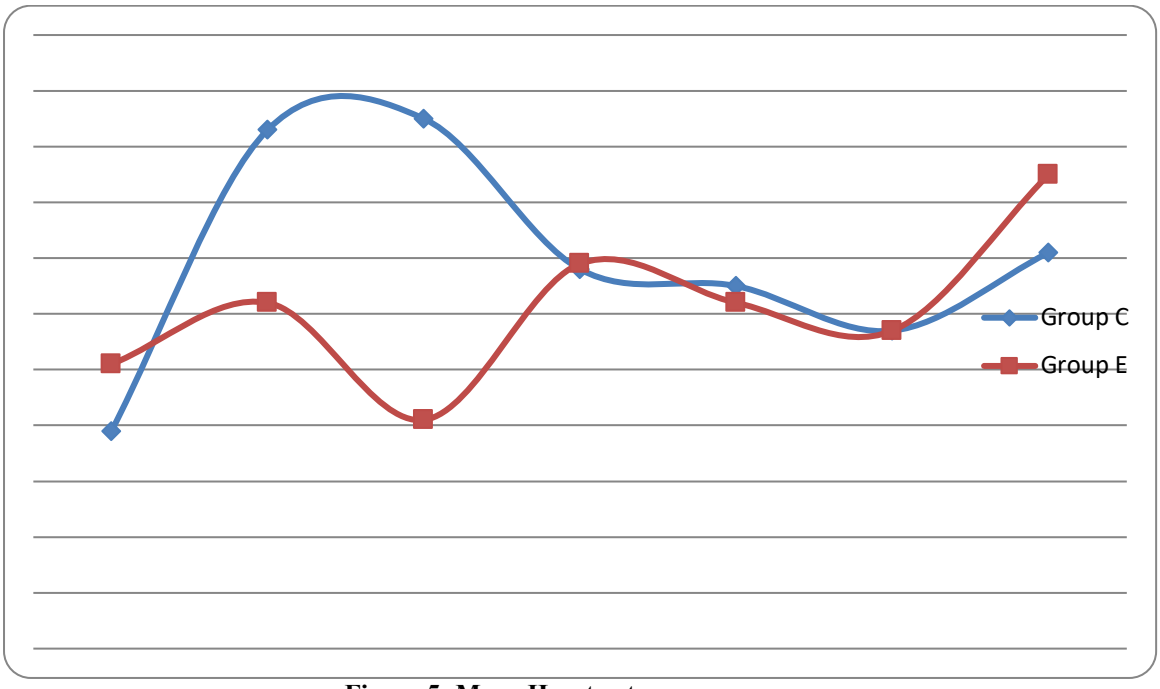

Figure 5: Mean Heart rate among groups

Discussion:

The direct action of local anaesthetics via their physical dispersion along with diffusion to the neuronal areas inside the fascial plane underneath the erector spinae muscle is the main mechanism by which the ESP block functions. The blockade of rami communicants in the ESPB may obstruct sympathetic fibres, resulting in systemic hypotension, but to a lesser extent than with an epidural block. [11] Hypotension occurs more frequently with epidural anaesthesia and paravertebral blocks compared to ESPB. [12] This ensures the safety of ESPB in a specific cohort of patients with restricted cardiovascular reserve, where sympathetic blockade may result in significant hypotension and hypoperfusion. [13] Nonetheless, complications such as epidural haematoma and dural puncture may occur with epidural analgesia. [14]

Furthermore, the motor impairment resulting from epidural analgesia post-surgery hinders postoperative neurological assessment. This may

prolong the diagnosis and management of postoperative surgical complications. Consequently, alternate solutions that circumvent these problems are essential. [15]

In our study, group E consistently exhibited lower VAS ratings than group C. In a research conducted by Moneim et al., US-ESPB dramatically diminished both intra-operative and post-operative total opioid intake, as well as lowered postoperative VAS ratings during the first 12 hours post-surgery, while also decreasing the incidence of postoperative problems in comparison to US-CEB. [16] Identical results were noted in the study by Abdelhamid et al. [17]

In our study, the mean duration of analgesia in group E was 7:28±1.00 hours, whereas the mean time until the first rescue analgesia request in group C was 4:04±1.00 hours. Compared to ultrasound-guided caudal epidural block, this study found a substantial decrease in the need for initial analgesic administration after bilateral ultrasound-guided erector spinae plane block as a preventive analgesic technique in the cases studied undergoing lumbar spine operations.

Pre-operative bilateral ultrasound-guided erector spinae plane blocks were shown to be more successful in controlling postoperative pain following lumbar spine surgeries than conventional post-operative analgesics, according to a study by Singh et al. [3]. A research comparing postoperative analgesia consumption, pain thresholds, and patient satisfaction was carried out by Oksuz et al. [18] on patients undergoing general anaesthesia for breast reduction surgery using the tumescent anaesthesia technique and erector spinae block. They came to the conclusion that ESP blocks are preferable than tumescent anaesthesia.

A study by Eskin et al. [19] corroborated our findings, indicating that US-ESPB is more effective in diminishing postoperative pain scores, reducing the time to the first analgesia request, and lowering total opioid consumption following lumbar spine surgeries, while also resulting in fewer postoperative complications.

Conversely, the ESP block may prove ineffective for visceral pain associated with certain abdominal surgeries. Research conducted by Sakae et al. [20] indicated that ESP blockade did not serve as an effective method for pain management following open cholecystectomy at the dosages utilized in their study, as opioid consumption was seven times greater in the ESP cohort.

The extended analgesic effect of the erector spinae block in the current study indicates that patients require rescue analgesia at a later time, therefore enhancing their comfort and overall recovery experience. Furthermore, the ESPB treatment has demonstrated safety, with no documented problems, hence reinforcing its dependability and benefits compared to the caudal block.

Limitation of study:

This study has few limitations. First, smaller sample size reduces the power of study. Another of the limitations of our study was assessment of VAS score which is subjective and can vary with the level of understanding between patient and anesthesiologists.

Conclusion

In lumbar spine procedures, ultrasound guided bilateral Erector Spinae Block (US-ESPB) is a useful and preferable method for providing adequate intraoperative and postoperative analgesia, improving patient outcomes as well as satisfaction with postoperative medical care in comparison to ultrasound guided Caudal Epidural Block (US-CEB).

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