

Efficacy of bilateral erector spinae block for intraoperative and post-operative analgesia in lumbar decompression surgeries: A prospective randomized controlled trial



Priyanka G¹, Chaithali Hebri²

^{1,2}Assistant Professor, Department of Anaesthesia and Critical Care, Rajrajeshwari Medical College and Hospital, Bengaluru, Karnataka, India

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ABSTRACT

Background: Lumbar surgery is known to cause severe pain in the post-operative period. Modalities to reduce pain in the perioperative period include opioids, non-steroidal anti-inflammatory drugs, neuraxial blocks, and erector spinae block (ESB). **Aims and Objectives:** In this study, we aimed to evaluate whether ESB could reduce perioperative pain, opioid consumption, and muscle relaxant consumption. **Materials and Methods:** Fifty patients scheduled for lumbar decompression spine surgery were randomly allocated to two groups, the erector spinae plane (ESP) group (n = 25) and the control group multimodal analgesia group (n = 25). Intraoperative hemodynamics, muscle relaxant requirement, opioid consumption post-operative visual analog score, and rescue analgesia were evaluated. **Results:** Compared with the control group, heart rate (91.24 ± 14.86 and 90.20 ± 14.26) (77.12 ± 11.96 and 77.44 ± 11.96) arterial blood pressures (87.12 ± 8.45 mmHg) (85.25 ± 7.25) (78.73 ± 5.56 and 79.64 ± 5.95) were higher during surgical incision and 1st-time interval than in ESP group, respectively. The visual analog scale scores were higher in the control group than in the ESP group during all measurements of time. The requirement for rescue analgesia was more in the control group compared to the ESP group. Post-operative analgesia lasted for 15–18 h. **Conclusion:** Ultrasound-guided ESP block is a simple and safe technique which provides effective intraoperative, and post-operative analgesia and patient satisfaction with reduced opioid and muscle relaxant consumption.

Key words: General anesthesia, Local anesthesia, Ultrasound, Sedatives, Adjuncts, Neuromuscular-blocking drugs, Narcotics, Analgesics

INTRODUCTION

Lumbar spine surgery is known to cause severe post-operative pain, marked analgesic, delayed recovery, and increased length of hospital stay.¹

Acute pain occurs following trauma to the tissues during surgery. The core responsibility of health-care professionals is to prevent post-operative pain.² Acute severe pain is associated with reduced patient satisfaction, delayed post-operative mobility, the risk of development of chronic post-operative pain,³ increased incidence of respiratory^{4,5}

and cardiovascular complications,⁶ and also increased incidence of morbidity and mortality.⁷

Opioid-based patient-controlled intravenous analgesia (PCIA) is commonly used for overcoming pain after spinal decompression surgery.⁸ However, opioid-based analgesia has side effects such as nausea, vomiting, hypotension, loss of consciousness, and respiratory depression.

The erector spinae plane (ESP) block is where a local anesthetic is injected into the inter-fascial plane below the erector spinae muscle. The mechanism of action of the

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Address for Correspondence:

Dr. Priyanka G, Assistant Professor, Department of Anaesthesia and Critical Care, Rajrajeshwari Medical College and Hospital, Bengaluru, Karnataka, India. **Mobile:** +91-7795439546. **E-mail:** drpriyanka2405@gmail.com

erector spinae block (ESB) is through the blockade of the dorsal rami of spinal nerves along with the sympathetic nerve fibers, leading to effective management of visceral and somatic pain. This block has been shown to provide good post-operative analgesia for thoracic, breast, and abdominal surgeries.^{9,10}

Bilateral ultrasound (US)-guided ESP block has been demonstrated to produce similar analgesic effects to epidural block.¹¹ The block is performed away from the spinal cord through sono-anatomy which can be easily recognizable and it is distant from the spinal cord and other vital structures such as the pleura. Hence, the procedural simplicity minimal complications lessen the risk of needle injury.

There are few studies in which erector spinae block was used to reduce post-operative pain during lumbar spine surgeries. So, novelty of our study is we given the ESP block before surgery with adjuvants in order to know the intra-operative reduction of requirement of opioids and muscle relaxants and duration of action; of ESP block post-operatively.

Aims

To determine whether erector spinae block effective in decreasing opioids and muscle relaxant usage intraoperatively and post operatively analgesia for 24hrs.

Objectives

To study the efficacy of erector spinae block in lumbar decompression surgery.

Primary: To study how much effectively erector spinae block reduces opioids, and muscle requirement intraoperatively.

Secondary: To compare the efficacy of erector spinae block v/s multimodal analgesia as postoperative analgesia.

MATERIALS AND METHODS

A prospective randomized double-blinded control study was done in Rajarajeswari Medical College and Hospital from January to December 2022. The study was approved by the Rajrajeshwari Medical College Institutional Review Board and the procedures were conducted following the Helsinki Declaration-2013. All the subjects participating in the study provided written informed consent was taken. The trial was registered before patient enrolment at ctri.nic.in with registry number and link (CTRI/2021/11/038059). (<https://ctri.nic.in/Clinicaltrials/rmaindet.php?trialid=59774&EncHid=45723.25060&modi d=1&compid=19>) Principal investigator: PRIYANKA G, Date of registration: November 15, 2021).

Inclusion criteria

Included American Society of Anesthesiologists (ASA) 1 posted for single and double levels lumbar decompression surgery.

Exclusion criteria

Included patient refusal, coagulation disorders, body mass index (BMI)>30 or <18, patients with surgical site infection, patients with unstable spine integrity such as fractures or scoliosis, hypertensive, cardiac, and diabetic patients. We have excluded patients with comorbidities because the hemodynamic changes will be significant in such patients which may hamper the results.

Fifty patients were allocated into two groups using computerized random numbers generated by www.random.org. Group I (ESP): The general anesthesia was combined with ESP block and Group II (MMA): Multimodal analgesia was given along with conventional general anesthesia receiving (MMA) which depicted in (Figure 1).

The pre-anesthetic evaluation was done in all the patients and was assessed thoroughly by detailed medical and surgical history taking, complete clinical examination, routine laboratory investigations (complete blood picture, renal function tests, coagulation profile, and fasting blood sugar), chest X-ray, and electrocardiogram (ECG). All patients were informed regarding the technique applied and any possible complications, and written consent was taken for the same.

Patients were kept fasting 6 h before surgery. On the day of surgery in the operation room: A multi-channel monitor was attached to the patient to display continuous ECG, heart rate (HR), non-invasive blood pressure, and oxygen saturation (SpO₂%). An intravenous line was secured and Ringer's lactate solution was started. Ten min before induction of anesthesia, all patients were pre-medicated with intravenous midazolam 0.02 mg/kg. Patients were pre-oxygenated with 100% oxygen for 3 min.

In both groups (I) and (II), induction of anesthesia was carried out by intravenous administration of fentanyl 2 µg/kg and propofol 2 mg/kg, 0.5 mg/kg atracurium was administered. Subsequently, endotracheal intubation was done with an appropriate-size cuffed endotracheal tube and intermittent positive pressure ventilation was adjusted to maintain an end-tidal carbon dioxide partial pressure between 30 and 35 mmHg. Anesthesia was maintained with oxygen 50%, nitrous oxide 50%, and isoflurane (0.8%). After the proning of the patient, a sealed envelope was given to anesthesiologist who was there in the operation theater regarding the allocation of the patients into groups.

In group (I), after prone positioning and before surgery, ESP block was performed bilaterally using a low-frequency-curved ultrasound transducer placed in a longitudinal orientation 3 cm lateral to the spinous process one vertebral level cranial to pre-determined marked surgical incision. A 23-gauge QB needle was inserted in a perpendicular direction to the specific transverse process until the play in the inter-fascial plane below the erector spinae muscle, the block was performed by injection of 20 mL of 0.25% bupivacaine with dexamethasone 4 mg on either side.

In group (II), paracetamol 10 mg/kg was given intravenously before surgical stimulus. In both groups (I) and (II), fentanyl 1µg/kg as rescue analgesia was given based on hemodynamic parameters.

If the mean arterial blood pressure was below 50 mmHg, ephedrine 6 mg was administered and an intravenous bolus of 0.6 mg atropine was administered in case of bradycardia.

Then at the end of the surgery, the isoflurane vaporizer was shut off and the muscle relaxant was reversed with neostigmine 0.04 mg/kg and glycopyrrolate 0.01 mg/kg. The patient was extubated after regaining consciousness, spontaneously breathing, and responding to verbal commands.

Hemodynamic parameters such as HR and blood pressure were monitored continuously and were recorded before induction of anesthesia, after induction, after proning, before ESB, after the ESB, the start of a surgical stimulus,

and then every 10 min interval throughout the surgery, at end of anesthesia, post-operative period.

Anesthetic requirements based on hemodynamic parameters were assessed. Fentanyl dose (µg) and muscle relaxant dose (mg) were kept into account.

In the post-anesthesia care unit, post-operative analgesia was assessed using a visual analog scale (VAS) at time intervals 1, 2, 4, 8, 12, 16, 20 up to 24 h, time to first analgesic requirements (min) based on reaching the score of 4 VAS where a rescue analgesia paracetamol 1 g IV was given intravenously. Anesthesiologists not involved in the study were assessing the hemodynamic parameters, opioid consumption, and muscle relaxants during the intraoperative period and VAS postoperatively.

Blinding was made sure as the anesthesiologist not involved in the study assessed the hemodynamic parameters, opioid consumption, and muscle relaxant during intraoperative period and VAS postoperatively.

The sample size calculation was done based on a previous study.¹² The sample size was estimated using the difference in mean post-operative analgesia score between the ESP group and multimodal group from the study using a 95% confidence limit and an 80% power sample size of 22 was obtained in each group. With a 10% non-response sample size of 22 + 2.2, ≈ 25 cases were included in each group.

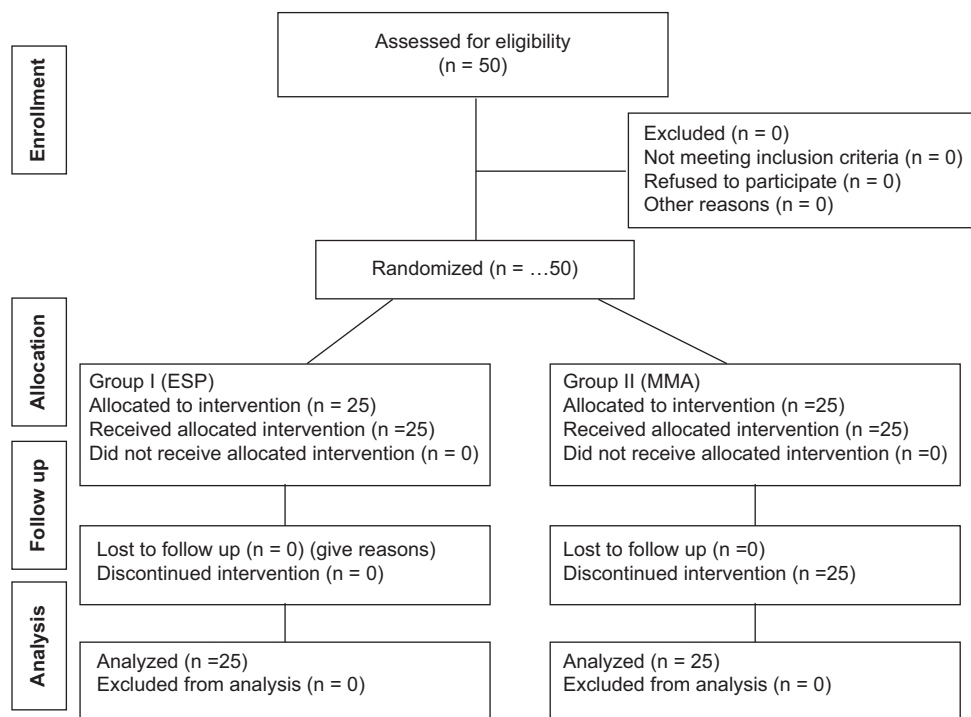


Figure 1: Consolidated standards of reporting trails diagram

Data were entered into a Microsoft Excel data sheet and were analyzed using SPSS 22 version software. Frequencies and proportions are which represent categorical data. The Chi-square test was the test used to identify significance. Continuous data were represented in the form of mean and standard deviation. To identify the mean difference between the two groups, independent t-test of significance was used. $P < 0.05$ was considered statistically significant.

RESULTS

Fifty patients of ASA Grade I were enrolled in this study. The incidence of increase in HR, systolic blood pressure, diastolic blood pressure (DBP), and mean artery pressure was significantly higher in the control group than in the ESP group after the incision but otherwise, there was no significant change throughout the procedure (Figures 2-5). There was an increase in opioid and muscle relaxant consumption after the incision and 10 min after the incision but there was no significant difference in total consumption (Figures 6 and 7). The rescue analgesia requirement was highly significant at the 4th, 8th, and 12th h after the procedure in the control group compared to the ESP group (Figure 8). Patients in the ESP group had rescue analgesia at around 15–18 h after the procedure (Table 1a and b). The analgesic duration of the ESP block was approximately 18–20 h. Demographic data are presented in Table 2 and there was a significant difference between the two groups in terms of height and weight but in overall, there was no significant difference between the two groups in terms of age and BMI but the randomization was done through computer random number which is generated by www.random.org.in and in the inclusion criteria we have given importance BMI only.

DISCUSSION

Lumbar spine surgeries were found to be one of the top six surgeries that have the highest level of post-operative pain.¹ The activation of several processes that include nociceptive, neuropathic, and inflammatory mechanisms happens because of pain. Thus, post-operative pain management is considered essential for these patients due to its strong influence on a better surgical outcome, as it allows early mobilization and hospital discharge, which in turn decreases the development of thromboembolic and pulmonary complications, as well as reduces post-operative mortality and morbidity.¹³

In our study in group I (ESP), the mean HR values were (77.12 ± 11.96 and 77.44 ± 11.96 beats/min) after surgical incision and 1st-time interval, respectively, while for

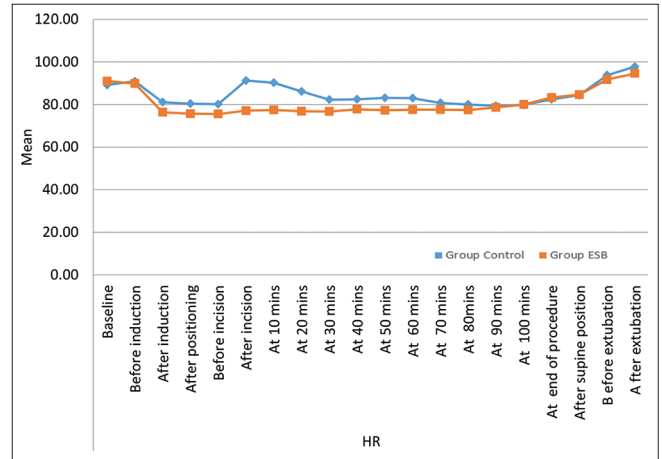


Figure 2: Difference in heart rate in both the groups during the procedure from baseline to post-extubation. Heart rate was high in control group compared to erector spinae block during incision and 10-min intervals after incision

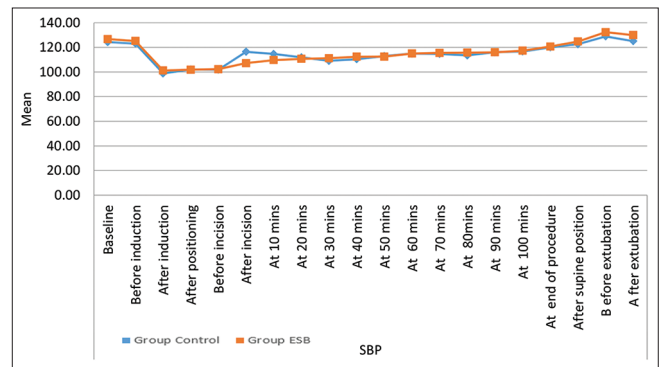


Figure 3: Difference in systolic blood pressure in both the groups during the procedure from baseline to post-extubation. The systolic blood pressure was high in control group compared to erector spinae block during incision and 10-min intervals after incision

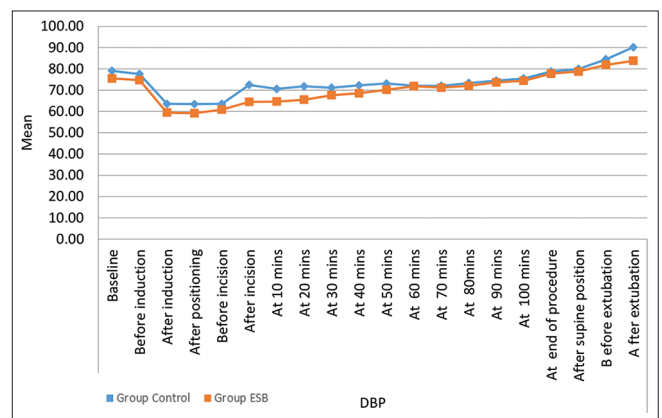


Figure 4: Difference in diastolic blood pressure in both groups during the procedure from baseline to post-extubation. The diastolic blood pressure was high in control group compared to erector spinae block during incision and 10-min intervals after incision

group II (MMA), the mean HR values were (91.24 ± 14.86 and 90.20 ± 14.64 beats/min) at the same time intervals. Hence, there was a statistically significant difference

Table 1: Demographic parameters in both the Control and ESB group. There was a significant difference between groups in terms of height and weight but overall, there was no significant in terms of BMI and age

| Group | N | Mean | Std. Deviation | t test | P value |
|---------|----|--------|----------------|--------|---------|
| Height | | | | | |
| Control | 25 | 166.32 | 9.21 | 0.012 | Sig |
| ESB | 25 | 173.72 | 9.56 | | |
| Age | | | | | |
| Control | 25 | 40.24 | 9.70 | 0.121 | NS |
| ESB | 25 | 45.20 | 12.39 | | |
| Weight | | | | | |
| Control | 25 | 68.28 | 11.06 | 0.022 | Sig |
| ESB | 25 | 75.84 | 11.45 | | |
| Bmi | | | | | |
| Control | 25 | 24.45 | 3.03 | 0.469 | NS |
| ESB | 25 | 25.19 | 4.00 | | |

Table 2: This table shows rescue analgesia after surgery in both groups. The rescue analgesia requirement was high in the control group compared to the ESB group. The overall duration of action of the block was found to be between 18-20 hours

| Group with the following parameters | Fishers exact test: p value | Sig |
|--|-----------------------------|-----|
| rescue analgesia immediately after surgery | . | NS |
| 4 th hour | 0.000 | HS |
| 8 th hour | . | NS |
| 12 th hour | 0.000 | HS |
| 16 th hour | 0.009 | HS |
| 20 th hour | 0.000 | HS |
| 24 th hour | 0.000 | HS |

ESB=erector spinae block group, P value<0.05 is considered significant
Sig=significancy, NS=not significant and HS=highly significant

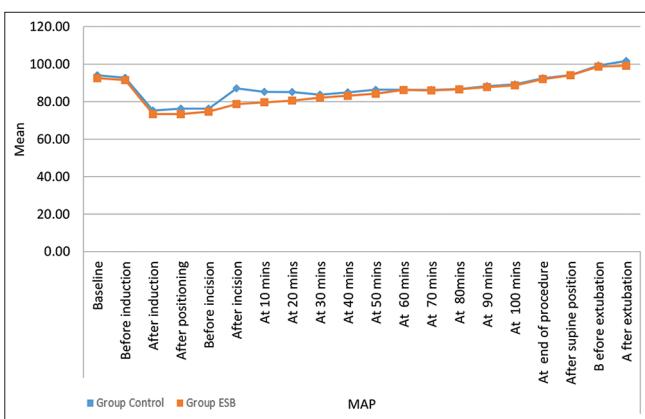


Figure 5: Difference in mean blood pressure in both the groups during the procedure from baseline to post-extubation. The mean blood pressure was high in control group compared to erector spinae block during incision and 10-min intervals after incision

between the two groups after surgical incision and at the 1st-time interval (P=0.001 and 0.001), respectively. For

group I (ESP), the mean arterial blood pressure values were (78.73±5.56 and 79.64±5.95 mmHg) after surgical incision and 1st-time interval, respectively, while for group II (MMA), the mean arterial blood pressure values were (87.12±8.45 mmHg and 85.25±7.27 mmHg) at the same time interval. Hence, there was a statistically significant difference between the two groups after surgical incision and at the 1st-time interval (P=0.000, 0.004), respectively. Furthermore, fentanyl consumption was statistically lower in group I (ESP) patients and group MMA (P=0.004 and P=0.002), respectively, during incision and the first interval after incision but overall fentanyl consumption was not significant during the procedure. Compared to other studies mentioned below, we also measured the requirement of muscle relaxants it found to be significantly reduced during surgical incision and 1st-time interval (P=0.042 and P=0.004), respectively. Our study results that the ESP block provided excellent analgesia for an average duration of 18–20 h from the time of the block. The VAS score on average was < 4 in the ESB group compared to the control group which was on average more than 6.

Ueshima et al. have done a similar study where the mean duration of the first analgesic requirement was significantly higher in the ESPB group compared to the control group. The VAS score was significantly lower in the ESPB group compared to the control group in the first 12 h after the surgery, whereas in our study, it was 18–20 h because an adjuvant dexamethasone 4 mg to the local anesthetic mixture.¹⁴

In a study conducted by Wahdan et al., the mean HR and mean arterial blood pressure were higher in the MMA group compared to the ESP group, after incision and 1st-time interval, respectively, which was in line with our study. The fentanyl consumption was statistically lower in group I (ESP) patients when compared to that in group (MMA) II but we chose to rescue analgesia with injection paracetamol 1 g iv requirement was higher in MMA.¹³

In another study done by Siam et al., MABP levels for group I (ESP) were lower during the 1st- and 2nd-time intervals compared to group II (multimodal), which was similar to our study.¹²

Agreeing with our study, Li et al. tested the efficacy of ESP block in lumbar spine surgery and found more stable hemodynamic parameters without any need for hypotensive drugs but the difference was statistically significant; the DBP and the HR were statistically lower with the ESP group rather than the control group.¹⁵

Concomitantly to our clinical trial, Zhang et al. compared ESP and general anesthesia regarding only the hemodynamic

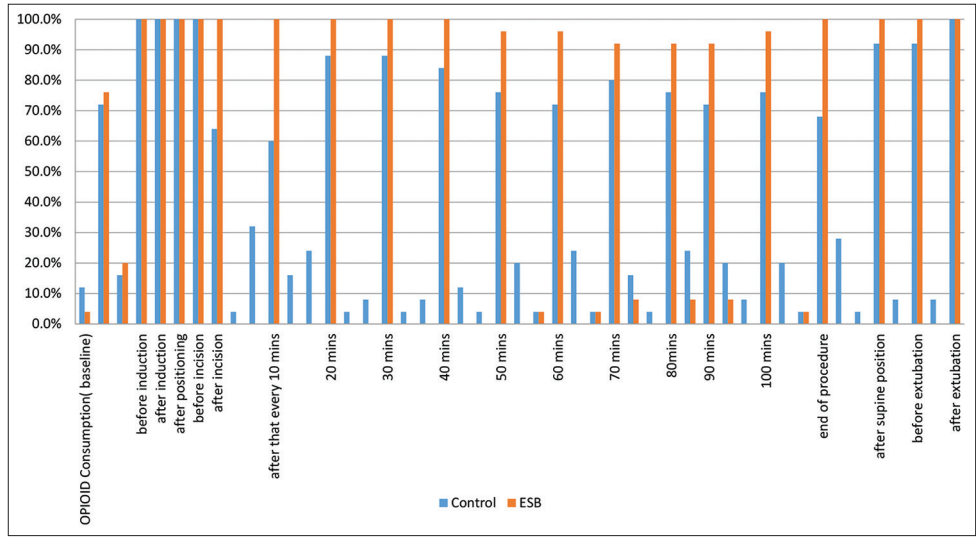


Figure 6: Difference in opioid consumption in both the groups during the procedure from baseline to post-extubation. Opioid consumption was high in control group compared to erector spinae block during incision and 10-min intervals after incision

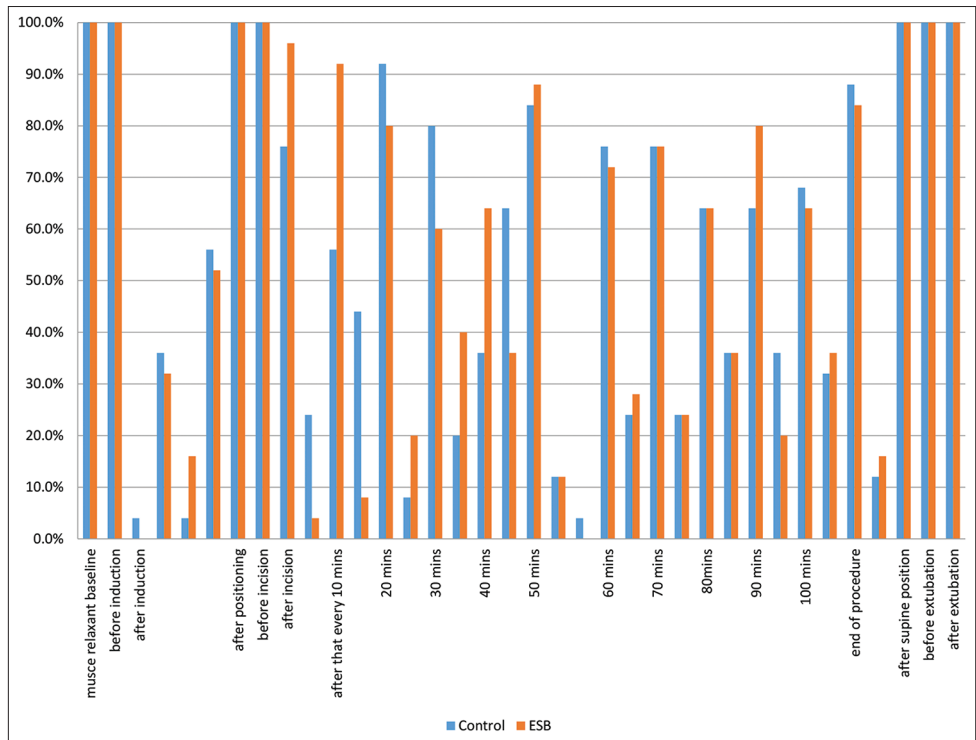


Figure 7: Difference in muscle relaxant consumption in both groups during the procedure from baseline to post-extubation. The muscle relaxant consumption was high in control group compared to erector spinae block during incision and 10-min intervals after incision

changes and opioid consumption, the HR and mean arterial blood pressure were lower in the ESP group than those who underwent only general anesthesia which is similar to our study.¹⁶

Metanalysis done by Liang et al., ESP block improved analgesic efficacy among patients undergoing spinal surgery compared with non-blocked controls which were in agreement with our study. In terms of safety, they found that the complications related to ESPB there were

no block-related complications, including local anesthetics toxicity, bleeding, or infection, probably because most of the ESPB procedures were performed under ultrasound guidance alone, visualization, and the fact that the target site was away from important vessels and nerves may also explain the rarity of associated complications even in our study also there was no block complications as it was done ultrasound guidance and drug was given after proper negative aspiration for blood to target site.¹⁷

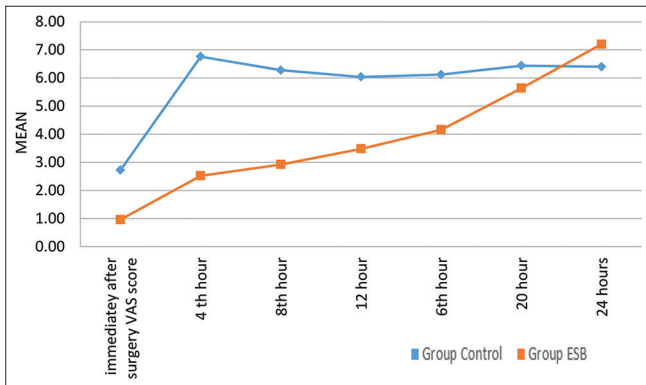


Figure 8: VAS after surgery in both groups. The VAS was high in control group compared to erector spinae block group. The overall duration of action of block found to be between 18 and 20 h. VAS: Visual analog scale score

In a study by Nashibi et al., “The effect of ESP block on the use of anesthetic medications in lumbar spine surgery” intraoperative use of fentanyl in the case group was significantly lower than the control group (14.29 ± 21.5 vs. 65.96 ± 73.33 μg , $P < 0.001$). Furthermore, isoflurane consumption in the intervention group compared to the controls was significantly lower (20.71 ± 5.02 vs. 28.83 ± 8.68 mL, $P < 0.001$) which has similar results to our study.¹⁸

In a study by Zhu et al., “Effect of ESP Block in Terms of Analgesic Efficacy in Elderly Patients Undergoing Posterior Lumbar Spine Surgery: A Retrospective, Propensity-Score Matched Study.” Two groups with each 115 patients. Patients in the ESPB group showed a significantly lower opioid consumption at 24 h after surgery. Compared with the control group, VAS pain scores at rest in the first 24 h, number of PCIA pump compressions, ratio of patients requesting rescue analgesia, incidence of nausea and vomiting, and length of stay were significantly reduced in the ESPB group.¹⁹

In our study, we did not take into account inhalation agent consumption; hence, we do not know how ESB can infer the depth of anesthesia and whether ESB block has any effect on blood loss during the surgery. We found that patients were comfortable and were mobilized early compared to the MMA group; however, we could not evaluate the post-operative recovery pattern and hospital stay. Patients with multiple-level discectomy surgery were not included in our study somehow further studies can be done either by inserting a catheter in the erector spine plane to increase the efficacy of the block. The evaluation of chronic pain after surgery was not done in our study.

A bilateral US-ESPB single shot block seems to be a useful intervention for providing adequate pain management during both intraoperative and post-operative periods for

patients undergoing lumbar spine single or double-level discectomy. It is simple and safe, which makes it unique when compared with other blocks, and found to decrease intraoperative opioid and muscle relaxant consumption, enhance recovery from anesthesia, and provide supportive analgesia up to 15–18-h postoperatively. However, the evidence of the ESP block was insufficient in view of beneficial of rapid recovery.

Limitations

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CONCLUSION

A bilateral US-ESPB single shot block seems to be a useful intervention for providing adequate pain management during both intraoperative and postoperative periods for patients undergoing lumbar spine single or double-level discectomy. It is simple and safe, which makes it unique when compared with other blocks and found to decrease intraoperative opioid and muscle relaxants consumption, enhance recovery from anaesthesia and provide supportive analgesia up to 15-18 h postoperatively. However, the evidence of the ESP block was insufficient in view of beneficial for rapid recovery.

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Authors Contribution:

PG- Conceptualization, methodology, project administration, data curation, data analysis, resources, supervision, validation, visualization, writing review, and editing. **CH-** Conceptualization, methodology, project administration, data curation, data analysis resources, supervision, validation, visualization, writing review, and editing.

Work attributed to:

Rajrajeshwari Medical College and Hospital, Bengaluru, Karnataka, India.

Orcid ID:

Priyanka G - <https://orcid.org/0000-0003-4386-5306>

Chaithali Hebri - <https://orcid.org/0000-0003-0149-7242>

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