Journal of Anesthesia (2021) 35:420–425
https://doi.org/10.1007/s00540-021-02920-0

ORIGINAL ARTICLE

# Erector spinae block for postoperative pain management in lumbar disc hernia repair

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Received: 10 September 2020 / Accepted: 13 March 2021 / Published online: 22 March 2021


## Abstract

**Purpose** Lumbar disc herniation is the most common spinal disorder and various less invasive techniques such as microdiscectomy have been described. However, postoperative pain management in patients undergoing discectomy is still commonly inadequate. Erector spinae plane (ESP) block is a relatively easier technique with lower risks of complications, and can be performed to provide postoperative analgesia for various procedures. The current study aimed to determine the effect of ESP block on postoperative analgesia in patients who underwent elective lumbar disc herniation repair surgeries.

**Methods** Fifty-four ASA I-II patients aged 18–65 years scheduled for elective discectomy surgery were included in the study. Patients were randomized either to the ESP or control group. Ultrasound-guided ESP block with 20 mL of 0.25% bupivacaine was performed preoperatively in the ESP group patients and a sham block was performed with 20 mL normal saline in the control group patients. All the patients were provided with intravenous patient-controlled analgesia devices containing morphine. Morphine consumption and numeric rating scale (NRS) scores for pain were recorded 1, 6, 12, and 24 h after surgery.

**Results** A significantly lower morphine consumption was observed at 6, 12, and 24 h timepoints in the ESP group ($p < 0.05$ for each timepoint). Total morphine consumption at 24 h after surgery decreased by 57% compared to that of the control group ($11.3 \pm 9.5$ mg in the ESP group and $27 \pm 16.7$ mg in the control group). NRS scores were similar between the two groups.

**Conclusion** This study showed that ESP block provided effective analgesia in patients who underwent lumbar disc herniation surgery.

**Clinical Trials Registry** NCT03744689

**Keywords** ESP block · Postoperative analgesia · Lumbar disc hernia

## Introduction

Lumbar disc herniation is a common spinal disorder, affecting an increasing number of people [1]. In addition, discectomy is the primary surgical intervention for lumbar disc herniation [2]. In recent years, various less invasive techniques such as microdiscectomy have been described with the goal of improving both the surgical and analgesic outcomes [3]. However, microdiscectomy surgery is associated with pain in the postoperative period [4] and inadequate pain control may lead to the undesired effects of postoperative pain [5].

Erector spinae plane (ESP) block was defined by Forero et al. [6] for thoracic neuropathic pain. Afterward, the ESP block gained popularity, and the use of the ESP block for postoperative pain management in various surgeries is described [7].

Commonly, ESP block is performed at the thoracic level and is preferred for thoracic and upper abdominal surgeries. Recently, ESP block in the lumbar region is being studied for the postoperative pain management of various procedures [8]. This study was designed to evaluate the analgesic effect of ESP block in patients undergoing lumbar disc herniation repair surgery. We hypothesized that lumbar ESP block would provide effective analgesia. In this study, the aim was to evaluate the analgesic effect of lumbar ESP block in patients scheduled for elective lumbar disc herniation

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repair surgery. Primary outcome measure was morphine consumption at the postoperative 24th h. Our secondary outcomes were morphine consumption at postoperative 1st, 6th, and 12th h, pain scores, and incidences of postoperative nausea-vomiting.

## Methods

This double-blinded, prospective, randomized controlled trial was performed after obtaining approval from the Kocaeli University Clinical Trials Ethical Committee (KIA 2018/440). The study was registered with clinicaltrials.gov (NCT03744689). Written informed consent was obtained from all the patients. The Consolidated Standards of Reporting Trials (CONSORT) flow diagram was used for patient enrollment and allocation. The study was conducted between October 2019 and January 2020.

Patients aged between 18 and 65 years with an American Society of Anesthesia (ASA) physical status I–II, scheduled for elective single-level lumbar microdiscectomy were included in the study. Exclusion criteria included re-operation of lumbar disc hernia, obesity (body mass index $> 35$ kg/m$^2$), infection of the skin at the site of needle puncture area, known allergies to any of the study drugs, coagulopathy, presence of renal disease (creatinine higher than the upper limit of normal), hepatic disease (higher levels of aspartate aminotransferase and alanine aminotransferase than the upper limit of normal), recent use of opioid drugs due to chronic pain therapy, and inability to comprehend or use the numeric rating pain scoring system (NRS) or patient-controlled analgesia (PCA) device.

Patients were randomized into two groups according to computer-generated random number tables: ESP group and control group. The ESP block was performed preoperatively to the patients in the ESP group, and a sham block was performed preoperatively to the patients in the control group. Blocks were performed preoperatively to detect possible complications like motor block or local anesthetic systemic toxicity. The patients were blinded to the groups. All the blocks were performed by experienced anesthesiologists (H.U.Y, C.A.) who were blinded to both data collection and analyses. A pain nurse who was blinded to the group assignment performed the postoperative follow-up of the patients and collected the data. Perioperative management of the patients and all the data analyses were performed by other researchers who were blinded to the groups.

### ESP block technique

All the patients were premedicated with midazolam 0.03 mg/kg intravenously upon arrival to the preoperative holding area. All the blocks were performed in the block room after sedation and monitored with SpO2, electrocardiography, and non-invasive blood pressure (NIBP). Esaote My Lab 6 US machine (Florence, Italy) with a convex probe (1–8 MHz) and 22G, 80 mm, insulated facet type needle (BBraun Sonoplex, Melsungen, Germany) were used during all the blocks after the appropriate skin disinfection had taken place.

ESP and sham blocks were performed bilaterally in the prone position. The probe was placed parallel to the vertebral spine in parasagittal plane at the surgical level and slid 2 or 3 cm laterally, regarding to the length of transverse process. Erector spinae muscle and transverse process were visualized. The needle was inserted in a craniocaudal direction deep into the erector spinae muscle using an in-plane approach and was contacted with the lateral edge of the transverse process. Bupivacaine 0.25% (20 mL) was administered to the ESP group patients and normal saline (20 mL) was administered to control group patients on each side. A Dome-shaped drug distribution was seen in both the cranial and caudal directions beneath the erector spinae muscle (Fig. 1).

### General anesthesia

In the operating room, all the patients underwent standardized monitoring, comprising $SpO_2$ evaluation, ECG, and NIBP. General anesthesia was induced with thiopental (5–7 mg/kg), remifentanil (0.5 mcg/kg), and rocuronium (0.6 mg/kg). Desflurane in combination with nitrous oxide in oxygen at a ratio of 2:1 was used for anesthesia maintenance. The inspired concentration of desflurane was adjusted to achieve a 1.3 minimum alveolar anesthetic concentration. Tramadol (100 mg) and paracetamol (1 g) were administered at the end of the surgery. Ondansetron 8 mg was also administered to prevent postoperative nausea and vomiting.

Patients were also provided with a PCA device containing a 0.5 mg/mL morphine set to deliver a 1 mg bolus dose, with an 8 min lock out time and 1 h limit of 6 mg. Rescue analgesia with tenoxicam 20 mg IV was planned if the NRS was $> 3$.

A pain nurse, blinded to the study, recorded morphine consumption and NRS (0–10, 0 is no pain and 10 is the worst pain imaginable) scores at postoperative 1st, 6th, 12th and 24th h. The pain nurse also recorded if complications were observed (motor weakness, hematoma, local anesthetic systemic toxicity), and the incidence of nausea and vomiting in the first postoperative 24 h.

### Statistical analysis

A preliminary study conducted in our clinic included 10 patients, which revealed a mean (± standard deviation [SD]) morphine consumption value of $27.5 \pm 8.73$ mg, 24 h after surgery. We calculated that for 80% power and an error of

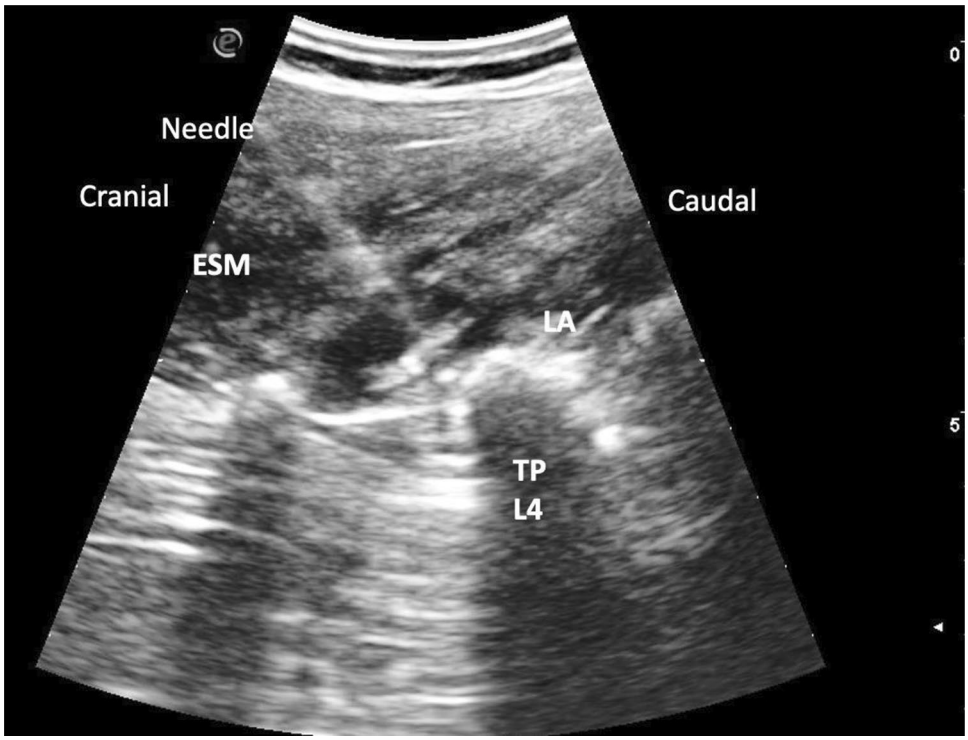


**Fig. 1** Ultrasound image of ESP block at L4 level. *TP* transverse process, *ESM* erector spinae muscle, *LA* spread of the local anesthetic

0.05, the required sample size to detect a 25% difference in morphine consumption at 24 h after the surgery was 25 patients per group. We included 30 patients in each group in case any patient dropped out of the study.

All statistical analyses were performed using IBM SPSS for Windows version 20.0 (IBM Corp., Armonk, NY, USA) software. Kolmogorov–Smirnov tests were used to test the normality of the data distribution. Continuous variables were expressed as mean ± SD and categorical variables were expressed as counts. Comparisons between the groups were made using a chi-squared test for categorical data, Student's *t* test, and Mann–Whitney *U* test for continuous data. A value of $p < 0.05$ was considered statistically significant.

## Results

Sixty patients were randomly assigned to either the ESP or control groups. Six patients were excluded from the study due to technical problems with the PCA device (three patients), patient refusal after randomization (two patients), and respiratory distress (one patient). Data from 54 patients were used in the final analyses (Fig. 2). Demographic data, ASA physical status, and duration of surgery were similar between the two groups (Table 1).

Although morphine consumption at postoperative 1st h was similar between the two groups, at the 6th, 12th, and 24th h, it was significantly lower in the ESP group (Table 2). Mean total morphine consumption was 11.3. ± 9.5 mg in the ESP group and 27 ± 16.7 mg in the control group ($p < 0.001$). Analyses showed that there was no statistically significant difference between the groups for NRS at any time interval ($p > 0.05$ for each time interval) (Table 2).

Five patients in the ESP group and 14 patients in the control group were administered rescue analgesics ($p = 0.006$). Three patients in the ESP group and ten patients in the control group had postoperative nausea ($p = 0.019$). One patient in the ESP group and three patients in the control group experienced postoperative vomiting ($p > 0.05$) (Table 2).

No complications related to the blocks performed were observed.

## Discussion

In this study, ESP block reduced total morphine consumption compared to the sham block with saline. Morphine consumption at postoperative 6th, 12th, and 24th h was significantly lower in the ESP group. With the lumbar ESP block, total morphine consumption at postoperative 24th h was decreased by 57% compared to the control group (Table 2). Although the NRS scores were similar between the groups, the mean doses of opioid consumption and the number of patients who were administered rescue analgesics were significantly higher in the control group. A possible explanation of similar NRS scores between the two groups could be higher consumption of opioids and rescue in the control group. The findings of this study support those of previous

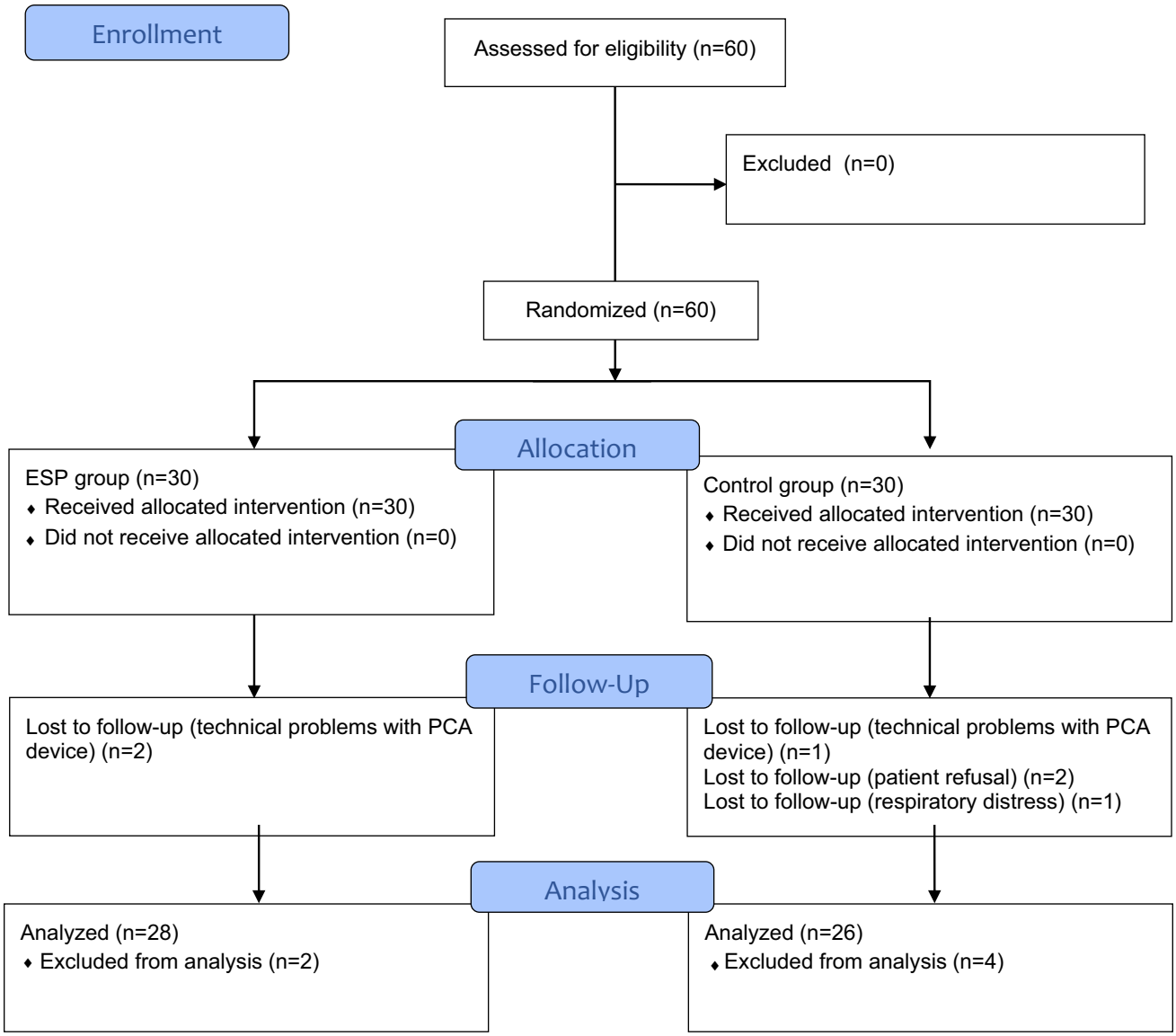


**Fig. 2** Consort flow diagram

**Table 1** Demographic data

| | ESP group ($n=28$) | Control group ($n=26$) | $P$ |
|---|---|---|---|
| Age (year) | 49.8 ± 11.3 | 47.6 ± 10.8 | 0.612 |
| Weight (kg) | 79 ± 14.1 | 79.5 ± 1 2.3 | 0.425 |
| Height (cm) | 170.2 ± 8.7 | 170.2 ± 8.2 | 0.772 |
| ASA status (I/II) | 13/15 | 9/17 | 0.130 |
| Duration of surgery (min) | 140.3 ± 31 | 135.3 ± 30.3 | 0.725 |

Data are presented as mean ± SD and patient numbers

studies that showed the effectiveness of the ESP block at lumbar levels [9, 10].

Among many regional anesthesia techniques, the ESP block has gained popularity in a short time. Three complications of ESP block have been reported. One of these was pneumothorax and the second was motor weakness [11, 12]. Both blocks were performed at thoracic levels. The third complication was priapism following lumbar ESP block at L4 level [13]. In this case, 30 mL of bupivacaine

**Table 2** Morphine consumptions and NRS scores at the postoperative 1st, 6th, 12th, 24th hour and postoperative nausea and vomiting incidences

| | ESP group ($n=28$) | Control group ($n=26$) | $P$ |
|---|---|---|---|
| Morphine consumtpions (mg) | | | |
| 1st hour | 1.2 ± 0.9 | 1.1 ± 1.2 | 0.070 |
| 6th hour | 5.4 ± 4 | 9.8 ± 6.6 | **0.018*** |
| 12th hour | 8.1 ± 6.8 | 16.3 ± 11.6 | **0.002*** |
| 24th hour | 11.3 ± 9.5 | 27 ± 16.7 | **< 0.001*** |
| NRS scores | | | |
| 1st hour | 3.6 ± 2 .6 | 3.5 ± 2.5 | 0.501 |
| 6th hour | 1.71 ± 1.3 | 1.5 ± 1.4 | 0.424 |
| 12th hour | 1.2 ± 1.2 | 1.2 ± 1.2 | 0.452 |
| 24th hour | 1.1 ± 1.2 | 1.5 ± 1.7 | 0.205 |
| Rescue analgesic administration (number of patients) | 5 | 14 | **0.006*** |
| Postoperative nausea (number of patients) | 3 | 10 | **0.019*** |
| Postoperative vomiting (number of patients) | 1 | 3 | 0.270 |

Data are presented as mean ± SD and patient numbers

*$p < 0.05$

0.5% and lidocaine 2% mixture was used. In our study, no complications were observed due to the ESP block.

To perform the ESP block, local anesthetic is injected into the interfacial plane between the transverse process of the vertebra and the erector spinae muscle. The mechanism of action is still not clearly understood. There are few studies that investigate the spread of drug in lumbar ESP block, and an accepted predictable spread cannot be suggested [14]. In a recent cadaveric study, ESP block was performed with 20 mL of drug at L4, and there was cephalocaudal spread from L3 to L5. There was no dye spread anteriorly into the dorsal root ganglion, ventral rami, or paravertebral space. However, there was spread to dorsal rami in all specimens [15]. Chung et al. [16] performed ESP block using a 20 mL mixture in a case with lower extremity complex regional pain syndrome. In this case, fluoroscopic imaging demonstrated spread to L2-S1 levels. Therefore, lumbar ESP block was expected to provide effective analgesia in microdiscectomy when applied at relevant level.

Transverse process of the thoracic vertebra ends at 2–3 cm lateral. However, the transverse process of the lumbar vertebra may reach up to 4–6 cm laterally. In some of the patients, we performed ESP block more laterally than at 3 cm from the midline due to this anatomical difference. In addition, the erector spinae muscle is thicker in the lumbar region and its effect on local anesthetic distribution is unclear compared with thoracic ESP blocks.

ESP block is performed to provide postoperative analgesia for various procedures [17], mostly in thoracic or upper abdominal surgeries, in which the ESP block is performed in the thoracic region. However, in pediatric patients, it has been reported that lumbar ESP provides effective postoperative analgesia [18]. Nevertheless, the anatomy of structures in pediatric patients may be different from that in adults. Pediatric patients have thinner muscle layers, loose connective tissues and sliding facial planes [18]. Therefore, the distribution could vary from the adults.

Recently, successful use of the ESP block at the lumbar region has been reported in numerous studies, such as in a hip arthroplasty case in which the block was performed at the L4 level [19]. Cesur et al. [9] reported effective postoperative analgesia with lumbar ESP in lumbar spine surgeries. Similarly, in a randomized controlled trial in 40 patients who underwent lumbar spine surgery, Singh et al. [10] showed that bilateral lumbar ESP block for postoperative analgesia reduced morphine consumption with improved patient satisfaction. Lumbar spine fusion surgery is expected to be more painful than discectomy operations. We aimed to reduce the use of postoperative opioids with ESP block. In addition, in this study, 20 mL of 0.5% bupivacaine was used on each side. In our study, we used a lower concentration of bupivacaine to avoid motor block, and our results were consistent with these reports.

We found that the incidence of postoperative nausea was significantly lower in the ESP group than in the control group. This difference could be explained by the decreased opioid consumption in the ESP group. Along with improved analgesia, reducing postoperative nausea and vomiting is one of the main goals of enhanced recovery after surgery protocols [20].

As a limitation, to determine the dermatomal distribution of the blocks, sensory testing could be done. It would be better to specify the limits of the dermatomes blocked, for further investigations of the lumbar ESP block. However, determining the dermatomes would cause a potential bias. Ethically, it would not be possible to test dermatomes in the

control group patients, since saline was used, and our study would not be double-blinded if we determined dermatomes in only the ESP group patients.

NRS scores were similar between the groups. All the patients received a multimodal analgesia regimen. However, morphine consumption was significantly higher and more patients were administered rescue analgesics in the control group. Performing ESP block reduced opioid consumption.

In conclusion, the main finding of this study was that the lumbar ESP block provided effective postoperative analgesia in patients who underwent lumbar discectomy surgeries.

**Funding** None.

## Declarations

**Assistance with the article** None.

**Conflict of interest** The authors declare that they have no competing interest.

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