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RESEARCH ARTICLE

Comparison of Lumbar Erector Spinae Plane Block and Modified Thoracolumbar Interfascial Plane Block in Single Level Lumbar Discectomy

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ABSTRACT

Objective: Lumbar disc herniation significantly impacts daily life, affecting 2-3% of the population. This condition is a major cause of low back pain, leading to motor weakness and acute pain. While most cases are treated non-surgically, 15% require surgery. Postoperative pain management is crucial, and recent advancements in regional anesthesia have introduced blocks like the Erector Spinae Plane (ESP) block and Modified Thoracolumbar Interfascial Plane (m-TLIP) block. This study compares the analgesic efficacy of these blocks in single-level lumbar discectomy.

Materials and Methods: This study included 52 patients who underwent lumbar discectomy between March 2021 and March 2022 at Istanbul Health Science University Kanuni Sultan Suleyman Hospital. Patients were randomized to receive either the ESP or m-TLIP block. General anesthesia was administered, and blocks were performed preoperatively. Visual Analogue Scale (VAS) scores were recorded postoperatively at 15 minutes, 4 hours, and 12 hours. Statistical analyses were conducted using IBM® SPSS® 20 and GraphPad 8.3.0 software.

Results: No significant difference was found in VAS scores between the ESP and m-TLIP blocks at any time point ($p>0.05$). Both blocks showed low pain scores and reduced opioid consumption. No patients experienced postoperative nausea and vomiting (PONV).

Conclusion: Both ESP and m-TLIP blocks effectively reduce postoperative pain and opioid consumption in lumbar discectomy patients, providing similar analgesic efficacy. These blocks can be safely used as part of multimodal analgesia strategies for postoperative pain management. Further studies are needed to evaluate long-term outcomes and patient satisfaction.

Keywords: ESP block, m-TLIP block, pain, regional anesthesia, spinal surgery

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INTRODUCTION

Lumbar disc herniation is a disease that affects the daily lives of many people worldwide. An average of 2–3% of the population is affected by lumbar disc herniation.[1] Lumbar disc herniation occurs with herniation of the nucleus pulposus due to increased tension in the annulus fibrosus of the lumbar vertebrae.

Lumbar disc herniation is one of the major causes of low back pain.[2] Lumbar disc herniation may lead to loss of motor weakness and acute pain.[3] Surgical methods are applied in approximately 15% of lumbar disc herniations which are mostly treated with non-surgical methods.[4]

Pharmacologic analgesia methods are commonly used in this surgery. Non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol and opioids are frequently used pharmacologic methods for this purpose.[5]

In recent years, with the development of regional anesthesia, various peripheral block applications have been used to provide postoperative analgesia for lumbar disc herniation repair.

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Especially with the introduction of ultrasonography (USG) into the daily life of anesthesiologists, rapid developments in regional anesthesia have contributed significantly to the minimization of postoperative pain.

Although there have been significant improvements in postoperative pain management with the introduction of new blocks into daily practice, more randomized controlled studies are needed to determine the mechanisms of action, indications, complications and contraindications of these blocks.

In this study, we investigated the efficacy of Erector Spinae Plane (ESP) block and Modified Thoracolumbar Interfascial Plane (m-TLIP) blocks, which are used in addition to pharmacological agents within the scope of multimodal analgesia to provide postoperative pain management in lumbar disc herniation (LDH) repair. We aimed to compare the analgesic efficacy of m-TLIP and ESP blocks by collecting Visual Analogue Scale (VAS) scores at 12-hour follow-up.

MATERIALS and METHODS

A total of 52 patients who underwent lumbar disc herniation surgery between March 2021 and March 2022 were included in this study. Ethical approval for this study was granted by an Ethical Committee. Randomization of the blocks was made via a computer application. Written informed consent was obtained from all patients and all procedures performed on patients were in line with the Helsinki Declaration 2013.

The sample size was calculated using a power analysis, with an effect size and power of 0.8. Considering similar studies in the literature, it was determined that the study would have sufficient sample size for the primary outcomes with 26 patients in each group.

Inclusion criteria for this study were:

- 18–75 years old patients who have undergone single-level lumbar disc herniation,
- American Society of Anesthesiolgy (ASA) score I-II patients,
- Patients with normal bleeding diathesis,
- Patients without any disease such as diabetes mellitus (DM) that may cause neuropathic problems.

Patients with diseases such as DM that may cause neuropathic problems were excluded from the study, as it was anticipated that possible neuropathy could alter pain perception and result in differences in pain scores, which might affect the outcomes. Coagulation disorders, patients with ASA III or higher scores, patients' age out of range 18–75 years old and patients who didn't give consent to perform blocks were excluded from the study.

Four patients were excluded from the study due to a diagnosis of DM, which led to their ostracization, while another patient was excluded for reporting excessively high VAS scores, considered as unsuccessful block (Fig. 1).

General Anesthesia

Routine monitoring methods SpO_2 by pulse oximetry, electrocardiography and noninvasive blood pressure measurements were performed. In all patients under general anesthesia after vascular access was provided, induction was started. Routine induction of general anesthesia was given with 0.03 mg/kg midazolam, 1–2 mcg/kg fentanyl, 2–3 mg/kg propofol and 0.6 mg/kg rocuronium and all patients were intubated orotracheally. For maintenance of anesthesia, 3 l/min 40% O_2-air mixture, 2% sevoflurane and 0.05 mcg/kg/min remifentanil infusions were started. Patients were then placed in prone position.

Block Applications

In all patients, USG (Esaotemylab) (linear (8–12 MHz) probe was used for both blocks. The block was performed in the prone position before the patients were awakened. The blocks were performed at the level of lumbar 2 vertebrae. In patients undergoing lumbar ESP, after the ultrasound (USG) linear probe was placed sagittal, the transverse processes were tried to be visualized by shifting approximately 2 cm from the midline to lateral. After the transverse processes were visualized, Braun brand 80–100 mm block needles were used with an in-plane approach and the needle was directed towards the transverse process. After confirming the location with saline, local anesthetics were given at concentrations of 1.5 mg/kg bupivacaine (0.25%) and 1.5 mg/kg lidocaine (0.25%) (Fig. 2).

When m-TLIP is performed, a linear USG probe is placed transverse to the medial line at the level of lumbar 2 vertebrae. After visualizing the spinous process, the probe is shifted laterally. After visualizing the longissimus muscle and iliocostalis muscles, a Braun brand 50 mm block needle was inserted into the fascia between the two muscles with an in-plane approach and the needle was advanced towards the fascia. When the fascia was reached, we confirmed the location with saline. After the confirmation, the patients were given local anesthetics at concentrations of 1.5 mg/kg bupivacaine (0.25%) and 1.5 mg/kg lidocaine (0.25%) (Fig. 3).

The blocks were performed bilaterally, and both drugs were drawn into the same syringe. A total maximum volume of 40 ml was planned for administration.

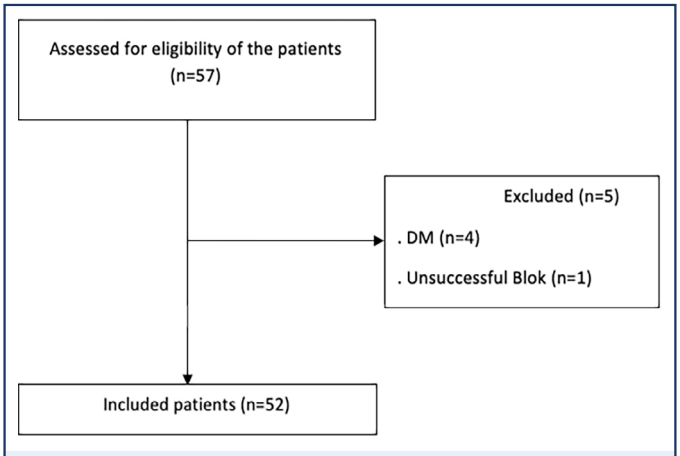

Figure 1. Flow diagram of patient population
DM: Diabetes mellitus

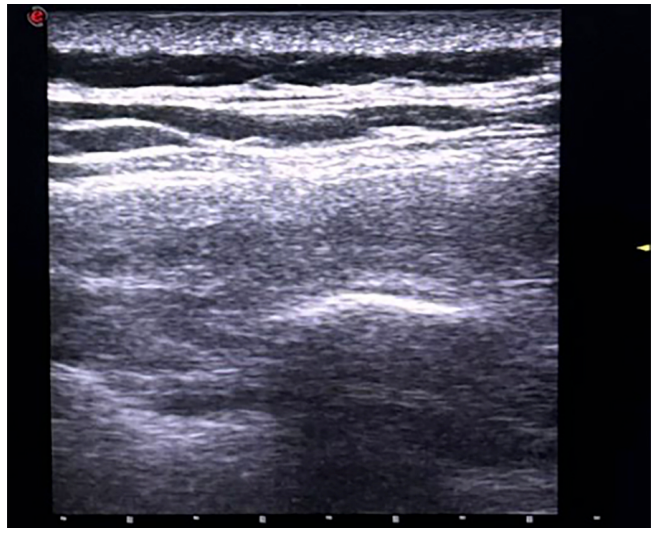

Figure 2. ESPB, transverse process visualization
ESPB: Erector spina plane block

Routine Analgesic Procedures

Patients in both groups received intravenous 1 mg/kg paracetamol and 1 mg/kg tramadol as part of multimodal analgesia. In patients with a VAS score of 4 and above, the block was considered inadequate and rescue analgesia was administered (1 g intravenous Paracetamol).

Follow Up

After the patient was awakened, the VAS score was questioned and drawn on paper after the patient regained consciousness. Similarly, VAS scores were questioned at 15th minute, 4th hour and 12th hour postoperatively. Nausea, vomiting, hypotension, bradycardia and pruritus were questioned as possible complications. Only the patients were blinded to which block was performed on them; no other blinding was applied. The person collecting the data was the same individual who performed the blocks.

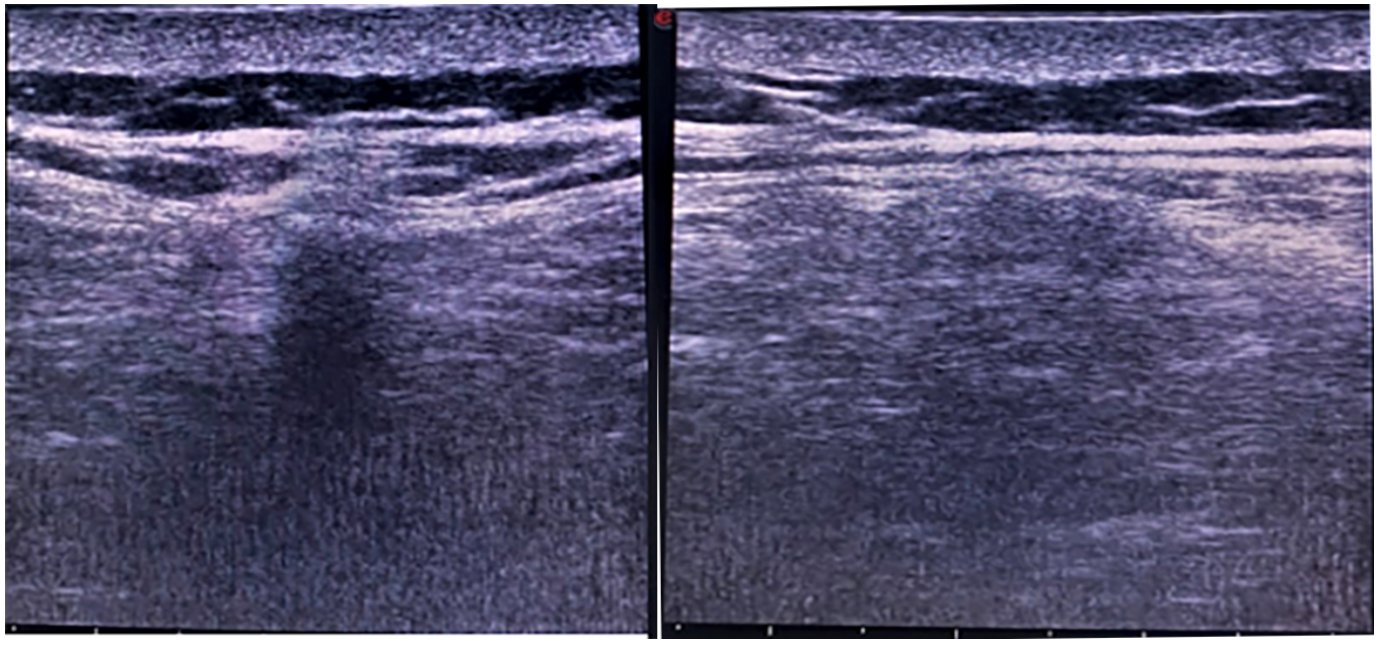

Figure 3. Spinous process, longissimus and iliocostalis muscles

Table 1. Comparison of patients' VAS scores according to the block performed

	ESP		m-TLIP		
	Mean±SD	Maximum	Mean±SD	Maximum	p
Postoperative	2.15±1.26	6	2.23±1.45	6	0.97
15th minutes	1.5±0.76	4	2.12±1.4	5	0.16
4th hours	1.38±0.5	2	1.65±1.06	4	0.79
12th hours	1.35±0.36	3	1.38±0.75	4	0.85
Age	50.81±13.5		53.58±14.7		0.44
Tramadol consumption in 24 hours, n (%)	5 (19)		3 (12)		0.44
Onset of pain	21.08				

Mann Whitney U test was applied. p<0.05 was considered statistically significant. VAS: Visual analogue scale; ESP: Erector Spina Plane block; m-TLIP: Modified Thoracolumbar Interfascial Plane block; SD: Standart deviation

Statistical Analysis

Statistical analyses were performed with IBM® SPSS® 20 (SPSS Inc., Chicago, IL, USA) and GraphPad 8.3.0 software. Descriptive analyses were expressed as mean±standard deviation and percentage. Descriptive statistics of categorical variables obtained from sociodemographic and clinical data were analyzed using frequency and percentage values. Kruskal-Wallis test was used to determine homogeneity across groups for non-parametric data. The distribution of VAS scores according to block types, onset of pain and need for additional dose analgesia were analyzed using the Mann-Whitney U test for pairwise comparisons because of non-parametric distribution. Independent sample t test was used to compare onset of pain and opioid consumption between the groups. p-values below 0.05 were considered statistically significant.

RESULTS

In terms of gender, there were the same number of patients in both blocks, but there were some differences in the number of comorbidities.

Male: Female ratio was 0.73:1 for both blocks. When the comorbid chronic diseases were evaluated between both groups, the patient group without any comorbidity constituted the majority in both groups. In the ESP block group, 65.4% of the patients (17 patients) were not accompanied by any chronic disease, whereas in the m-TLIP block group, 50% of the patients (13 patients) were not accompanied by any disease.

When the mean age of the patients in both groups was evaluated, the mean age was 50.81±13.5 years in the ESP block group and 53.58±14.7 years in the m-TLIP block group. Independent samples t test performed between both groups. p=0.48 and there was no statistically significant difference between the two groups in terms of age (Table 1).

Table 1 shows the comparison of VAS scores of the patients according to the type of block performed. In this comparison, VAS scores did not show statistically significant difference between block types in all time periods.

In the Mann-Whitney U test, no significant difference was found between the two groups in the VAS scores questioned in the postoperative period (p=0.97). There was no significant difference between the two groups in the VAS scores questioned at 15 minutes in the postoperative period (p=0.16). There was no significant difference between the VAS scores questioned at 4 hours in the postoperative period between the two groups (p=0.79). There was no significant difference between the VAS scores questioned at 12 hours in the postoperative period between the two groups (p=0.85).

Mean onset of pain was calculated as 21.08 hours in the ESP block group and 22.81 hours in the m-TLIP block group. When the onset of pain was compared according to the block types, the p-value was found to be 0.15. According to these results, there was no statistically significant difference in the onset of pain.

There was no statistically significant difference in the need for additional analgesics when the two groups were compared according to the block type (p=0.44). The need for additional analgesia was present in 5 patients (19%) in the ESP group and in 3 patients (12%) in the m-TLIP block group.

DISCUSSION

ESP block is a relatively new approach to pain management for surgical procedures.[6] This block, which has applications in chronic pain as well as acute pain, was found by Forero et al.[7] to be used in the treatment of thoracic neuropathic pain in which oral and topical pharmacotherapeutic approaches did not produce adequate response.

ESP block can be administered as a single injection (single shot) as well as continuous infusion and intermittent bolus doses by placing a catheter.[8] Initially identified for use in the thoracic region, this block can also be applied in the lumbar region. Although this technique was first used by Forero et al.[7] for metastatic disease of the costae and secondly for multiple costal fractures,[6] it has become a frequently used method to provide analgesia for many surgical procedures.

ESP block is one of the block techniques in which in-plane USG technique is mostly used and it is a paraspinal fascial plan block. Both the dorsal ramus and ventral ramus of the thoracic and abdominal spinal nerves are blocked. Cadaveric studies have even shown that this block can stain all epidural spaces with the given dye.[9] Thus, the success of ESP block in eliminating visceral pain along with somatic pain can be explained.

TLIP block was first described by Hand et al.[10] in 2015. Hand et al. first performed TLIP block by injecting local anesthetic into the fascia between the multifidus muscle and longissimus muscles at the level of the 3rd lumbar vertebra.

In 2017, Ahıskalıoğlu et al.[11] injected local anesthetic into the fascia between the longissimus muscle and the iliocostalis muscle, which is located more laterally. It was reported in a randomized clinical study that it was easier to identify the muscles in this block located more laterally. This block, which can be performed in the dorsal region, has limited indications for fascial plane blocks and there are limited number of studies and case reports on these blocks. Anatomically, the multifidus, longissimus and iliocostalis muscles, which are among the Erector Spina muscle groups, and the fascia between these muscles are targeted.

When both blocks were compared, Çiftçi and Ekinci[12] showed that the block duration was significantly shorter in m-TLIP block compared to TLIP block.

Studies have shown that this block, which has been shown to be effective as an anesthetic in 2 or 3 level lumbar disc surgeries, also reduces opioid consumption.[13] Again, according to Ahıskalıoğlu et al.[11] it is possible to avoid dural puncture by applying the block from medial to lateral direction.

In cadaveric studies, the spread of the block has been tried to be shown and may show differences. Nevertheless, it is stated that local anesthetic spread is limited to dorsal nerve roots and ventral nerve roots cannot be blocked.[14] In the same cadaveric study, 10 ml of blue dye was given at the level of the 3rd lumbar vertebra and it was shown that the dye spread between the 1st and 4th vertebrae. Thus, similar to the ESP block, the m-TLIP block was reported to show craniocaudal spread. m-TLIP block is limited to the lumbar region in terms of application. This is due to the anatomical features of the longissimus muscles and iliocostalis muscles. The iliocostalis, longissimus and spinalis muscles form the erector spinae muscle group. The iliocostalis muscle is located laterally, the longissimus muscle in the middle and the spinalis muscle in the most medial position, respectively.

ESP block has been reported to show similar effects to epidural block when performed under USG guidance.[7] In addition, this block can be performed more easily from an area farther away from the surgical site.

In a study of ESP block, it was reported that block at the L2 level provided adequate analgesia in low back pain.[15] In another retrospective study, postoperative pain scores were found to be lower in lumbar surgeries with ESP block.[14]

In a case series by Melvin et al.,[16] ESP block performed from the lower thoracic regions was found to be an effective method to provide postoperative analgesia in lumbosacral spinal surgeries. A study by Zhang et al.[17] showed that bilateral ESP block application was effective in providing postoperative analgesia in posterior lumbar surgeries.

In addition to low pain scores, the absence of symptoms such as depression, nausea, vomiting and constipation provides faster recovery in patients. Available data have shown that ESP block has the effect of reducing postoperative opioid use.

At the same time, approximately 70% of patients undergoing major spinal surgery require preoperative opioid use for pain relief. Preoperative opioid use and lack of adequate pain management may lead to misuse and abuse of opioids in the postoperative period.[18]

In another randomized controlled study Singh et al.[19] revealed that lower pain scores, less morphine consumption and better patient satisfaction were obtained in patients who underwent ESP block compared with standard opioid-dominant analgesia methods.

In a meta-analysis, the efficacy of ESP block for postoperative nausea and vomiting (PONV) was evaluated. ESP block was found to be more effective than other analgesia methods in terms of PONV.[20]

In a meta-analysis of randomized controlled trials conducted by Oh et al.,[21] ESP block was reported to be an effective analgesic method in terms of patient satisfaction, pain scores and nausea and vomiting.

Our data suggest that ESP block performed within the scope of multimodal analgesia in patients undergoing lumbar disc

herniation repair is highly effective in reducing pain scores, the block can be applied safely, and the frequency of nausea and vomiting is extremely low. Again, in accordance with other data, it shows that there is a decrease in opioid consumption up to 24 hours, and even in our study, opioid use was severely limited and opioid-free analgesia was provided in the vast majority of patients. When evaluated in terms of nausea and vomiting, nausea and vomiting were not observed in any of our patients. No hemodynamic deterioration was observed in any patient. In the light of these data, we think that ESP block is a safe method.

In a case series presentation by Xu et al.,[22] it was shown that bilateral application of 20 ml of m-TLIP block bilaterally provided effective analgesia for up to 48 hours at rest and up to 24 hours in motion. In a randomized controlled study by Çiftçi et al.[23] the efficacy of m-TLIP block was compared with ESP block in 90 patients undergoing lumbar discectomy surgery and it was observed that both provided adequate analgesia but had similar effects. In a randomized controlled study by Ahıskalıoğlu et al.,[24] VAS scores were found to be significantly lower in the m-TLIP block compared with the control group, and PONV was significantly higher in the control group. In this study, in which the patient-controlled analgesia (PCA) method was also used, fentanyl consumption in the first 24 hours was found to be significantly lower in the m-TLIP block.

In addition to posterior surgeries, m-TLIP block was also used in surgical procedures such as inguinal hernia and was found to be analgesically successful.[25] In this case series, the efficacy of m-TLIP block applied postoperatively in 4 inguinal hernia patients in whom open methods were used is mentioned.

In a study by Pavithran et al.[26] m-TLIP block was compared with wound site infiltration analgesia and m-TLIP block was associated with lower VAS score and lower opioid use at 48-hour follow-up.

Similar to the data obtained in these studies, our results showed low pain scores in the first 24 hours. It was observed that the analgesic effect lasted up to 24 hours in the majority of patients, similar to the data in other studies. Similar to ESP block, the need for opioids was found to be very low and even opioid-free analgesia could be achieved in many cases. We believe that this block, which is also very effective in terms of PONV, can be safely applied. Especially in obese patients and patients in whom transverse processes cannot be visualized sufficiently, we evaluated it as an easier technique compared to ESP block because it is both superficial and easy to visualize.

Rescue analgesia was performed when the VAS score was 4 and above. No statistically significant difference was observed in VAS scores between the two blocks at all times, while no difference was observed in terms of PONV in both blocks. PONV was not observed in any patient. We believe that the single-level lumbar surgery and the low operation time also contributed to this situation.

Limitations

Firstly, the limited sample size could diminish the power of certain statistical analyses. Although power analysis was utilized in determining the sample size, a larger sample could have been more sensitive in detecting potential differences between the ESP and m-TLIP blocks. This is particularly relevant in the context of identifying rare side effects or evaluating different levels of analgesic efficacy in subpopulations.

Secondly, although the study design is a randomized controlled trial with measures taken to ensure procedural consistency between both groups, complete blinding was not feasible due to the nature of the block applications. This could be a source of bias in the evaluation of subjective outcome measures, especially pain scores.

Lastly, the implications of our study's results for clinical practice are focused solely on short-term postoperative pain and analgesia requirements. Long-term outcomes, patient satisfaction, functional recovery, and the development of chronic pain were not addressed in this research. Considering these factors could be significant, especially for patients undergoing lumbar disc surgery, future studies incorporating these aspects would be beneficial.

Not only does this equivalence in analgesic efficacy suggest that both blocks can be effectively used in clinical practice for pain management following lumbar discectomy surgery, but it also indicates a potential for flexibility in anesthetic choice based on the practitioner's expertise, the patient's anatomical considerations, and equipment availability.

CONCLUSION

In conclusion, the lack of significant differences between the two blocks highlights important considerations about their mechanisms of action and regional variation in analgesic distribution. While the ESP block may provide a wider craniocaudal spread, offering broader pain coverage, the more localized m-TLIP block might be preferable for targeted pain relief. The similar analgesic outcomes suggest that both blocks, when incorporated into a multimodal analgesia approach, could reduce opioid use and enhance postoperative recovery, aligning with current pain management guidelines.

Disclosures

Ethics Committee Approval: The study was approved by the Kanuni Sultan Süleyman Training and Research Hospital Clinical Research Ethics Committee (No: 2022.08.185, Date: 11/08/2022).

Authorship Contributions: Concept: E.İ.T, S.Ç., S.K.K., E.K., S.I., A.S.Ş.; Design: E.İ.T, S.Ç., S.K.K., E.K., S.I., A.S.Ş.; Supervision: E.İ.T, S.Ç., S.K.K., S.I., A.S.Ş.; Materials: E.İ.T, S.Ç., S.K.K., S.I., A.S.Ş.; Data Collection or Processing: E.İ.T, S.Ç., S.K.K., S.I., A.S.Ş.; Analysis or Interpretation: E.İ.T, S.Ç., S.K.K., S.I., A.S.Ş.; Literature Search: E.İ.T, E.K.; Writing: E.İ.T, E.K.; Critical review: E.İ.T, E.K.

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Informed Consent: Written informed consent was obtained from all patients.

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