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Erector spinae plane block for postoperative analgesia in total hip arthroplasty: A randomized-controlled trial

Total kalça artroplastisinde postoperatif analjezi için erektör spina plan bloku: Randomize kontrollü bir çalışma

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ABSTRACT

Background: This study aims to assess the efficacy of erector spinae plane block (ESPB) for postoperative analgesia in patients undergoing total hip arthroplasty (THA) under spinal anesthesia.

Patients and Methods: In this randomized-controlled trial, a total of 30 patients (American Society of Anesthesiologists Class I-III, 20 to 65 years) who underwent elective unilateral THA under spinal anesthesia were included between January 2023 and December 2023. The patients were randomized either to Group E (n = 15) to receive ultrasound-guided lumbar ESPB with 40 mL of 0.25% bupivacaine in addition to spinal anesthesia (2.5 mL of 0.5% hyperbaric bupivacaine with 10 µg of fentanyl), or Group C (n = 15) who received spinal anesthesia alone. Primary outcomes were duration of analgesia and Visual Analog Scale (VAS) scores at 6 h. Secondary outcomes included VAS scores at 0, 0.5, 2, 4, 12, 24 h and total additional analgesic requirement in the first 24 h.

Results: Of a total of 30 patients included in the study, 22 were male and 8 were female with a mean age of 36.86 ± 13.24 (range, 18 to 65) years. The duration of analgesia was significantly longer in group E (10.76 ± 1.96 h ***vs.*** 4.18 ± 1.36 h; $p < 0.01$). The VAS scores were lower in group E at 0.5 h ($p = 0.009$), 2 h ($p < 0.001$), 4 h ($p < 0.001$), 6 h ($p < 0.001$), and 12 h ($p = 0.02$). Additional analgesic requirement during the first 24 h was higher in Group C. Surgeon and patient satisfaction scores significantly improved in Group E. No hemodynamic instability or motor weakness was observed.

Conclusion: Lumbar ESPB with 40 mL of 0.25% bupivacaine significantly prolongs postoperative analgesia and reduces pain scores and analgesic consumption in patients undergoing THA under spinal anesthesia. Based on these findings, lumbar ESPB may provide effective and safe adjunctive analgesia in this patient population.

Keywords: Erector spinae plane block, pain score, postoperative analgesia. total hip replacement.

ÖZ

Amaç: Bu çalışmada, spinal anestezi altında total kalça artroplastisi (TKA) uygulanan hastalarda postoperatif analjezi için erektör spina plan blokunun (ESPB) etkinliği değerlendirildi.

Hastalar ve Yöntemler: Bu randomize kontrollü çalışmaya, Ocak 2023-Aralık 2023 tarihleri arasında spinal anestezi altında elektif unilateral TKA uygulanan (Amerikan Anesteziyoloji Derneği Sınıf I-III, 20 ila 65 yaş) toplam 30 hasta dahil edildi. Hastalar Grup E (n = 15), spinal anesteziye ek olarak 40 mL %0.25 bupivakain ile ultrason eşliğinde lomber ESPB uygulanacak şekilde ve Grup C (n = 15), yalnızca spinal anestezi alacak şekilde randomize edildi (spinal anestezi 2,5 mL %0.5 hiperbarik bupivakain ve 10 µg fentanil). Primer sonuçlar analjezi süresi ve 6. saat Görsel Analog Ölçeği (VAS) skorları idi. Sekonder sonuçlar 0, 0,5, 2, 4, 12 ve 24. saat VAS skorları ile ilk 24 saatteki toplam ek analjezik gereksinimi idi.

Bulgular: Çalışmaya dahil edilen 30 hastanın 22'si erkek, 8'si kadın olup, ortalama yaş 36.86 ± 13.24 (dağılım, 18-65) yıl idi. Analjezi süresi Grup E'de anlamlı olarak daha uzundu (10.76 ± 1.96 saate kıyasla 4.18 ± 1.36 saat; $p < 0.01$). VAS skorları Grup E'de 0.5. saat ($p = 0.009$), 2. saat ($p < 0.001$), 4. saat ($p < 0.001$), 6. saat ($p < 0.001$) ve 12. saatte ($p = 0.02$) daha düşük bulundu. İlk 24 saatte ek analjezik ihtiyacı Grup C'de daha yüksekti. Cerrah ve hasta memnuniyet skorları Grup E'de anlamlı olarak daha yüksekti. Hemodinamik instabilite veya motor blok izlenmedi.

Sonuç: Lomber ESPB, 40 mL %0.25 bupivakain ile uygulandığında, spinal anestezi altında TKA geçiren hastalarda postoperatif analjezi süresini anlamlı olarak uzatmakta, ağrı skorlarını ve analjezik tüketimini azaltmaktadır. Bu bulgulara göre lomber ESPB, bu hasta grubunda etkili ve güvenli bir adjuvan analjezi yöntemi olabilir.

Anahtar sözcükler: Erektör spina plan bloku, ağrı skoru, postoperatif analjezi, total kalça protezi.

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Total hip arthroplasty (THA) is commonly performed for the management of advanced hip osteoarthritis and other debilitating hip pathologies. Adequate postoperative analgesia following THA is essential to facilitate early mobilization, enhance functional recovery, and improve patient satisfaction. Inadequate pain control may result in delayed ambulation, increasing the risk of venous thromboembolism, pulmonary complications, sympathetic overactivity leading to myocardial ischemia, impaired wound healing, prolonged hospital stay, and other adverse outcomes.[1,2]

The hip joint has complex sensory innervation derived primarily from the femoral, obturator, sciatic, and superior gluteal nerves. Owing to this intricate neural supply, no single analgesic modality has been shown to provide consistently optimal pain relief following THA. Although opioids remain widely used for postoperative analgesia, their use is associated with well-recognized adverse effects such as respiratory depression, sedation, nausea and vomiting, urinary retention, constipation, and potential long-term dependence.[3] Epidural analgesia provides effective pain control but may be limited by side effects including hypotension, motor blockade, bladder dysfunction, and delayed ambulation.[4]

Multimodal analgesia combined with regional anesthesia techniques is currently considered the standard of care for major orthopedic procedures. An ideal regional anesthetic technique for THA should be reliable, effective, technically simple, and safe, while preserving lower limb motor function. Various techniques have been described, including local infiltration analgesia, fascia iliaca block, femoral nerve block, lumbar plexus block, and quadratus lumborum block. Although these approaches can provide satisfactory postoperative analgesia, they may result in quadriceps muscle weakness, potentially delaying early mobilization.[4,5] Furthermore, the lumbar plexus block is technically demanding and performed at significant depth in close proximity to the neuraxial structures.[4] Local infiltration analgesia, while simple and relatively safe, may offer only limited duration and variable quality of analgesia.[1]

The erector spinae plane block (ESPB) is a relatively novel interfascial plane block which provides multi-segmental analgesia at cervical, thoracic, and lumbar levels.[6,7] It is performed under ultrasound guidance using easily identifiable anatomical landmarks and is considered to have a favorable safety profile.[7] The ESPB has been successfully employed for acute and chronic pain management, as well as postoperative analgesia following thoracic and upper abdominal surgeries.[8-11] More recently, its application has been extended to lumbar levels for analgesia in lumbar spine and hip surgeries.[12-15] Cadaveric and imaging studies have demonstrated diffusion of local anesthetic to the intervertebral foramina and lumbar nerve roots following injection at the L4 level, suggesting a plausible mechanism for analgesia in hip surgery.[16]

The ESPB has been included among the seven "Plan A" blocks proposed by Regional Anaesthesia UK, representing core regional anesthesia techniques for common surgical procedures.[17] Despite increasing clinical use, evidence supporting its role in upper and lower limb surgeries remains limited.[17] In general, THA is performed in elderly patients and in those with comorbidities in whom preservation of hemodynamic stability and early ambulation are particularly important. Unlike neuraxial techniques, it does not produce significant sympathetic blockade and is therefore less likely to cause hemodynamic instability. Additionally, it does not typically result in lower limb motor weakness, potentially facilitating early mobilization. Being a relatively superficial block,[17] it may also be advantageous in patients receiving anticoagulant or antithrombotic therapy, in whom neuraxial or deep plexus blocks may be contraindicated. Furthermore, neuraxial techniques may be technically challenging in elderly patients or those with spinal deformities such as ankylosing spondylitis.

A recent pilot study evaluating ultrasound-guided ESPB for postoperative analgesia in patients undergoing THA under spinal anesthesia demonstrated significantly reduced postoperative analgesic requirements during the first 24 h compared to controls.[18] Additionally, a recent meta-analysis reported that ESPB in hip surgery significantly decreased 24-h postoperative opioid consumption and reduced pain scores up to 9 h postoperatively.[19]

In the present study, we hypothesized that the addition of lumbar ESPB to spinal anesthesia would provide superior postoperative analgesia compared to spinal anesthesia alone in patients undergoing elective primary THA. We, therefore, aimed to evaluate the efficacy of lumbar ESPB for postoperative pain management in patients undergoing THA under subarachnoid block.

PATIENTS AND METHODS

This single-center, parallel-group, prospective, randomized-controlled study was conducted at Maulana Azad Medical College and Associated Hospitals, Department of Anaesthesiology & Intensive Care, between January 15th, 2023 and December 31st, 2023. Patients of the American Society of Anesthesiologists (ASA) Class I-III aged between 20 and 65 years of either sex, scheduled to undergo elective unilateral THA under spinal anesthesia were included in the study. Patients for revision or bilateral THA and with history of neuropsychiatric disorders, neuromuscular disease, long-standing diabetes mellitus, cardiac or neurological disease, kidney or liver failure, extreme BMI values, chronic pain, preoperative analgesic or opioid use, allergy to local anesthetics, and with contraindications for spinal anesthesia such as injection site infection, increased intracranial tension, spine pathology or surgery, coagulopathy and thrombocytopenia were excluded from the study. Of a total of 40 patients who were deemed eligible, four declined to participate and six did not meet the inclusion criteria. Finally, a total of 30 patients were recruited for the study. The study flowchart is shown in Figure 1. A written informed consent was obtained from each patient. The study protocol was approved by the Maulana Azad Medical College and Associated Hospitals Ethics Committee (Date: 29.08.2022, No. F.1/IEC/MAMC/MD/MS 92/04/2022/No 226). The study was conducted in accordance with the principles of the Declaration of Helsinki. The study was registered at Clinical Trials Registry of India with No: CTRI/2022/12/048103. This study adheres to the Consolidated Standards of Reporting Trials (CONSORT) guidelines for randomized-controlled trials.

Intervention

The patients were randomized in a 1:1 allocation ratio into two groups: Group E received ultrasound-guided ESPB in addition to spinal anesthesia (n = 15), and Group C received spinal anesthesia alone (n = 15).

Primary and secondary outcomes

The primary outcomes were duration of analgesia (time to first rescue analgesic request) and the Visual Analog Scale (VAS) pain score at 6 h postoperatively. Secondary outcomes included VAS scores at 0, 0.5, 2,

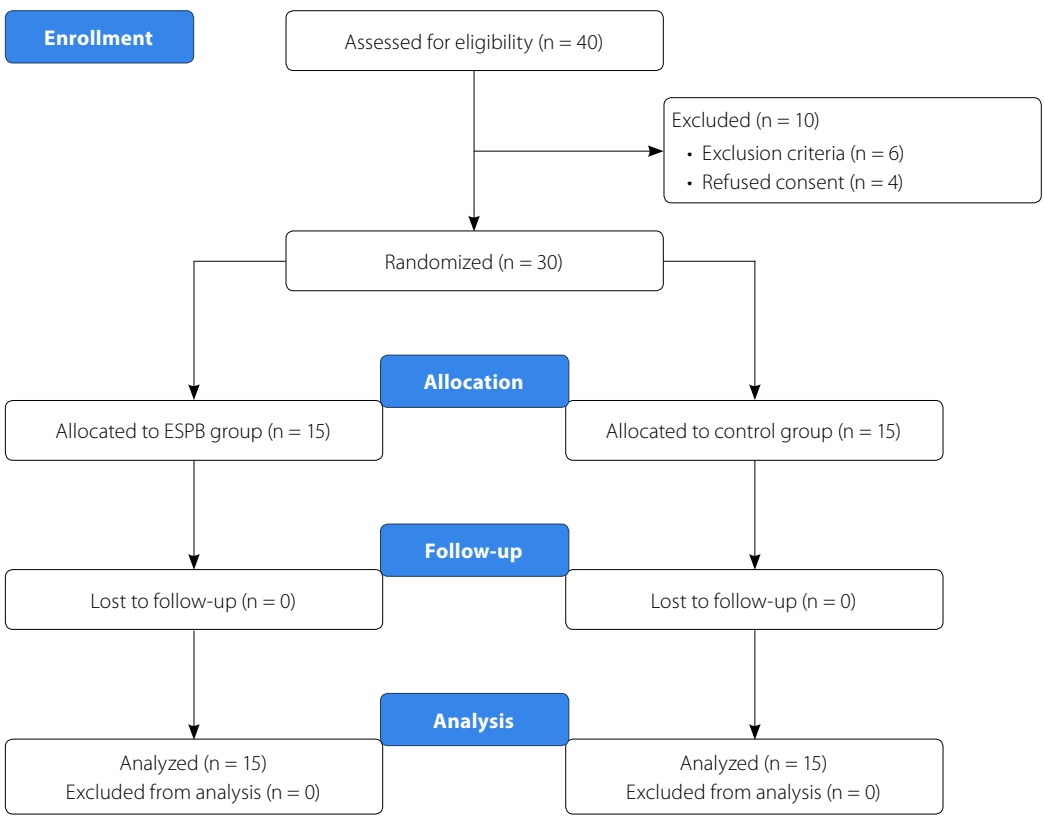

Figure 1. CONSORT flow diagram.
ESPB, Erector Spinae Plane Block.

4, 12, and 24 h and total rescue analgesic consumption within 24 h.

Randomization

The randomization sequence was generated using a computer-generated random number table. Allocation concealment was achieved using sequentially numbered, sealed, opaque envelopes prepared by an independent investigator. On the day of surgery, patients selected an envelope immediately before the procedure, and the assigned intervention was implemented accordingly.

Anesthesia technique

All patients underwent a detailed pre-anesthetic evaluation, including history and physical examination. They were instructed on the use of the VAS for pain assessment (0-10, where 0 represents no pain and 10 represents the worst imaginable pain).[20] Patients were kept fasting in accordance with the ASA guidelines and received oral alprazolam 0.25 mg the night before surgery and 2 h prior to the procedure. Upon arrival in the operating theatre, standard monitoring was instituted, including heart rate (HR), non-invasive blood pressure (NIBP), and peripheral oxygen saturation (SpO_2). Baseline values were recorded. An 18G intravenous cannula was secured, and patients were preloaded with lactated Ringer's solution at 5 to 7 mL/kg.

In Group E, the patients were positioned in the lateral decubitus position for performance of the ESPB. All blocks were performed by an anesthesiologist with prior experience of at least 10 ESPBs, under the supervision of a senior anesthesiologist. Under strict aseptic precautions, an ultrasound-guided ESPB was performed using an in-plane technique with a sterile-covered low-frequency (2 to 5 MHz) curvilinear probe (SonoSite M-Turbo; FUJIFILM SonoSite Inc., Bothell, WA, USA). The probe was placed at the level of the fourth lumbar vertebra (L4) on the operative side to identify the transverse process and overlying erector spinae muscle. A block needle was advanced in-plane until contact with the transverse process was made. After negative aspiration, 40 mL of 0.25% bupivacaine (not exceeding 2 mg/kg) was injected into the fascial plane between the erector spinae muscle and the transverse process, with real-time visualization of cranio-caudal spread of the local anesthetic. No adjuvants were added. Following ESPB, spinal anesthesia was administered at the L3-L4 or L4-L5 interspace in the same position using a 25G spinal needle via a midline approach. Hyperbaric 0.5% bupivacaine 2.5 mL (12.5 mg) with fentanyl 10 µg was injected intrathecally. As spinal anesthesia was administered immediately after ESPB, formal preoperative sensory assessment of block efficacy was not performed. Successful block placement was confirmed by ultrasound visualization of appropriate local anesthetic spread, and block efficacy was evaluated based on postoperative analgesic outcomes.

In Group C (control group), the patients received spinal anesthesia alone under strict aseptic precautions at the L3-L4 or L4-L5 interspace using a 25G spinal needle via a midline approach. Hyperbaric 0.5% bupivacaine 2.5 mL (12.5 mg) with fentanyl 10 µg was administered intrathecally. The patients were positioned supine immediately after spinal anesthesia. Once an adequate sensory level of subarachnoid block was achieved, patients in both groups were positioned for surgery and the procedure was commenced. All patients received intravenous dexamethasone 8 mg and supplemental oxygen via nasal prongs at 2 L/min intraoperatively.

Hemodynamic parameters including mean arterial pressure (MAP), systolic blood pressure (SBP), diastolic blood pressure (DBP), HR, and SpO_2 were recorded at baseline prior to spinal anesthesia (T0) and at 2, 5, 10, 20 min, and at regular intervals thereafter (T2, T5, T10, T20, etc.). In Group E, additional hemodynamic readings were recorded immediately before ESPB and 5 min after block placement. Total anesthesia time, defined as the time from application of monitors to positioning the patient supine following completion of spinal anesthesia, was documented. At the end of surgery, patients were transferred to the post-anesthesia care unit (PACU). All patients received intravenous paracetamol 1 g on arrival in the PACU and subsequently every 8 h for 24 h.

Postoperative monitoring

Postoperative pain was assessed using the VAS on arrival in the PACU (0 h), and at 30 min, 2, 4, 6, 12, and 24 h postoperatively. Intravenous diclofenac 75 mg was administered as rescue analgesia when the VAS score exceeded 3, and the time to first rescue analgesic request was recorded. Duration of analgesia was defined as the time from completion of the block to the first administration of rescue analgesia. If pain persisted despite diclofenac, intravenous tramadol 100 mg diluted in normal saline was administered as an infusion as second-line rescue analgesia. Intravenous ondansetron 4 mg was given

for associated nausea or vomiting, if present. Total rescue analgesic consumption during the first 24 h was recorded.

Motor strength on the operative side was assessed hourly until complete recovery using the Medical Research Council (MRC) scale for muscle strength.[21]

At 24 h postoperatively, surgeon and patient satisfaction were evaluated using a five-point verbal rating scale (1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent).[22] Surgeon satisfaction was based on overall intraoperative and postoperative conditions, whereas patient satisfaction reflected overall comfort during the first 24 h.

Adverse events including nerve injury, hematoma, local anesthetic systemic toxicity, inadvertent intravascular injection, postoperative nausea and vomiting (PONV), and hemodynamic instability were documented.

Statistical analysis

Based on the findings of Abdelnasser et al.,[18] and considering the VAS score at 6 h as the primary outcome variable, the calculated sample size was at least nine patients per group (power 80%, α = 0.05). When duration of analgesia was used as the primary outcome, the required sample size was two patients per group under the same assumptions. To account for potential attrition and to enhance the robustness of the analysis, we enrolled 15 patients in each group.

Statistical analysis was performed using the IBM SPSS version 25.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were presented in mean ± standard deviation (SD) or median (min-max), while categorical variables were presented in number and frequency. Normality of distribution was assessed using the Shapiro-Wilk test. The Student t-test or Mann-Whitney U test was used for between-group comparisons of continuous variables, as appropriate. The chi-square test or Fisher exact test was used to compare categorical variables. No adjustment for multiple comparisons was performed for secondary time-point analyses, as these were considered exploratory. A two-tailed p value of <0.05 was considered statistically significant.

RESULTS

Of a total of 30 patients included in the study, 22 were male and 8 were female with a mean age of 36.86 ± 13.24 (range, 18 to 65) years. Baseline demographic characteristics were comparable between the two groups, except for total anesthesia time, which was significantly longer in Group E (Table I).

At 6 h postoperatively, VAS scores were significantly lower in Group E compared to Group C. The duration of analgesia was significantly longer in Group E (Table II).

VAS scores were significantly lower in Group E at 30 min, 2 h, 4 h, and 12 h postoperatively compared with the control group. However, VAS scores were comparable between groups at 0 h and 24 h (Table II). The requirement for additional analgesia during

Table 1. Baseline demographic data of patients

	ESPB group (n = 15)		Control group (n = 15)		
Variables	n	Mean ± SD	n	Mean ± SD	p
Age (year)		36.26 ± 13.63		37.46 ± 13.31	0.809
Sex					1.000
Male	11		11		
Female	4		4		
Weight (kg)		65 ± 11.66		68.6 ± 11.32	0.398
Height (cm)		162.36 ± 5.46		167.16 ± 8.61	0.079
BMI (kg/m^2)		24.48 ± 3.48		24.52 ± 2.41	0.971
ASA-PS					0.809
I	10		8		
II	4		6		
III	1		1		
Duration of surgery (min)		107.33 ± 10.99		110.66 ± 8.83	0.368
Total anesthesia time (min)		13.73 ± 2.86		7.86 ± 1.68	<0.001

ESPB, Erector Spinae Plane Block; SD, standard deviation; ASA-PS, American Society of Anesthesiologists-Physical Status.

Table 2. Postoperative data

Variables	ESPB group (n = 15)				Control group (n = 15)				*p*
	n	Mean ± SD	Median	IQR	n	Mean ± SD	Median	IQR	
VAS scores									
PACU			0	0-0			0	0-0	0.539
30 min			0	0-0			1.00	0-2.00	0.009
2 h			1.00	0-1.00			3.00	2.00-4.00	< 0.001
4 h			1.00	1.00-2.00			2.00	2.00-4.00	< 0.001
6 h			1.00	1.00-2.00			3.00	2.00-4.00	< 0.001
12 h			3.00	2.00-4.00			4.00	4.00-4.00	0.002
24 h			3.00	3.00-4.00			4.00	3.00-4.00	0.250
Time to first rescue analgesia (h)		10.76 ± 1.96				4.18 ± 1.36			< 0.001
Additional doses of analgesia in first 24 h									
Diclofenac									0.005
2 doses	8				1				
3 doses	7				14				
Tramadol									< 0.001
1 dose	0				8				
2 doses	0				3				
Surgeon satisfaction scores									< 0.001
1	0				2				
2	1				11				
3	0				2				
4	9				1				
5	5				0				
Patient satisfaction scores									< 0.001
1	0				10				
2	1				3				
3	2				2				
4	8				0				
5	4				0				

ESPB, Erector Spinae Plane Block; SD, standard deviation; IQR, Interquartile range; VAS, Visual Analog Scale; PACU, post anesthesia care unit.

the first 24 h was significantly higher in Group C (Table II).

Intraoperative hemodynamic parameters, including HR, MAP, SBP and DBP, were comparable between groups at all recorded time points (Figures 2 and 3). Peripheral oxygen saturation remained 100% in all patients throughout the intraoperative period. Assessment of motor function during the first 24 postoperative h was limited due to patient positioning; however, no clinically detectable quadriceps weakness was observed in either group. Surgeon and patient satisfaction scores were higher in Group E (Table II). No adverse events were reported in either group.

DISCUSSION

In the present study, we evaluated the efficacy of lumbar ESPB for postoperative pain management in patients undergoing THA under subarachnoid block. The main finding of this study was that lumbar ESPB with 40 mL of 0.25% bupivacaine significantly prolonged postoperative analgesia and reduced pain scores and analgesic consumption in patients undergoing THA under spinal anesthesia. In addition, patients in the ESPB group demonstrated lower VAS scores at multiple postoperative time points and higher satisfaction scores compared to the control group, without hemodynamic instability or motor weakness. These findings suggest that lumbar ESPB may provide effective and safe adjunctive analgesia in patients undergoing total hip arthroplasty under spinal anesthesia.

Neuraxial anesthesia remains the most commonly employed technique for THA. Many anesthesiologists use combined spinal-epidural techniques, spinal anesthesia with peripheral nerve

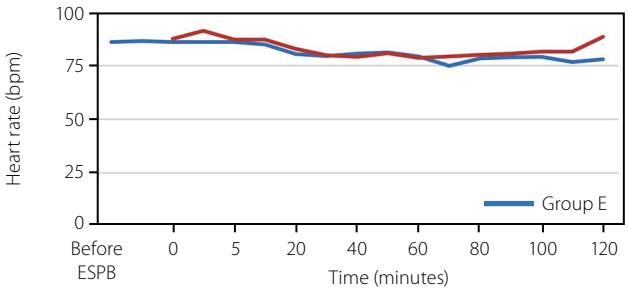

Figure 2. The intraoperative heart rate was comparable in both the groups at all times points.
ESPB, Erector Spinae Plane Block.

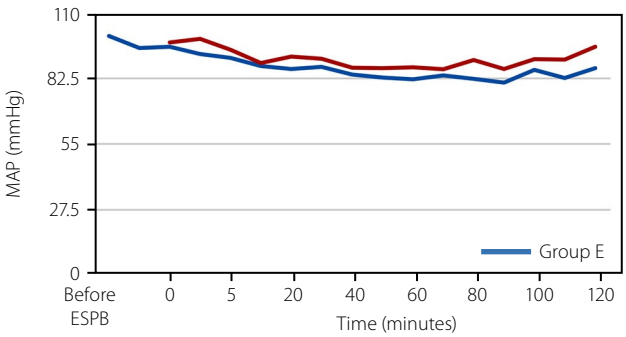

Figure 3. The intraoperative mean arterial pressure was comparable in both the groups at all times points.
ESPB, Erector Spinae Plane Block.

blocks, or spinal anesthesia with adjuvants. At our institution, spinal anesthesia with intrathecal fentanyl is considered standard practice for THA. Accordingly, the control group received spinal anesthesia with 2.5 mL of 0.5% hyperbaric bupivacaine and 10 µg of fentanyl, while the ESPB group received lumbar ESPB at the L4 level with 40 mL of 0.25% bupivacaine followed by the same spinal anesthetic regimen. Intrathecal fentanyl has been shown to prolong postoperative analgesia for up to 6 h following THA.[23] We, therefore, attempted to determine whether the addition of lumbar ESPB would provide incremental analgesic benefit beyond that achieved with intrathecal fentanyl alone.

Effective analgesia for THA is challenging due to the complex innervation of the hip joint, which involves contributions from the femoral, obturator, sciatic, superior gluteal, and nerve to quadratus femoris.[24] The lateral surgical approach, most commonly used at our institution,[25] involves incision over areas supplied by the superior cluneal and lateral femoral cutaneous nerves,[26,27] followed by capsulotomy and femoral neck osteotomy involving structures innervated primarily by branches of the lumbar and sacral plexuses.[28,29] Blocking each of these nerves individually is technically demanding and carries risks of nerve injury and motor weakness. Although lumbar plexus blocks can provide effective analgesia, they are associated with quadriceps weakness and potential delay in mobilization.[24]

The ESPB has gained increasing popularity owing to its relative technical simplicity and favorable safety profile under ultrasound guidance. While most literature pertains to thoracic ESPB, lumbar ESPB has shown promising results in lumbar spine and hip surgeries.[17,30-32] However, the number of randomized-controlled trials remains limited. Imaging studies have demonstrated spread of local anesthetic from T12 to S1 following injection at L4, with diffusion to lumbar neural foramina and possible involvement of femoral and obturator nerves.[13,33] Conversely, cadaveric studies have reported variable and sometimes limited spread to ventral rami and the paravertebral space,[34,35] highlighting ongoing debate regarding its precise mechanism of action. Most previous studies have used 20-30 mL of local anesthetic; we elected to use 40 mL of 0.25% bupivacaine to enhance cranio-caudal spread and potentially prolong postoperative analgesia. Similar volumes have been reported in the literature.[16,36]

In this randomized-controlled study, ultrasound-guided lumbar ESPB performed prior to spinal anesthesia significantly prolonged the duration of postoperative analgesia and reduced pain scores compared to spinal anesthesia alone. The study was powered to detect differences in the primary outcomes; i.e., VAS scores at 6 h and duration of analgesia (time to first rescue analgesic request), both of which demonstrated statistical and clinical significance. Postoperative VAS scores were significantly lower in the ESPB group at 30 min, 2, 4, 6, and 12 h. More importantly, the reduction in pain scores exceeded the minimal clinically important difference for acute postoperative pain (approximately 1.5 to 2 points), supporting clinical relevance in addition to statistical significance. Our findings are consistent with a pilot randomized study by Abdelnasser et al.,[18] which demonstrated improved analgesia with lumbar ESPB in THA, and with a case series reporting low postoperative pain scores during the first 12 h.[33] A recent meta-analysis similarly demonstrated reduced opioid consumption and lower pain scores up to 9 h postoperatively in hip surgeries.[19] In our study, we observed no

significant difference at 24 h, likely because patients in the control group received rescue analgesics by that time. Similar findings have been reported.[18,36,37] Nevertheless, not all trials have shown benefit,[36,38] suggesting that variability in technique, volume, patient characteristics, and surgical approach may influence outcomes.

The mean duration of analgesia in our ESPB group was 10.76 ± 1.96 h, shorter than the 17.5 ± 7 h reported previously.[18] Differences in local anesthetic concentration, volume, perioperative analgesic protocols, and use of adjuvants[39-42] may account for this variation. Although no adjuvants were added to the ESPB, all patients received intravenous dexamethasone 8 mg, which may independently prolong the analgesic effect of regional blocks.[43,44] Prolonged opioid-sparing analgesia during the first postoperative day is clinically meaningful, as it may enhance patient comfort and potentially facilitate early mobilization.

The requirement for additional analgesia within 24 h was significantly lower in the ESPB group, consistent with several previous reports,[18,19,33,37] although not universally observed.[36] Reduced rescue analgesic consumption is particularly relevant in orthopedic populations, where minimizing opioid exposure may reduce nausea, sedation, and delayed mobilization.

Motor blockade following ESPB has been rarely reported,[45-48] typically attributed to extensive spread to the lumbar plexus or epidural space. No clinically detectable quadriceps weakness was observed in our study, although formal assessment in the immediate postoperative period was limited by surgical positioning.

Hemodynamic parameters were comparable between groups throughout the intraoperative period. As lumbar ESPB is not expected to produce significant sympathetic blockade, hemodynamic instability is uncommon, with only isolated reports in the literature.[45] No adverse events, including hematoma, nerve injury, local anesthetic systemic toxicity, or hemodynamic instability, were observed. Taken together, our findings suggest that lumbar ESPB is a simple and safe adjunct that enhances postoperative analgesia following THA performed under spinal anesthesia. Its potential advantages include technical ease, hemodynamic stability, and minimal motor impairment. Future larger, multi-center studies incorporating objective functional recovery endpoints are warranted.

Nonetheless, there are several limitations that should be acknowledged. Blinding was not feasible, as only patients in the ESPB group received a block. Consequently, patients, anesthesiologists, surgeons, nursing staff, and the acute pain team were aware of group allocation, introducing potential performance and assessment bias, particularly for subjective outcomes such as pain scores and satisfaction. Although a sham block could have preserved blinding, we considered it ethically inappropriate to subject patients to a simulated invasive procedure without therapeutic benefit. The sample size was calculated to detect differences in primary outcomes and may have been insufficient for secondary outcomes. Additionally, multiple comparisons of pain scores at different postoperative time points were performed without adjustment for multiplicity, increasing the risk of type 1 error. Dermatomal sensory assessment was not feasible, as spinal anesthesia was administered shortly after ESPB. Thus, block efficacy was inferred indirectly from postoperative analgesic outcomes rather than confirmed by direct sensory mapping. Also, as the motor block could not be assessed conclusively due to surgical positioning, we cannot comment on motor safety. Only a single volume and concentration of local anesthetic were evaluated in one surgical population. No adjuvants were added to the ESPB, as intrathecal fentanyl was already administered. Further studies should compare different volumes, concentrations, adjuvants, and catheter-based techniques. Although surgeon and patient satisfaction scores were significantly higher in the ESPB group, these outcomes should be interpreted cautiously. Satisfaction was assessed using a simple five-point verbal rating scale, which is subjective and not a validated multidimensional instrument. Follow-up was limited to 24 h; longer-term outcomes such as mobilization milestones, rehabilitation progress, and length of hospital stay were not evaluated. Finally, the single-center design, relatively small sample size, and potential operator-related variability may limit generalizability.

In conclusion, our study results showed that the use of lumbar ESPB with 40 mL 0.25% bupivacaine in patients undergoing THA under spinal anesthesia resulted in decrease in postoperative pain scores, a longer duration of analgesia and a reduced requirement for additional analgesia in the first 24 h. Both patients and surgeons of patients who received ESPB were more satisfied with the overall anesthesia experience than those who did not. There was no hemodynamic instability or side effects associated with the block. Despite inherent limitations, the

findings suggest that lumbar ESPB is an effective and safe adjunct to spinal anesthesia, providing prolonged postoperative analgesia and reducing rescue analgesic requirements without clinically significant motor blockade or hemodynamic instability. Further large-scale, multi-center, prospective studies incorporating objective functional recovery endpoints and standardized assessment of block success are warranted to further define the role of ESPB in perioperative analgesic protocols.

Author Contributions

M.T.: Idea/concept, design, data collection and/or processing, literature review, writing the article; A.R.B.: Idea/concept, design, control/supervision, analysis and/or interpretation, critical review; S.S.: Control/supervision, data collection and/or processing, literature review, writing the article; R.S.: Design, control /supervision, analysis and /or interpretation, literature review, writing the article, critical review.

Conflict of Interest

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Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

AI Disclosure

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