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Original Article

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The effects of erector spinae plane block on pain scores and patient experience in unilateral breast cancer surgery: A prospective, randomized clinical trial

Abstract

Aim: Breast cancer incidence continues to rise, leading to increased demand for surgical interventions. Postoperative analgesia following breast operations remains an area requiring optimization. The erector spinae plane block (ESP) represents a newer regional technique that may provide advantages over alternative methods. In breast cancer surgeries, We investigated whether unilateral ESP blockade before surgery affected opioid consumption during surgery and improved postoperative pain management and patient satisfaction.
Materials and Methods: The study was prospectively randomized and controlled. One hundred women scheduled for unilateral breast cancer surgery were enrolled in the study and randomly assigned to either the ESP block group (Group I, n=50) or the standard care group without block (Group II, n=50). The primary outcome was perioperative opioid consumption. Secondary outcomes included postoperative narcotic consumption, Visual Analog Scale (VAS) pain ratings, urgent analgesic requirements, and patient satisfaction.
Results: Intraoperative opioid consumption was lower in Group I; postoperative pain scores, opioid consumption, and patient satisfaction scores were better compared to Group II.
Conclusion: ESP block, a recently developed regional analgesia approach, improved postoperative pain outcomes and enhanced patient satisfaction following breast cancer surgery.

Keywords: Erector spinae plane block, patient satisfaction, breast surgery, postoperative analgesia

INTRODUCTION

The frequency of breast cancer operations has grown substantially as disease prevalence increases. Pain management in breast procedures presents particular challenges given the extensive surgical field and the intricate innervation patterns of the breast region. From a physiological perspective, nociceptive pain stems from tissue trauma, while neuropathic pain predominantly originates from intercostal nerve injury between levels T2 and T6. Such neuropathic symptoms emerge through disruption of central or peripheral nerve pathways (1).

Adequate acute pain control following surgery, combined with appropriate intraoperative anesthetic support, significantly influences patient wellbeing and clinical trajectories. With expanding numbers of breast cancer procedures, there is an

evident requirement for anesthetic strategies offering superior pain relief, enhanced safety profiles, and fewer adverse events.

Current international protocols advocate for combined analgesia approaches throughout the perioperative period (2). Regional anesthetic methods constitute a vital element of multimodal pain strategies in surgical practice. These interventions may be delivered as single-shot techniques administered preoperatively or postoperatively, or via continuous catheter systems providing analgesia intraoperatively and during recovery (2,3).

Fascial plane blocks have gained widespread adoption relative to neuraxial and paravertebral approaches, primarily due to reduced complication profiles and technical simplicity (4). Within these emerging modalities, the erector spinae plane (ESP) block was introduced in 2016, originally for thoracic surgical analgesia (5). Subsequently, clinical evidence has substantiated its utility across multiple contexts, establishing its role in regional anesthesia and pain care. ESP block applications now extend beyond thoracic operations to include abdominal and breast procedures, demonstrating substantial benefit for postoperative pain management (6). Our study aimed to determine the effect of the ESP block on intraoperative remifentanil consumption and its effectiveness in controlling postoperative pain in unilateral breast cancer surgeries. Additionally, it was to evaluate patient satisfaction regarding improvements in pain control in patients who received this intervention.

MATERIALS AND METHODS

Study Design

This prospective, controlled, randomized, single-center study was conducted in the general surgery operating room of İnönü University Faculty of Medicine. Outcome assessments were performed by an anesthesiologist who was unaware of group assignments. The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the İnönü University Clinical Research Ethics Committee (approval number: 2018/178). The registration process was completed on ClinicalTrials.gov (Registration No. NCT07134933, we received it after the work was completed.). The theoretical sample size was calculated using G*Power (version 3.1.9.3). Based on a default effect size of 0.50, an alpha error of 0.05, and a power of 0.80, this calculation indicated that at least 30 patients were required for each group's intraoperative remifentanil consumption; however we included 50 patients in each group. We enrolled 100 female patients, ages 18 to 65 years with ASA physical status I–II, scheduled for unilateral breast surgery (lumpectomy, lumpectomy with axillary lymph node dissection, modified radical mastectomy, or simple mastectomy with axillary lymph node dissection). Exclusion criteria included patients beyond these parameters plus those with obesity, active infection at proposed injection sites, documented medication allergies, coagulopathy, or chronic opioid usage history (Figure 1).

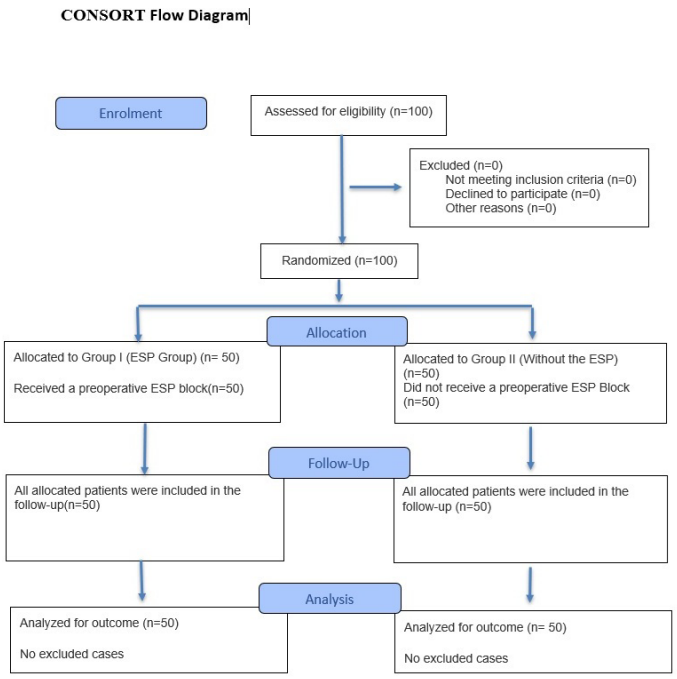

Figure 1. CONSORT Flow Diagram

Anesthesia Management and Block Procedure

Computer-generated randomization minimized selection bias by dividing patients into two groups. Group I underwent unilateral ESP block under ultrasound guidance prior to general anesthesia. Group II underwent surgery under general anesthesia without regional block and served as the control group. Both groups underwent standard anesthesia monitoring, including bispectral index (BIS).

The ESP block was applied unilaterally at thoracic vertebra 4 (T4) on the side to be operated on. All blocks were performed by the same experienced anesthesiologist. The equipment included an ultrasound system, a convex probe, and a 22-gauge block needle (Figure 2). The in-plane technique was used. After identifying the T4 spinous process, the needle was displaced 3 cm laterally from the midline in the parasagittal plane. The transverse process was localized with ultrasound, and the fascia between the paraspinal muscles and the transverse process was punctured with a 1 mL injection of 0.9% saline to confirm adequate spread. Following confirmation, 20 mL of 0.5% bupivacaine was administered. Cranial-caudal spread was observed.

After the ESP block was completed, anesthesia induction was performed with propofol (2-3 mg/kg), fentanyl (2 mcg/kg), and rocuronium (0.6 mg/kg) at appropriate doses. Following drug administration, intubation was performed using an appropriate endotracheal tube. Total intravenous anesthesia was used for anesthesia maintenance with remifentanil (0.25–0.5 mcg/kg/min) and propofol (150 mcg/kg/min). For TIVA, infusion doses were used with actual dose changes to maintain the BIS value in the range of 40–60.

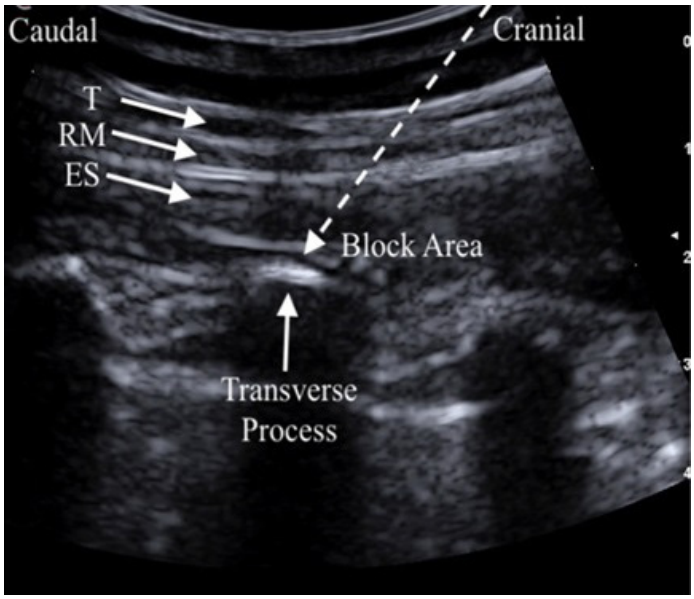

Figure 2. Obtaining ESP Block Image with In-Plane Technique. T: Trapezius, RM: Rhomboid muscle, ES; Erector Spinae

Due to the variability in surgery times, intraoperative hemodynamic monitoring was standardized based on the shortest anesthesia time (60 minutes). From induction to extubation, vital parameters, including heart rate, noninvasive systolic, diastolic, and mean arterial pressures, BIS and end-tidal CO2 measurements, were measured at 5-minute intervals. Upon completion of the operation, intravenous paracetamol was administered. Antiemetic prophylaxis was provided with ondansetron (8 mg IV). Neostigmine (0.05 mg/kg) and atropine (0.02 mg/kg) reversed neuromuscular blockade. Intraoperative remifentanil doses were noted for each patient. After extubation, patient-controlled analgesia was initiated with ıv morphine (0.5 mg/mL; 1 mg bolus; 8-min lockout; maximum 6 mg/hour).

Pain Assessment and Satisfaction

Pain assessment was performed by a blinded anesthesiologist who did not know which group of patients they were treating. The Visual Analog Scale (VAS) measured pain intensity. Measurements were taken at 5, 15, 30, and 60 minutes after surgery, then at 2, 4, 6, 8, 16, and 24 hours, both at rest and during movement. Patients with a VAS score exceeding 40 were given 1 mg/kg of tramadol. VAS scores and urgent analgesic needs were recorded. Additionally, a four-point satisfaction scale was applied (1: poor, 2: fair, 3: good, 4: excellent). The primary outcome was intraoperative opioid consumption; secondary outcomes included postoperative narcotic consumption, pain assessment, additional analgesic requirements, and patient satisfaction.

Statistical Analysis

Analyses employed IBM SPSS Statistics version 25.0. Continuous data were expressed as median (minimum–maximum) and mean±standard deviation, categorical data as counts and percentages. Kolmogorov–Smirnov test evaluated distribution normality. Comparisons utilized independent samples t-test, Mann–Whitney U test, Chi-square test, and Friedman test as appropriate. Statistical significance was defined as $p < 0.05$.

RESULTS

Analysis of demographic characteristics among the 100 enrolled patients revealed no significant differences between groups (Table 1).

Regarding resting VAS scores, Group I demonstrated substantially lower values compared with Group II across all postoperative timepoints from 5 minutes through 24 hours ($p<0.05$) (Figure 3). During mobilization, VAS scores were similarly reduced in Group I versus Group II ($p<0.05$) (Figure 4).

After anesthesia induction, both heart rate and mean arterial pressure were lower than baseline values; however, no statistically significant difference emerged between groups ($p>0.05$). Intraoperative remifentanil consumption decreased in Group I, and a statistically significant difference emerged ($p<0.05$). Postoperative opioid use was significantly reduced in Group I, showing a statistically significant decrease compared to Group II ($p<0.05$) (Table 1). Patient satisfaction ratings also increased significantly in Group I ($p<0.05$) (Table 2). Additionally, rescue analgesic requirements were significantly lower in Group I compared to Group II ($p<0.05$) (Table 2).

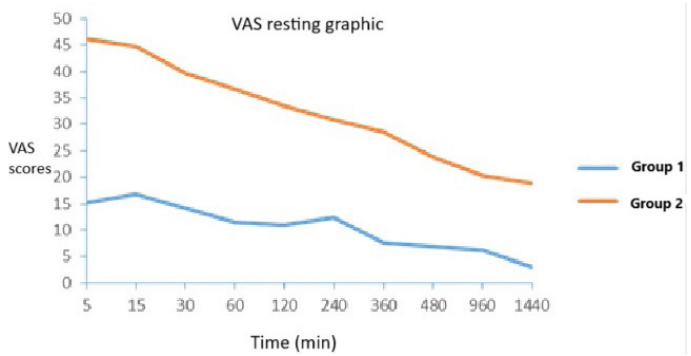

Figure 3. Comparison of VAS scores of the groups in the first 24 hours postoperatively

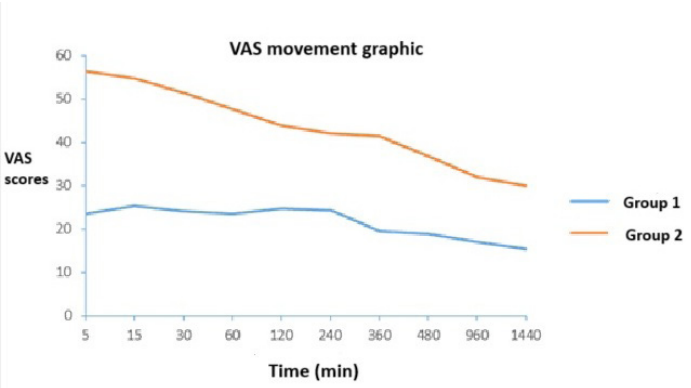

Figure 4. Evaluation of VAS scores with movement in the first 24 hours postoperatively

Table 1. Comparison of quantitative variables between groups

Variable	Group I (n=50)	Group II (n=50)	p-value
Age (years, mean ± SD)	48 ± 10	49 ± 10	0.377*
Weight (kg, mean ± SD)	68 ± 12	69 ± 13	0.834*
Propofol (mg, mean ± SD)	632 ± 297	681 ± 231	0.363*
Height (cm, median [min-max])	160 (150-173)	160 (155-172)	0.961**
BMI (kg/m², median [min-max])	26 (16-34)	25 (19-37)	0.547**
Anesthesia Duration (min, median [min-max])	120 (55-180)	108 (40-200)	0.218**
Surgical Duration (min, median [min-max])	100 (45-170)	93 (35-160)	0.376**
Remifentanil (mcg, median [min-max])	500 (200-1020)	600 (160-1080)	0.046**
Morphine (mg, median [min-max])	4 (2-11)	22 (12-32)	<0.001**

*: Independent Samples T-Test, **: Mann-Whitney U Test SD: standard deviation; min: minimum; max: maximum

Table 2. Comparison of categorical variables between groups (column percentages)

Variables	Categories	Group I (n=50)	Group II (n=50)	P-value*
ASA	1	28 (56.0)	20 (40.0)	0.109
	2	22 (44.0)	30 (60.0)	
Type of Surgery	Lumpectomy	25 (50.0)	24 (48.0)	0.976
	Lumpectomy + axillary lymph node dissection	11 (22.0)	10 (20.0)	
	Modified radical mastectomy	9 (18.0)	10 (20.0)	
	Simple mastectomy + axillary lymph node dissection	5 (10.0)	6 (12.0)	
Need for Analgesia	No need for analgesia	36 (72.0)	6 (12.0)	<0.001
	Need for analgesia	14 (28.0)	44 (88.0)	
Patient Satisfaction Score	Poor	0 (0.0)	4 (8.0)	<0.001
	Fair	2 (4.0)	42 (84.0)	
	Good	12 (24.0)	4 (8.0)	
	Excellent	36 (72.0)	0 (0.0)	

*: Chi-Square Test, Data are expressed as count (column percentage calculated from group size n=50)

DISCUSSION

The use of the ESP block has become widespread as a component of multimodal analgesic regimens for postoperative pain relief. Our study found that the ESP block reduced both intraoperative remifentanil consumption and postoperative morphine requirements in patients undergoing unilateral breast surgery. As a result, this intervention improved pain scores and patient satisfaction outcomes.

A meta-analysis by Leong et al. demonstrated that preoperative ESP block effectively reduced postoperative opioid consumption and 24-hour VAS scores. Their analysis highlighted the benefits of a modified single-dose ESP block in 65 patients prior to anesthesia induction, showing a decrease in intraoperative anesthetic requirements, a reduction in VAS values, a decrease in perioperative opioid use, and shorter extubation times (7).

Gürkan et al. (8) conducted a prospective randomized controlled investigation in breast surgery patients, administering 20 mL of 0.25% bupivacaine at T4 to assess preoperative ESP block efficacy. All patients received 100 mg tramadol and 1 g intravenous paracetamol, followed by postoperative patient-controlled morphine analgesia. Twenty-four-hour morphine consumption measured 5.76 ± 3.8 mg in the ESP cohort versus 16.6 ± 6.92 mg in controls, confirming analgesic advantages. Our study found total morphine use of 4 mg in the ESP group compared with 22 mg in controls. While both investigations reported consistent favorable outcomes regarding reduced opioid consumption, the observed differences may relate to bupivacaine concentration—Gürkan et al. used 0.25% whereas we employed 0.5%. Supporting this, Altiparmak et al. (9) compared 0.375% versus 0.25% bupivacaine in ESP blocks after mastectomy, finding higher concentrations associated with superior pain control and reduced tramadol requirements.

A literature review examining patient satisfaction with regional

anesthesia in breast surgery reported satisfaction rates with pain management after lumpectomy or mastectomy of at least 92%, significantly exceeding placebo groups (10). These analyses encompassed pectoral nerve blocks, local anesthetic wound infiltration, and serratus anterior plane blocks (11–13). Our study found patients receiving ESP block reported significantly higher satisfaction scores than those without block.

ESP block for breast surgery is typically performed at T4 or T5 levels. Bonvinci et al. (14) administered 23 ml total, containing 75 mg ropivacaine and 16 mg mepivacaine, at T5 bilaterally during bilateral breast surgery. Similar to our methodology, they observed reduced postoperative pain scores in patients receiving intraoperative remifentanil and propofol via total intravenous anesthesia, suggesting ESP block provides successful analgesia as part of multimodal approaches in breast procedures where postoperative pain is common. Another report of ESP block application in breast surgery performed the block at T5, differing from our approach (15). That case used 20 ml of 0.5% levobupivacaine, resulting in significant pain score reductions and improved sleep quality. Like Gürkan et al. (8), we performed blocks at T4, demonstrating effective analgesia can be achieved at both levels for breast surgery.

ESP block application level naturally depends on surgical site. For breast procedures, the needle is generally oriented at T4 in a cranio-caudal direction (8). For chest wall surgeries, a cranio-caudal approach at T5 is preferred, while abdominal operations utilize a caudo-cranial technique at T7 (16). Successful ESP block performance relies substantially on patient cooperation and practitioner experience. The block can be performed in sitting, lateral decubitus, or prone positions (16,17). In our study, the block was applied in the lateral decubitus position with the surgical field on top to preserve the localization of radiologically wire-marked breast masses, increase patient comfort, and standardize the procedure.

Effective local anesthetic spread along the fascial plane and accurate delivery near target neural structures are essential for optimal block performance. Injection technique variations may therefore contribute to sensory blockade extent differences. Currently, no consensus exists regarding optimal volume or concentration for ESP blocks, and systemic toxicity risk—particularly with bilateral injections—should be considered. A cadaver study showed the block performed at T5 demonstrated anesthetic spread from C7 to T8 (5). Similarly, another investigation showed injections at T7 could provide effective abdominal analgesia, further supporting extensive cephalocaudal spread associated with ESP block. In this study, conducted on fresh cadavers and patients, the injectate spread caudally to L2–L3 transverse processes, producing sensory blockade from T6 to T12 in one patient, while levels were unspecified for others (18). Local anesthetic generally spreads approximately three vertebral levels cranially and four levels caudally. In our study, because general anesthesia induction commenced immediately after ESP block, we could not directly assess block level or onset time. However, postoperative VAS scores and patient satisfaction suggest the block achieved intended effects.

Since its 2016 introduction, ESP block has been performed using various concentrations of bupivacaine, ropivacaine, lidocaine, and other local anesthetics and adjuvants (9, 14, 15, 17–20). Kumar et al. (17) reported liposomal bupivacaine use for breast surgery, while Cao et al. (20) combined ropivacaine with hydromorphine for ESP blocks in mastectomy patients. We selected 0.5% bupivacaine due to its widespread use and prolonged action duration, which proved sufficient for our purposes.

Several randomized controlled trials have evaluated ultrasound-guided ESP blocks in breast surgery patients. Bedewy et al. (21) found ESP block offered more effective analgesia than both serratus anterior plane block and control groups, resulting in lower postoperative opioid consumption, reduced stress hormone levels, and more stable hemodynamics. Another study comparing ESP block, rhomboid intercostal block, and serratus anterior block in modified radical mastectomy patients found both ESP block and rhomboid intercostal block more effective than serratus anterior block in reducing 24-hour tramadol use (22). A separate study comparing ESP block with thoracic paravertebral block demonstrated ESP block achieved similar reductions in postoperative opioid consumption while being technically simpler and potentially safer (23). Consistent with these results, our study showed decreased intraoperative and postoperative opioid use in patients receiving ESP block, without block-related complications. While these findings confirm short-term efficacy and safety of ESP block, long-term benefits—such as potential reductions in chronic post-mastectomy pain or improvements in functional recovery—remain unclear. Future studies should explore these outcomes to better understand sustained clinical impact of ESP block in breast surgery.

This study has several limitations. First, it was conducted at a single center. Second, although we initially planned to assess sensory block level, this could not be performed after the block because anesthesia induction commenced immediately, and postoperative evaluation was not feasible due to surgical bandaging. Although there were no significant statistical differences in surgical duration or procedure type between groups, our study included various breast surgery procedures. Assessing the block's effects within single, standardized surgical type could provide more robust and interpretable results. Finally, absence of blinding in the non-block group may have introduced performance bias.

CONCLUSION

Ultrasound-guided regional nerve blocks have become a fundamental component of multimodal analgesia at our center. The ESP block is increasingly being used as a standard element of pain control throughout the perioperative period for patients undergoing unilateral breast surgery. Our results show that a preoperative ESP block performed at thoracic vertebra 4 using

20 mL of 0.5% bupivacaine significantly reduced intraoperative remifentanil and postoperative morphine consumption, as well as the need for emergency analgesics, and improved patients' reported pain intensity and satisfaction levels.

The reduction in opioid requirements leads to important clinical outcomes such as a decrease in opioid-related side effects, faster recovery, earlier mobilization, and potentially shorter hospital stays. Furthermore, limiting opioid exposure in the early postoperative period may help reduce the risk of continuous opioid use, which is an increasing concern in today's surgical practice. Considering these advantages and the safety profile of the ESP block, we have adopted it as part of our routine anesthesia protocol for breast surgery, and its use is expected to become more widespread in advanced recovery pathways.

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Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

*The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the İnönü University Clinical Research Ethics Committee (approval number: 2018/178). The registration process was completed on ClinicalTrials.gov (Registration No. NCT07134933, we received it after the work was completed.). The theoretical sample size was calculated using G*Power (version 3.1.9.3).*

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