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Original Contribution

Ultrasound guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: A randomized controlled study

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ABSTRACT

Study objective: To evaluate the analgesic effect of ultrasound-guided erector spinae plane (ESP) block in breast cancer surgery.
Design: Randomized controlled, single-blinded trial.
Setting: Operating room.
Patients: Fifty ASA I–II patients aged 25–65 and scheduled for elective breast cancer surgery were included in the study.
Interventions: Patients were randomized into two groups, ESP and control. Single-shot ultrasound (US)-guided ESP block with 20 ml 0.25% bupivacaine at the T4 vertebral level was performed preoperatively to all patients in the ESP group. The control group received no intervention. Patients in both groups were provided with intravenous patient-controlled analgesia device containing morphine for postoperative analgesia.
Measurements: Morphine consumption and numeric rating scale (NRS) pain scores were recorded at 1, 6, 12 and 24 h postoperatively.
Main results: Morphine consumption at postoperative hours 1, 6, 12 and 24 decreased significantly in the ESP group ($p < 0.05$ for each time interval). Total morphine consumption decreased by 65% at 24 h compared to the control group (5.76 ± 3.8 mg vs 16.6 ± 6.92 mg). There was no statistically significant difference between the groups in terms of NRS scores.
Conclusions: Our study findings show that US-guided ESP block exhibits a significant analgesic effect in patients undergoing breast cancer surgery. Further studies comparing different regional anesthesia techniques are needed to identify the optimal analgesia technique for this group of patients.

1. Introduction

Breast surgery is one of the most common surgeries, due to the high incidence of breast cancer [1]. Postoperative analgesia in breast surgery is difficult due to the extensive nature of the surgery and the complex innervation of the breast [2]. A recent review showed that the nerves that lead to pain vary, depending on the type of the surgery, and that different regional anesthesia techniques cover different parts of the surgical field [2]. Paravertebral block (PVB) has been proved to be one of the most effective regional anesthesia techniques for effective postoperative analgesia [3]. However, this is also a particularly challenging technique, because of the anatomic proximity of the pleura and central neuraxial system.

The erector spinae plane (ESP) block is a newly defined regional anesthesia technique for thoracic analgesia. Its use for other indications, such as abdominal and thoracic surgery, has also recently been reported [4–8]. In this technique, local anesthetic injection is performed beneath the erector spinae muscle. Local anesthetic (LA) expected to achieve paravertebral spread of three vertebral levels cranially and four levels caudally [9]. One cadaveric study showed that the spread of the dye involved both the ventral and dorsal rami of the spinal nerves, causing a sensory blockade over the anterolateral thorax [4].

To the best of our knowledge, there have been no previously published randomized, controlled studies of ESP block use for postoperative analgesia in breast surgery. The purpose of this randomized, controlled prospective study was to evaluate the analgesic effect of US-guided ESP block in patients undergoing elective breast surgery. Our primary aim was to compare postoperative opioid consumption rates at 24 h. Secondary end points were to compare pain scores, opioid-related side-effects, nausea and vomiting.

2. Materials and methods

This prospective, randomized controlled study was performed

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following obtaining of Kocaeli City Clinical Trials Ethical Committee approval (KAEK 2017-347) and of written informed consent from the patients.

Fifty female patient aged 20–65 years with American Society of Anesthesiologists (ASA) physical status I–II and scheduled for elective surgery for breast cancer were included in the study. Only unilateral surgical procedures were included. Exclusion criteria included obesity (body mass index $> 35\ kg/m^2$), infection of the skin at the site of the needle puncture, known allergies to any of the study drugs, coagulopathy, and recent use of opioid drugs.

Randomization was achieved using the sequentially numbered opaque sealed envelope technique (SNOSE) [10]. Patients were randomized to receive either single-shot ESP block (ESP group) or no intervention (control group). All patients were pre-medicated using midazolam $0.03\ mg\ kg^{-1}$ iv on arrival at the preoperative holding area.

2.1. ESP technique

ESP block was performed in the preoperative block area following standardized monitoring, including noninvasive blood pressure, electrocardiogram, and pulse oximetry. All blocks were performed approximately 20 min before induction of general anesthesia. The block was performed as described by Chin et al. [9], unilaterally, with patients in the prone position. Skin preparation was performed using 10% povidone iodine. The probe was covered with a sterile cover. All blocks were carried out by the same two anesthesiologists (YG, CA), both with experience in US-guided nerve blocks. An Esaote My Lab 6 US machine (Florence, Italy) with a large bandwidth, multifrequency convex probe (1–8 MHz) was used for block performance. A 22G, 50-mm, insulated facet type needle (B·Braun Sonoplex, Melsungen, Germany) was used during all blocks. The blocks were performed at the T4 level of the spine using an in-plane approach.

A convex probe was placed 2–3 cm laterally to the spine using a sagittal approach. Once the erector spinae muscle and the transverse processes had been identified, the needle was inserted deep into the muscle (Fig. 1). The needle was directed from a cranial to a caudal direction. Following confirmation of the correct position of the needle tip with administration of 0.5–1 ml of LA, 20 ml of 0.25% bupivacaine was administered for block performance. LA distribution was observed in both cranial and caudal directions.

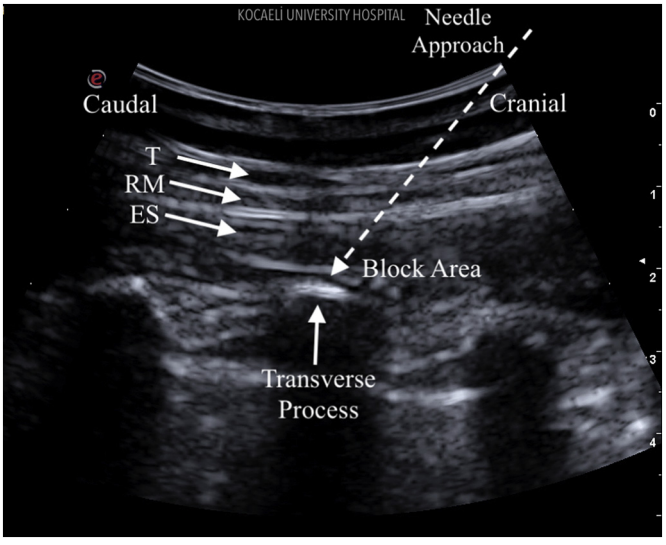

Fig. 1. Ultrasound image of erector spinae block. T: Trapezius, RM: Rhomboid major, ES: erector spinae.

2.2. General anesthesia

General anesthesia induction was achieved using propofol ($2–3\ mg\ kg^{-1}$) and fentanyl ($2\ mg\ kg^{-1}$) iv. Rocuronium $0.6\ mg\ kg^{-1}$ was administered iv for tracheal intubation. General anesthesia was maintained with desflurane in combination with nitrous oxide in oxygen at a ratio of 2:1 in 3 l of fresh gas flow. During anesthesia maintenance, monitoring included pulse oximetry, an electrocardiogram, non-invasive blood pressure (NIBP), end-tidal carbon dioxide, end-tidal desflurane, and fraction of inspired oxygen. Tramadol 100 mg and paracetamol 1 g iv were administered for postoperative analgesia at the end of surgery. Ondansetron 8 mg was also administered to prevent postoperative nausea and vomiting.

At the end of surgery, neuromuscular reversal was provided with the administration of $0.05\ mg\ kg^{-1}$ of neostigmine and $0.02\ mg\ kg^{-1}$ of iv atropine.

Postoperative pain was assessed using a numeric rating scale (NRS) ranging from 0 (no pain) to 10 (worst imaginable pain). In the recovery room, all subjects were given a patient-controlled analgesia device (PCA) containing morphine $0.5\ mg/ml^{-1}$, set to deliver a 1 mg bolus dose of morphine, with an 8 min lockout time and 6 mg 1 h limit. On the ward, NRS scores were recorded at 1, 6, 12 and 24 h postoperatively. Incidences of nausea and vomiting, and total morphine consumption during the 24-h postoperative period were recorded. A pain nurse blinded to the study groups was responsible for postoperative follow-up.

A preliminary study in our clinic showed a mean (± SD) morphine consumption of 17 mg (± 7) in the first 24 h postoperatively. For 80% power and an error of 0.05, the sample size necessary to detect a 30% difference in postoperative morphine requirements at 24 h using ESP compared to the control group was calculated as 19 subjects for each group. We included 25 patients in each group for securing patient dropouts.

All statistical analyses were performed using IBM SPSS for Windows® version 20.0 software (SPSS, Chicago, IL, USA). The Kolmogorov-Smirnov test was used to determine normality of data distribution. Continuous variables were expressed as mean ± standard deviation, and median (25th–75th percentiles), and categorical variables as counts (percentages). Comparisons of normally distributed continuous variables between the groups were performed using Student's *t*-test, while non-normally distributed continuous variables between the groups were compared using the Mann Whitney *U* test. Comparisons of categorical variables between the groups were performed using Fisher's Exact Chi Square test, the Yates Chi Square test, and the Monte Carlo Chi Square test. A two-sided p value < 0.05 was considered statistically significant.

3. Results

Fifty patients were enrolled in the study. Demographic data, and types and durations of surgeries were similar between the two groups (Table 1).

Mean morphine consumption at postoperative 24 h was 5.76 ± 3.8 mg in the ESP group, and 16.6 ± 6.92 mg in the control group. ESP block significantly reduced morphine consumption at 1, 6, 12 and 24 h postoperatively. There was no statistically significant difference between the groups in terms of NRS pain scores (Table 2).

Eight patients in the ESP group had postoperative nausea, and three of these also experienced vomiting. In the control group, 10 patients had nausea, and four of these also experienced vomiting. There was no significant difference between the groups in terms of postoperative nausea ($p = 0.768$ – Yates' Chi square) or vomiting ($p = 1.000$ – Fisher's Exact chi square) (PONV). No other complications were observed preoperatively or postoperatively in either group.