Ultrasound guided Erector Spinae Plane block versus thoracic epidural for post-mastectomy analgesia

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Ultrasound Guided Erector Spinae Plane Block versus Thoracic Epidural for Post-mastectomy Analgesia

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ABSTRACT

Background: Thoracic epidural analgesia (TEA) was considered as the gold standard for postoperative analgesia in thoracic surgeries, particularly in bilateral procedures. However, it isn't routinely used as it is associated with some haemodynamic side effects. Erector spinae plane (ESP) block is recognized as a promising postoperative analgesia technique.

Aim of the study: The primary outcome was to compare post-mastectomy pain control in TEA and ESP block groups, and secondary outcomes were to compare post-operative hypotension, number of morphine boluses, and patient satisfaction.

Patient and Methods: Sixty female patients scheduled for elective mastectomy were enrolled in this study. Patients were allocated into 2 groups, 30 patients each. Group (TE) patients undertook ultrasound-guided single-shot TEA, while group (ES) were handled with ultrasound-guided single-shot ESP block. Peri-operative details, Post-operative hypotension, visual analog scale (VAS) assessment of pain, number of postoperative morphine boluses, and patient satisfaction were recorded.

Results: Time needed to give block was shorter in the group (ES) (p<0.001). Group (ES) patients reported significantly lower pain scores according to VAS (P<0.001). Hypotension was more recorded in group (TE) patients, with statistical significance at 0 point (p<0.001). Required post-operative morphine boluses were significantly lower in the group (ES), as 3.3% of patients received 3 boluses compared to 27% in the group (TE) (p=0.01). More patients were highly satisfied with group ES (60%) than group TE (30%) (p=0.037).

Conclusion: Ultrasound-guided ESP block is a choice with a better outcome in patients undergoing elective mastectomy as regards the lower frequency of hypotension, better efficiency, and patient satisfaction.

Keywords: Ultrasound-guided Erector Spinae Plane block; pain; post-mastectomy.

INTRODUCTION

Breast surgery is a common procedure, particularly in middle-aged women. The procedure is associated with an increased incidence of acute and chronic pain. Postoperative analgesia following breast surgery extending beyond lumpectomy is sometimes challenging, about 20% to 50% were recorded to develop post-mastectomy pain syndrome. Multimodal techniques for pain management have been recommended by The American Society of Anesthesiologists (ASA) task force for the management of acute postoperative pain. These techniques include regional analgesia, intravenous (IV), and oral analgesics as opioids, paracetamol, and nonsteroidal anti-inflammatory drugs (NSAIDs). Inappropriate postoperative analgesia may increase morbidity and mortality. Satisfactory postoperative analgesia prevents unnecessary patient discomfort, may play a role in decreasing morbidity, postoperative hospital stay, and the cost. When opioids are used solely for analgesia, they may cause nausea, vomiting, pruritus, and respiratory depression. Regional techniques, especially Thoracic Epidural Analgesia (TEA) have been described to reduce the postoperative pain with improved outcome.

Ultrasound-guided (USG) erector spinae plane (ESP) block has become a recognizable technique for regional analgesia in thoracic surgeries. This block can be given unilaterally for simple mastectomy surgery. A local anaesthetic (LA) is dripped deep to the erector spinae muscle and superficial to the tip of
the transverse process at the myofascial plane. The instilled LA can induce sensory block at the multi-
dermatomal levels across the posterior, lateral, and anterior thoracic wall, probably due to the diffusion
into the paravertebral space. In addition to its effect at the rami communicans that supply the sympathetic
chain \(^{10}\), the ESP block affects the dorsal and ventral primary rami of the thoracic nerves \(^{11}\). ESP is
relatively easier to apply in breast surgeries as compared to neuraxial, nerve blocks, TEA, and other
regional modalities \(^{9,12}\).

**Aim of the work**

The primary outcome was to compare post-
mastectomy pain control in TEA and ESP block
groups, and the secondary outcomes were to compare the post-operative hypotension, the number of
morphine boluses, and patient satisfaction.

**PATIENT AND METHODS**

This prospective randomized clinical study was
conducted on sixty female patients, aged 40-60-year-
old, with the American Society of Anesthesiologists’
physical status I–II enrolled for elective simple
mastectomy. The study was done between March and
October 2019 in a military tertiary care center in Saudi
Arabia after approval of the local ethics committee
and informed written consent. Randomization was
performed to two groups each of 30, using computer-
generated closed and opaque envelopes method to 2
groups according to the technique used; ultrasound-
guided single-shot Thoracic Epidural Analgesia (TE)
group, and ultrasound-guided single shot Erector
Spinae Plane block (ES) group.

All patients who completed the study had a clinical
assessment on the pre-operative visit.

**Exclusion criteria**

Patient refusal, Morbidly obese (BMI ≥40),
Anomalies of the vertebral column, patient on
anti-coagulants, bleeding diathesis.

**Technique**

On arrival at the operating theatre, patients were
connected to standard monitors: non-invasive arterial
blood pressure (NIBP), electrocardiogram (ECG), and
pulse oximetry (SpO2). Balanced general anesthesia
(GA) was induced with propofol 2 mg/kg, fentanyl 1
μg/kg, rocuronium 0.6 mg/kg, and tracheal intubation
was done in both groups. Anesthesia was maintained
with sevoflurane 1.8% and 50% nitrous oxide in
oxygen.

After the end of surgery and before extubation, the
studied technique was done.

In Group TE (TEA),

A linear transducer was placed in a horizontal
orientation at the T5 spinous process corresponding to
T4 transverse process. Three muscles trapezius
(uppermost), rhomboids major (middle), and erector
spinae (lowermost) were identified superior to the
hyperechoic transverse process. Site of insertion, skin
to epidural space distance, and direction were
identified and marked before insertion of an 18 Gauge
Touhi needle (prefix epidural Catheter set, b Braun)
(Figure 1), then 20 ml BUPIVACAINE 0.25 %
(0.25% BUPIVACAINE HCl inj, USP HOSPIRA
INC USA) was injected after negative aspiration.

In Group ES (ESP Block),

A linear transducer was placed in a longitudinal
orientation 3 cm lateral to the T4 spinous process.
Three muscles trapezius (uppermost), rhomboids
major (middle), and erector spinae (lowermost) were
identified superior to the hyperechoic transverse
process (Figure 2). Using in-plane approach an 22
Gauge echogenic needle (sonolex STIM PAJUNK)
was inserted in caudal–cephalad direction, until the
tip is deep to erector spinae muscle, as evidenced by
visible hydro dissection below the muscle plane, then
20 ml bupivacaine 0.25 % was injected after negative
aspiration.

Time to give the block was assessed in both groups in
minutes. Extubation was done after satisfying
extubation criteria, then patients were transferred to
the recovery room.

The pain assessment after full recovery was
performed using a 10 cm visual analog scale (VAS)
(0- no pain and 10 cm maximum pain) \(^{11}\). The
postoperative pain assessments using VAS at rest and
during cough were performed postoperatively at 0
point (the full recovery state), 1 hr, 2 hr, 4 hr, 6 hr, and
at 24 hr. IV paracetamol 1 g every 6 hours was
administered. Rescue analgesia was administered, if
VAS was ≥ 4 at rest or on patient’s demand, with IV
morphine sulphate 0.03 mg/kg, the number of
morphine boluses and the total amount in the first
postoperative 24 hours was calculated. Mean arterial
blood pressure (MABP) was assessed post-
operatively at 0 point (immediately after the
procedure), 1 hr, 2 hr, 4 hr, 6 hr, and at 24 hr. Patient
satisfaction related to block performance, post-
operative pain relief was evaluated by an 11- point
satisfaction score (0=unsatisfied and 10 = most
satisfied) \(^{14}\), and the score was divided as follows 0-3
(not satisfied), 4-6 (partly satisfied), and 7-10 (highly
satisfied).
Statistical analysis
A pilot study was conducted on 20 females indicated for elective mastectomy and post hoc analysis was performed using VAS scores with an alpha error (Type I) of 0.05 and calculated the beta error (Type II) 90%. A total of 30 patients in each group completed the study; Group TE and Group ES.

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov-Smirnov test was used to verify the normality of distribution of variables. Comparisons between groups for categorical variables were assessed using Chi-square test (Fisher or Monte Carlo). The student t-test was used to compare two groups for normally distributed quantitative variables. Mann Whitney test was used to compare between two groups for non-normally distributed quantitative variables. P-value was considered significant at <0.05.

RESULTS

The demographic data (age, weight), ASA status were comparable between the studied groups (P>0.05) as shown in Table (1). Surgery duration was comparable between the 2 groups, while time to give the block was significantly lower in group ES as shown in Table (2). Post-operative MABP readings were lower in group TE of patients with a statistically significant decrease at 0 point (P<0.001) as shown in table (3). As regards post-operative pain using VAS score, there was statistically significant decrease in group (ES) patients (P<0.001) as shown in table (4). The required post-operative morphine boluses were significantly lower in the group (ES) than group (TE) patients, as 3.3% of patients in 2nd group received 3 boluses compared to 27% of the first group (p=0.01) as shown in table (5). As regards patient satisfaction, more patients were highly satisfied in this study in group ES (60%) than group TE (30%) (p=0.037) as shown in table (6).

<table>
<thead>
<tr>
<th></th>
<th>Group TE (n = 30)</th>
<th>Group ES (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>50.5±5.3</td>
<td>51.2±4.9</td>
<td>0.596</td>
</tr>
<tr>
<td>BMI</td>
<td>29.48±2.36</td>
<td>28.84±2.03</td>
<td>0.26</td>
</tr>
<tr>
<td>ASA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>17(65.7%)</td>
<td>21(70.0%)</td>
<td>0.422</td>
</tr>
<tr>
<td>II</td>
<td>13(43.3%)</td>
<td>9(30.0%)</td>
<td></td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>64.4±11.3</td>
<td>64.9±12.0</td>
<td>0.869</td>
</tr>
</tbody>
</table>

Table 1: Comparison between the two studied groups according to demographic data
*: Statistically significant (p < 0.05).

<table>
<thead>
<tr>
<th></th>
<th>Group TE (n = 30)</th>
<th>Group ES (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to give the block</td>
<td>14.1±2.1</td>
<td>7.8±1.8</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

Table 2: Comparison between the two studied groups according to the time needed to give block
*: Statistically significant (p < 0.05).

<table>
<thead>
<tr>
<th></th>
<th>Group TE (n = 30)</th>
<th>Group ES (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean arterial blood pressure (mmHg)</td>
<td>68.2±3.6</td>
<td>80.4±3.4</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

*: Statistically significant (p < 0.05).
Table 3: Comparison between the two studied groups according to Mean arterial blood pressure (mm Hg)

<table>
<thead>
<tr>
<th>Time</th>
<th>Group TE Mean±SD</th>
<th>Group ES Mean±SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 min.</td>
<td>68.1±2.2</td>
<td>68.5±3.2</td>
<td>0.61</td>
</tr>
<tr>
<td>120 min.</td>
<td>68.0±2.2</td>
<td>67.6±3.3</td>
<td>0.52</td>
</tr>
<tr>
<td>3 hr.</td>
<td>67.7±2.5</td>
<td>68.0±3.1</td>
<td>0.64</td>
</tr>
<tr>
<td>4 hr.</td>
<td>68.1±2.6</td>
<td>68.7±3.5</td>
<td>0.41</td>
</tr>
<tr>
<td>6 hr.</td>
<td>67.4±1.8</td>
<td>68.3±2.5</td>
<td>0.12</td>
</tr>
<tr>
<td>12 hr.</td>
<td>67.8±2.0</td>
<td>68.4±2.8</td>
<td>0.37</td>
</tr>
<tr>
<td>24 hr.</td>
<td>67.6±2.7</td>
<td>68.5±2.9</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*: Statistically significant (p < 0.05).

Table 4: Comparison between the two studied groups according to visual analogue scale

<table>
<thead>
<tr>
<th>Time</th>
<th>VAS: visual analogue scale, IQR: interquartile range, *: Statistically significant (p &lt; 0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group TE (n = 30)</td>
</tr>
<tr>
<td>0</td>
<td>1(0–1)</td>
</tr>
<tr>
<td>2 hr.</td>
<td>1(1–2)</td>
</tr>
<tr>
<td>4 hr.</td>
<td>2(1–2)</td>
</tr>
<tr>
<td>6 hr.</td>
<td>2(2–3)</td>
</tr>
<tr>
<td>12 hr.</td>
<td>3(2–4)</td>
</tr>
<tr>
<td>24 hr.</td>
<td>3(2–4)</td>
</tr>
</tbody>
</table>

Table 5: Comparison between the two studied groups according to Number of morphine boluses

<table>
<thead>
<tr>
<th>Time</th>
<th>Number of morphine boluses</th>
<th>Group TE (n = 30)</th>
<th>Group ES (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>9 (30.0%)</td>
<td>19 (63.3%)</td>
<td>0.01*</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6 (20.0%)</td>
<td>6 (20.0%)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7 (23.3%)</td>
<td>4 (13.3%)</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8 (27.0%)</td>
<td>1 (3.3%)</td>
<td>0.01*</td>
<td></td>
</tr>
</tbody>
</table>

*: Statistically significant (p < 0.05).

Table 6: Comparison between the two studied groups according to Patients satisfaction

<table>
<thead>
<tr>
<th>Time</th>
<th>Patients satisfaction</th>
<th>Group TE (n = 30)</th>
<th>Group ES (n = 30)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 (not satisfied)</td>
<td>11 (36.7%)</td>
<td>4 (13.3%)</td>
<td>0.072</td>
<td></td>
</tr>
<tr>
<td>4-6 (partly satisfied)</td>
<td>10 (33.3%)</td>
<td>8 (26.7%)</td>
<td>0.779</td>
<td></td>
</tr>
<tr>
<td>7-10 (highly satisfied)</td>
<td>9 (30.0%)</td>
<td>18 (60.0%)</td>
<td>0.037*</td>
<td></td>
</tr>
</tbody>
</table>

*: Statistically significant (p < 0.05).

**DISCUSSION**

The need for ideal post-operative pain management is crucial. Although thoracic epidural analgesia (TEA) has been considered as the golden standard, Erector spinae plane (ESP) block is now emerging as a better alternative technique. The value of ESP block as a rescue analgesic technique was highlighted by Forero et al.\(^{15}\) in a case report discussing thoracotomy after a failed epidural technique.

In the present study, the time needed to give the anaesthesia block, mean arterial blood pressure (MABP), visual analogue scale (VAS) assessment for post-operative pain, boluses of morphine, and patient satisfaction were evaluated. Main complications as hypotension were recorded.

The time needed in our study to give the anaesthesia block was found to be significantly lower in group ES that received erector spinae plane (ESP) block (p<0.001) as compared to group TE. The pain score assessed in this work according to the visual analogue scale (VAS) was significantly lower in group ES as compared to group TE (p<0.001). Post-operative readings of MABP tended to be lower in the group (TE), but without statistically significant difference (p>0.05).

In support of our results, Nagaraja et al.\(^{16}\) recorded VAS scores persistently ≤4 until 48 h in 2 study groups of TEA and ESP block performed for post-thoracotomy pain until 12 h post-extubation. They stated that the VAS scores were comparable between both groups, with the relative advantage of ESP block to be easier to perform as compared to TEA and paravertebral block (PVB) in breast surgeries. Similarly, Chin et al.\(^{17}\) stated that ESP block avoided the complications attributed to those two major methods, as they had negligible effects on the dorsal, ventral, or communicant rami of the spinal nerve roots. Furthermore, Bonvini et al.\(^{18}\) suggested that the use of ultrasound-guided (USG) ESP block in
bilateral breast cancer reconstructive surgery can be an effective safe alternative to TEA and paravertebral block techniques. The administered boluses of morphine recorded in our results were significantly lower in group ES in comparison to group TE patients, as 3.3% of patients in group ES received 3 boluses compared to 27% (p=0.01). In accordance, Singh and colleagues documented that a significant decrease in the requirement of postoperative morphine in patients who received erector spinae plane block, and patient satisfaction scores were better in ESP group. Similarly, Gurkan and coworkers in a randomized control trial on the analgesic effect of US-guided single shot ESP for breast surgery observed a statistically significant decrease in postoperative morphine consumption, establishing its role for analgesia and postoperative opioid-sparing effect. Nair et al reported efficacy of this block in a case series of 5 patients subjected to thoracic surgery. Also, previous authors stated in their case reports that both visceral and somatic pain were efficiently abolished by the use of ESP block. In agreement, Kimachi et al used US-guided ESP for accomplishing surgical anesthesia for a right-sided mastectomy and axillary dissection in a patient with high cardiovascular risk, and she had a minimal requirement of postoperative analgesia. They explained that the ability to carry out the anesthesia was attributed to that ESP isn't a limited area surrounded by the spinal column as compared with the epidural zone. The ESP plane is larger than the epidural space as the erector spinae muscle runs along the length of the thoracolumbar spine, thus providing extensive cranio-caudal spread. More patients were highly satisfied in this study in group ES (60%) than group TE (30%) (p=0.037). This coincides with Forteo et al who recommended the use of ESP block for patients with chronic thoracic neuropathic pain, who were poorly responsive to oral pharmacotherapy. The authors attributed this effect to the extent of the cutaneous sensory block when an injection of 25 ml of LA was administered at the level of T5, as it spreads cephalocaudal over the anterior-posterior thorax ranging from T1 to T11.

**CONCLUSION**

Ultrasound-guided ESP block is a good choice with a better outcome in patients undergoing elective mastectomy as regards better efficiency, satisfaction, and fewer complications.

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