A comparative study to assess the efficacy of dexmedetomidine as an adjuvant to bupivacaine in the ultrasound-guided pectoral and serratus plane nerve block for patients undergoing modified radical mastectomy

Enas W. Mahdy\textsuperscript{a}, Ahmed H. Abd Elrahman\textsuperscript{b}, Elsayed M. Abdelzaam\textsuperscript{b}

\textsuperscript{a}Department of Anesthesia and Surgical Intensive Care, Benha University, \textsuperscript{b}Department of Anesthesiology and Intensive Care, Faculty of Medicine, Benha University, Benha, Egypt

Correspondence to Enas Wageh Mahdy, Lecture of Anesthesia and Intensive Care Unit, Postal Code: 13511. Tel: Tel; 01029286117; e-mail: ewm01221592827@gmail.com

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Background and aims
Dexmedetomidine has been noticed to be safe and efficient in prolonging the duration of peripheral nerve blocks. This study was designed to compare the length, quality of postoperative analgesia, hemodynamic stability, and patient’s satisfaction and number of patients requiring analgesia with the addition of dexmedetomidine to bupivacaine versus plain bupivacaine in pectoral nerve block (pecs) for modified radical mastectomy (MRM).

Patients and methods
These patients were randomly allocated using a computerized random number generator into two groups: group I (control group) (30 patients) received 25 ml of 0.25% of plain bupivacaine that was used for modified pecs block. Group II (study group) (30 patients) received 25 ml of 0.25% of plain bupivacaine plus dexmedetomidine (Precedex) 1 \( \mu \)g/kg that were used for pecs block.

Results
The results showed a longer duration of analgesia in group II (21±3 h) in comparison with group I (16±4 h). Statistical analysis showed a statistically highly significant (\( P=0.006 \)). Also, consumption of morphine was lower in group II (5±3 mg/24 h) in comparison with group I (9±4 mg/24 h). Statistical analysis showed a statistically significant (\( P=0.01 \)).

Conclusion
Dexmedetomidine as an adjunct to bupivacaine helps increase the duration and improves the quality of postoperative analgesia in pecs block without serious side effects.

Keywords:
dexmedetomidine, mastectomy, pectoral nerve block and bupivacaine

Background
The marked increase in the number of breast surgeries between females as therapy for many purposes such as breast cancer and cosmetic purposes has resulted in an increased demand for anesthetic techniques with improved pain reduction and safety and fewer complications that result in early immobilization [1].

In breast cancer surgery, acute postoperative pain from injured muscles and nerves is an associated risk factor for chronic postoperative pain. Management of acute postoperative pain is essential for a good outcome and patients’ satisfaction. Regional techniques are considered the best choice for the management of severe postoperative pain and decrease the incidence of chronic pain after breast cancer surgery [2].

There are many regional anesthetic techniques used in breast surgeries like thoracic spinal block, thoracic epidural block, thoracic paravertebral block, and multiple intercostal nerve blocks are the regional anesthesia techniques that have been used in breast surgery. The previous techniques may be associated with some disadvantages, including pneumothorax (1% thoracic paravertebral block, 2% intercostal), bleeding risk (especially epidural hematoma), dural puncture, and hypotension [3,4].

The pectoral nerve block (pecs block) is less invasive and has fewer complications, as compared with the other technique. It is a different superficial nerve block, alternative to neuraxial and paravertebral blocks, which provides excellent analgesia during and after ambulatory breast surgery. Pecs block has been considered postoperative pain management [5].
This block combines both motor and sensory nerve blocks when compared with wound-infiltration technique, which aims to sensory block only, and there is no sympathetic block associated with the paravertebral and epidural blocks. It is a fast-acting and straightforward block. Injecting in the fascial plane between the pectoral muscles is not enough to reach the anterior branches of the intercostal nerves, and it will not be a good block, but pecs block obtains consistent anesthesia of the dermatomes from T2 to T4 with variable spread to T6 [6,7].

Dexmedetomidine mechanism may by acting on central action, α2 receptor-mediated vasoconstriction, attenuation of inflammatory responses, direct effect on peripheral nerves, or by increasing the activity-dependent hyperpolarization through blocking the hyperpolarization-activated cation (Ih) current [8]. The available preclinical and clinical data propose that the addition of dexmedetomidine with local anesthetics is well tolerated without signs of neurotoxicity [9].

We aimed to primarily assess the effect of dexmedetomidine as an adjuvant to bupivacaine in pecs block on the duration of postoperative analgesia, total consumption of analgesics in 24 h, and number of patients requiring analgesia, and secondarily to evaluate hemodynamic stability, patient-satisfaction scores, and any incidence of adversities, such as hematoma, pneumothorax, and bradycardia if heart rate is less 60 beats/min.

Patients and methods
After the local ethical committee of Benha University Hospital approval and patients’ informed written consent, this prospective, randomized, double-blind clinical trial was conducted on 72 female patients. This study started from June 2020 to March 2021. Their ages ranged between 18 and 50 years old and class I and II American Society of Anesthesiologists physical status. These patients were scheduled for breast cancer surgery. Patients with coagulation disorders, hepatic or renal impairment, previous chest surgery, uncooperative patients, skin infection at the puncture site, and patients with a history of allergy to any of the study drugs were excluded from the study.

These patients were randomly allocated using a computerized random number generator into two groups:

Group II (study group) (30 patients) received 25 ml of 0.25% of plain bupivacaine plus dexmedetomidine (Precedex; Hospital Inc., Lake Forest, Illinois, USA) 1 μg/kg were used for pecs block.

All patients, nursing staff, and drug providers were blinded to the nature of the injected drugs. Sealed envelopes containing group allocation were opened before the blocks were performed.

One hour before surgery after insertion of venous access, all patients received premedication in the form of 0.05–0.1 mg/kg of intravenous midazolam. Perioperative monitoring included ECG, pulse oximetry, and noninvasive blood pressure. Modified pecs II block was performed under ultrasound guidance using sonosite M Turbo (SonoSite, Worldwide Headquarters, 21919 30th Drive SE, 98021-3904 Bothell, WA, United States, Washington, US) with linear multifrequency 6–13-MHz transducer (L25×13–6-MHz linear array) scanning probe. Under complete aseptic condition and with the patient in the supine position with the arm abducted 90°, the probe was applied at the mid-clavicular level and angled inferolateral. The pectoral muscle was identified with the axillary artery and vein on a sonographer. Under ultrasound-guided pecs block, the patients received 10 ml of bupivacaine 0.25%, injected at the fascial plain between the pectoral major and minor muscles (pecs I) and also 15 ml of bupivacaine of 0.25% injected above the serratus anterior muscle (pecs II). General anesthesia was induced in all patients with fentanyl (1–2 μg/kg), propofol (1–2 mg/kg), and an intuitive dose of cisatracurium (0.15 mg/kg), endotracheal intubation secured the airway. All patients were reversed with neostigmine 0.04 mg/kg and atropine (0.01–0.02 mg/kg). If visual analog scale (VAS) was more than 4, we gave morphine 5 mg (by intravenous route) to this patient, postoperatively.

The primary outcome measures postoperative VAS were to assess pain intensity, the first analgesic requested, and maximum opioid analgesic consumption for 24 h. The secondary outcome measures included heart rate and blood pressure every hour for the first 6 h postoperatively. Any complication related to the blocks was recorded.

Statistical analysis
(1) Data were analyzed using SPSS (version 16; SPSS Inc., Chicago, Illinois, USA).
Quantitative data were shown as a mean and SD and were analyzed using unpaired Student’s t test.

Qualitative data were shown as number and percentages and were analyzed using the $\chi^2$ and Z tests.

A $P$ value of less than 0.05 was considered statistically significant, while a $P$ value less than 0.01 was considered statistically highly significant.

The sample size.

Sigma plot 12 was used for sample-size calculation, where a sample size of 30 patients per group will achieve 83% power to detect a difference of 50% in the proportion of postoperative complications.

Data were collected, revised, coded, and entered into the Statistical Package for Social Science (IBM SPSS), version 23 [10].

Results

A total of 72 patients were screened during the study period. Of them, 12 patients did not match the inclusion criteria. A total of 60 patients were contained in the study (Figs 1–3).

Demographic variables and duration of surgery were comparable in both groups (Table 1). Regarding age, weight, height, BMI, surgical duration, and American Society of Anesthesiologists, there were insignificant statistical differences between the two groups.

Table 2 shown as during rest. This table showed no significant differences between groups, as regards VAS at postanesthetic care unit (PACU), 4, 8, 20, and 24 h postoperatively. But, as regards VAS at 12 h, in group I postoperatively, was a highly significant reduction ($P<0.001$) and at 16 h, in group II postoperatively, a statistically significant reduction ($P=0.013$).

Table 3 shows VAS during movement. This table showed no significant differences between groups, as regards VAS at PACU, 4, 8, 20, and 24 h postoperatively. But, as regards to VAS at 16 h, postoperatively, was highly significant in group II reduction ($P<0.033$), and at 12 h, in group II postoperatively, a statistically significant reduction ($P<0.001$).

Table 4 shows a longer duration of analgesia in group II (21±3 h) in comparison with group I (16±4 h).
Statistical analysis showed a statistically highly significant ($P=0.006$). Also, consumption of morphine was lower in group II (5±3 mg/24 h) in comparison with group I (9±4 mg/24 h). Statistical analysis showed a statistically significant ($P=0.01$).

**Discussion**

Many different ways have been used to provide postoperative analgesia in breast surgeries, such as opiates, nonsteroidal anti-inflammatory agents, wound infiltration with local anesthetic agents like the thoracic epidural, and paravertebral blocks. Pecs I and II block is one of the new techniques and may be an effective and safe method. These blocks are easy, reliable techniques and lack any sympathetic blockade and severe adverse hemodynamic effects [11].

Regional anesthesia techniques provide better-quality acute pain control with less chronic pain after modified radical mastectomy (MRM). The control of acute pain improves the immune function by suppressing the stress response to surgery and reducing the requirements for opioids, especially morphine, which
can inhibit humoral and cellular immune functions [12].

Dexmedetomidine has been shown to produce antinociception in humans, acute, and chronic pain states. Perineural dexmedetomidine decreases the bupivacaine-induced acute perineural inflammation [13].

O'Scanaill et al. [14] have shown that pecs I does not improve postoperative analgesia after breast cancer surgery, whereas many other studies have provided evidence that pecs II is an effective pain management for patients undergoing mastectomy. Numbers of studies have focused on the efficacy of pecs I with pecs II applied to MRM.

### Table 1 Demographic data of both groups

<table>
<thead>
<tr>
<th></th>
<th>Group I (N=30)</th>
<th>Group II (N=30)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>54.38±5.93</td>
<td>56.41±6.54</td>
<td>0.237</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74.23±9.23</td>
<td>76.34±8.38</td>
<td>0.401</td>
</tr>
<tr>
<td>ASA [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>18 (60)</td>
<td>16 (53.33)</td>
<td>0.43</td>
</tr>
<tr>
<td>II</td>
<td>12 (40)</td>
<td>14 (47.67)</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>166.12±6.89</td>
<td>168.45±7.54</td>
<td>0.259</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>92.43±11.56</td>
<td>93.74±12.45</td>
<td>0.705</td>
</tr>
</tbody>
</table>

ASA, American Society of Anesthesiologists.

### Table 2 Visual analog scale at rest in both groups during 24 h postoperatively

<table>
<thead>
<tr>
<th></th>
<th>Group I (N=30)</th>
<th>Group II (N=30)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At PACU Median (range)</td>
<td>0 (0–4)</td>
<td>1 (0–4)</td>
<td>0.201</td>
</tr>
<tr>
<td>At 4 h Median (range)</td>
<td>1 (0–4)</td>
<td>1 (0–3)</td>
<td>0.681</td>
</tr>
<tr>
<td>At 8 h Median (range)</td>
<td>2 (0–3)</td>
<td>2 (0–4)</td>
<td>0.314</td>
</tr>
<tr>
<td>At 12 h Median (range)</td>
<td>3 (0–5)</td>
<td>2 (0–4)</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>At 16 h Median (range)</td>
<td>3 (0–5)</td>
<td>2 (0–5)</td>
<td>0.013*</td>
</tr>
<tr>
<td>At 20 h Median (range)</td>
<td>3 (0–5)</td>
<td>3 (0–5)</td>
<td>0.625</td>
</tr>
<tr>
<td>At 24 h Median (range)</td>
<td>3 (0–5)</td>
<td>3 (0–5)</td>
<td>0.287</td>
</tr>
</tbody>
</table>

PACU, postanesthetic care unit. *Significant to other groups. **Highly significant.

### Table 3 Visual analog scale at movement in both groups during 24 h postoperatively

<table>
<thead>
<tr>
<th></th>
<th>Group I (N=30)</th>
<th>Group II (N=30)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>At PACU Median (range)</td>
<td>0 (0–4)</td>
<td>1 (0–4)</td>
<td>0.201</td>
</tr>
<tr>
<td>At 4 h Median (range)</td>
<td>1 (0–4)</td>
<td>1 (0–4)</td>
<td>0.581</td>
</tr>
<tr>
<td>At 8 h Median (range)</td>
<td>2 (1–3)</td>
<td>2 (0–4)</td>
<td>0.514</td>
</tr>
<tr>
<td>At 12 h Median (range)</td>
<td>3 (1–6)</td>
<td>2 (0–4)</td>
<td>0.033*</td>
</tr>
<tr>
<td>At 16 h Median (range)</td>
<td>3 (0–5)</td>
<td>2 (0–4)</td>
<td>0.001**</td>
</tr>
<tr>
<td>At 20 h Median (range)</td>
<td>4 (0–6)</td>
<td>3 (0–6)</td>
<td>0.625</td>
</tr>
<tr>
<td>At 24 h Median (range)</td>
<td>4 (0–6)</td>
<td>3 (0–6)</td>
<td>0.387</td>
</tr>
</tbody>
</table>

PACU, postanesthetic care unit. *Significant to other groups. **Highly significant.
In agreement with these results, Matsumoto [18] found that, relative to the thoracic spinal cord in breast surgery, VAS was significantly decreased in the pecs unit during surgery and also he found a significant increase of the time of postoperative analgesia with a significant reduction of the fentanyl requirement when he compared pecs II block with thoracic spinal cord in breast cancer surgery using 20 ml of levobupivacaine 0.5%.

Also, Razek et al. [16] found that the amount of postoperative morphine was significantly lower in the pecs group than in the general anesthesia (GA) group, and Torre et al. [17] stated that VAS was significantly lower in the pecs group than thoracic epidural block (TEB).

In agreement with these results, Matsumoto et al. [18] reported significantly reducing of VAS scores in the PACU and at 24 h after MRM in GA with serratus plane block (SPB)+pecs I group compared with GA-only group. Also, in agreement with these results, Farran and Sawsan [19] reported that VAS pain scores were highly statistically significantly reduced immediately and at 4 h postoperative in the pecs group than the TEB group. Also, the time for the first request for pethidine was highly significantly increased in the pecs group than in the TEB group and the total amount of pethidine at 4 h postoperative in the pecs group than the TEB group.

Also, Manzoor et al. [20] found that addition of dexmedetomidine to bupivacaine versus plain bupivacaine in pecs types I and II in breast surgeries, is safe and efficacious in prolonging the duration of peripheral nerve blocks. They found a 40% increase in the duration of complete analgesia in dexmedetomidine group (1024.0±124.9 min) when compared with plain bupivacaine (726.4±155.3 min; \( P<0.001 \)) and also the total consumption of injection of diclofenac sodium in 24 h was 23% less in group II (77.5±13.6 mg) when compared with group I (100.0±35.9 mg, \( P=0.003 \)).

Supporting the present results, a study by Eldeen [15] found that, relative to the thoracic spinal cord in breast surgery, VAS was significantly decreased in the pecs unit during surgery and also he found a significant increase of the time of postoperative analgesia with a significant reduction of the fentanyl requirement when he compared pecs II block with thoracic spinal cord in breast cancer surgery using 20 ml of levobupivacaine 0.5%.

Therefore, the current study points out that adding dexmedetomidine to bupivacaine in ultrasound-guided pectoral block during breast surgery prolongs the postoperative analgesia, delays the time of the first analgesic request, and reduces postoperative opioid consumption without serious side effects.

**Financial support and sponsorship**
Nil.

**Conflicts of interest**
There are no conflicts of interest.

### References


### Table 4 Pain rescue analgesia consumption in the first 24 h in both groups

<table>
<thead>
<tr>
<th></th>
<th>Group I (N=30)</th>
<th>Group II (N=30)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of the first rescue dose (h)</td>
<td>16±4</td>
<td>21±3</td>
<td>0.006**</td>
</tr>
<tr>
<td>Total dose of morphine (mg)</td>
<td>9±4</td>
<td>5±3</td>
<td>0.01*</td>
</tr>
</tbody>
</table>

*Significant to another group. **Highly significant.


