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[a], Ahmed H.Abd Elrahman[b], Elsayed M. Abdelzaam[b]

[a]Department of Anesthesia and Surgical Intensive Care, Benha University, [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 μg/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

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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, α-2 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 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; 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 90^0, 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).

(2) Quantitative data were shown as a mean and SD and were analyzed using unpaired Student's t test.
(3) Qualitative data were shown as number and percen-tages and were analyzed using the χ^2 and Z tests.
(4) 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.
(5) The sample size.
(6) 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).

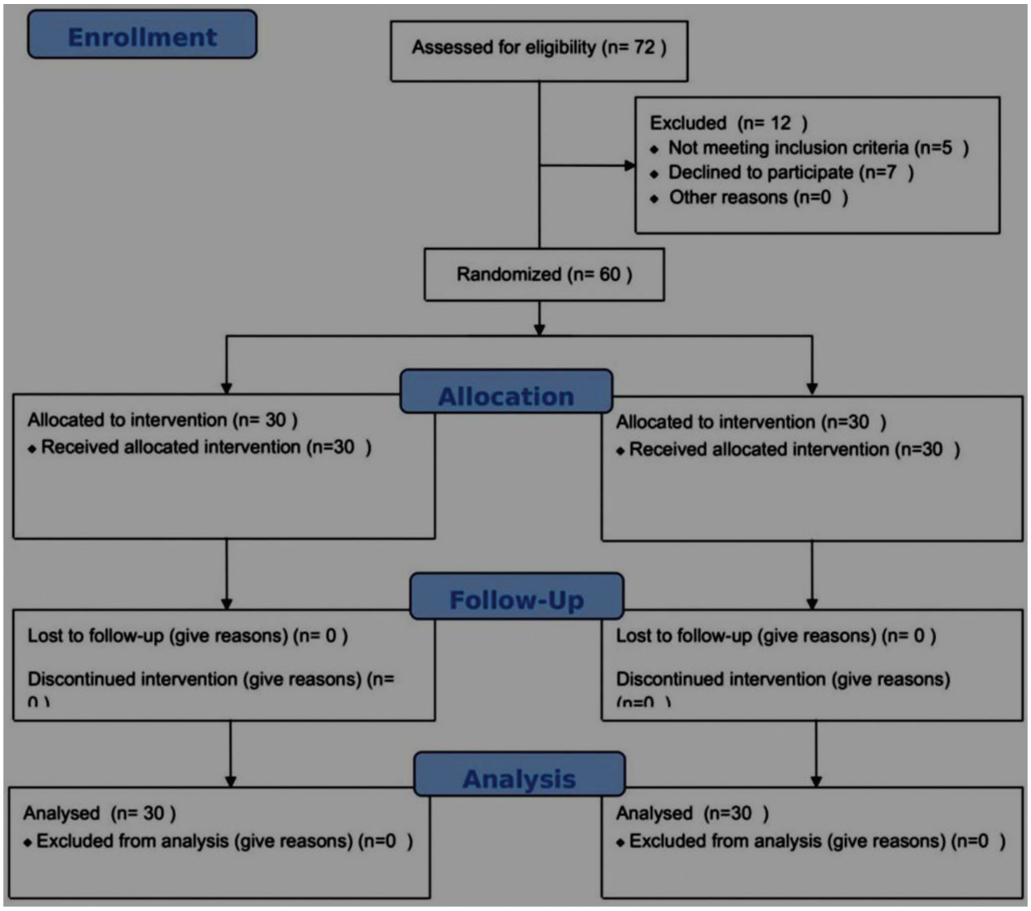
Demographic variables and duration of surgery were comparable in both groups (Table 1). Regarding age, weight, height, BMI, surgical duration, and American Society of Anesthesiologists, there were insignificant statistical differences between the two groups.

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 ($P<0.001$).

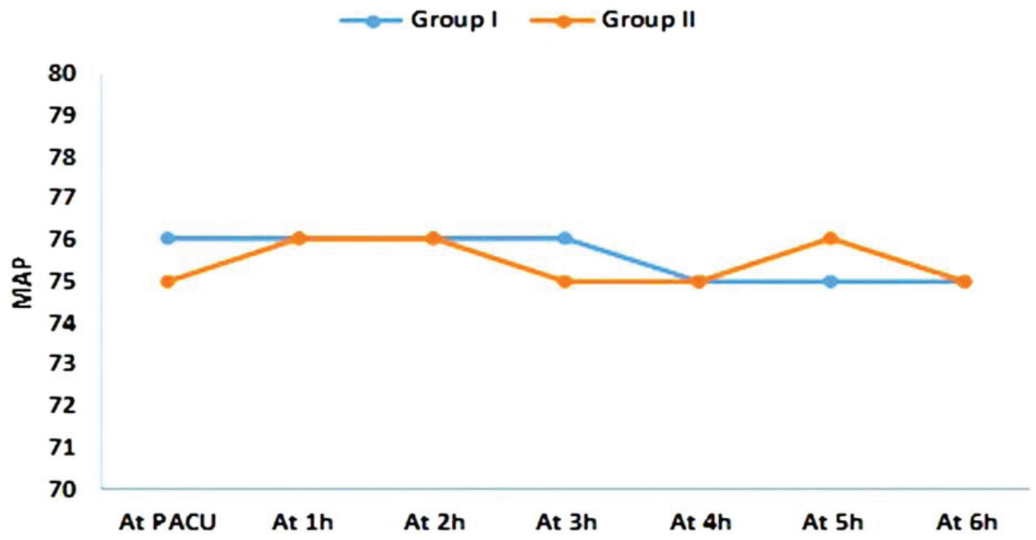
Table 4 shows a longer duration of analgesia in group II (21±3 h) in comparison with group I (16±4 h).

Figure 1



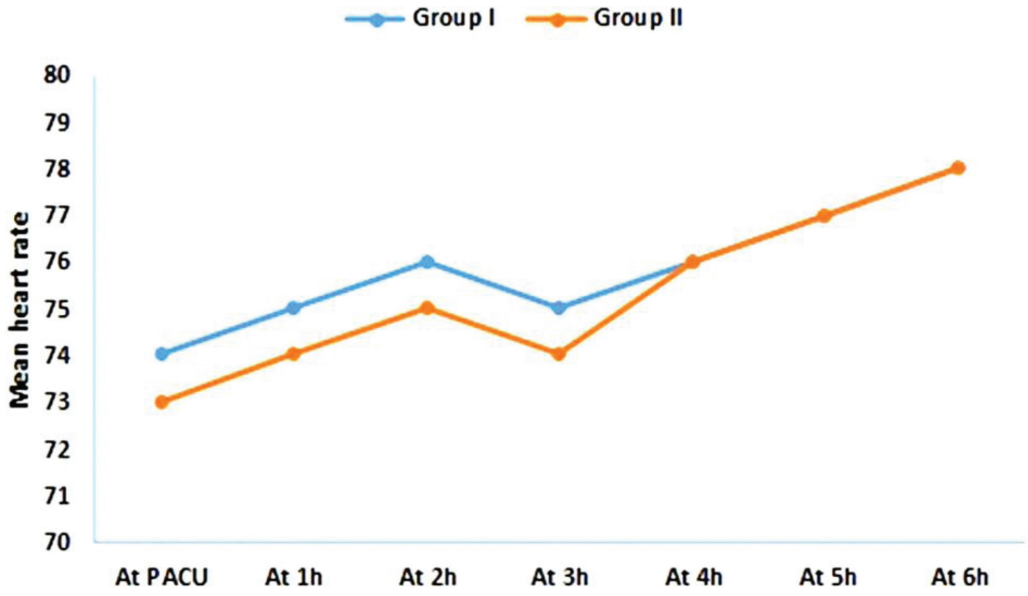
Consort flow chart.

Figure 2



Mean arterial pressure between the two groups.

Figure 3



Heart rate between the two groups.

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

Table 1 Demographic data of both groups

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

ASA, American Society of Anesthesiologists.

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

	Group I (*N*=30)	Group II (*N*=30)	*P* value
At PACU			
Median (range)	0 (0–4)	1 (0–4)	0.201
At 4 h			
Median (range)	1 (0–4)	1 (0–3)	0.681
At 8 h			
Median (range)	2 (0–3)	2 (0–4)	0.314
At 12 h			
Median (range)	3 (0–5)	2 (0–4)	<0.001**
At 16 h			
Median (range)	3 (0–5)	2 (0–5)	0.013*
At 20 h			
Median (range)	3 (0–5)	3 (0–5)	0.625
At 24 h			
Median (range)	3 (0–5)	3 (0–5)	0.287

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

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

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

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

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

	Group I (*N*=30)	Group II (*N*=30)	*P* value
Time of the first rescue dose (h)	16±4	21±3	0.006**
Total dose of morphine (mg)	9±4	5±3	0.01*

*Significant to another group. **Highly significant.

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%.

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 thorathic 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 24 h was highly significantly reducing in the pecs group when compared with 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, $P=0.003$).

Conclusion

The addition of dexmedetomidine to bupivacaine in ultrasound-guided pecs 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.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Couceiro TC, Valença MM, Raposo MC, Orange FA, Amorim MM. Prevalence of post-mastectomy pain syndrome and associated risk factors: a cross-sectional cohort study. Pain Manag Nurs 2014; 15:731–737.

2 Gartner R, Jensen MB, Nielsen J, Ewertz M, Kroman N, Kehlet H. Prevalence of and factors associated with persistent pain following breast cancer surgery. JAMA 2009; 302:1985–1992.

3 Westbrook AJ, Buggy DJ. Anaesthesia for breast surgery. Br J Anaesth 2003; 8:151–154.

4 Tait RC, Zoberi K, Ferguson M, Levenhagen K, Luebbert RA, Rowland K, Salsich GB, Herndon C. Persistent postmastectomypain: risk factors and currentapproaches to treatment. J Pain 2018; 19:1369–1383.

5 Cali Cassi L, Biffoli F, Francesconi D, Petrella G, Buonomo O. Anesthesia andanalgesia in breast surgery: the benefitsof peripheral nerve block. Eur Rev Med Pharmacol Sci 2017; 21:1341–1345.

6 Karaca O, Pınar HU, Arpacı E, Dogan R, Cok OY, Ahiskalioglu A. The Efficacyof ultrasound-guided type-I and type-II pectoral nerve blocks for postoperativeanalgesia after breast augmentation: Aprospective, randomized study. Anaesth Crit Care Pain Med 2019; 38:47–52.

7 Bakr MA, Mohamed SA, Mohamad MF, Mohamed MA, El Sherif FA, Mosad E, Abdel-Hamed MF. Effect of dexmedetomidine added to modified pectoral block on postoperative pain and stress response in patient undergoing modifiedradical mastectomy. Pain Physician 2018; 21: E87–E96.

8 Das B, Lakshmegowda M, Sharma M, Mitra S, Chauhan R. Supraclavicular brachial plexus block using ropivacaine alone or combined with dexmedetomidine for upper limb surgery: a prospective, randomized, double-blinded, comparative study. Rev Esp Anestesiol Reanim 2016; 63:135–140.

9 Gu XY, Liu BL, Zang KK, Yang L, Xu H, Pan H-L., Zhao ZQ, Zhang YQ. Dexmedetomidine inhibits tetrodo-toxin-resistant Nav1.8 sodium channel activity through Gi/Co-dependent pathways inratdorsal root ganglion neurons. Mol Brain 2015; 8:15.

10 Gupta K, Srikanth K, Girdhar KK, Chan V. Analgesic efficacy of ultrasound-guided paravertebral block versus serratus plane block for modified radical mastectomy: a randomized, controlled trial. Indian J Anaesth 2017; 16:381–386.

11 Marhofer D, Marhofer P, Triffterer L, Leonhardt M, Weber M, Zeitlinger M. Dislocation rates of perineural catheters: a volunteer study. Br J Anaesth 2013; 111:800–806.

12 Gupta K, Kshirsagar S, Chang L, Schwartz R, Law PY, Yee D, Hebbel RP. Morphine stimulates angiogenesis by activating proangiogenic and survival-promoting signaling and promotes breast tumor growth. Cancer Res 2002; 62:4491–4498.

13 Mohamed SA, Fares KM, Mohamed AA, Alieldin NH. Dexmedetomidine as an adjunctive analgesic with bupivacaine in paravertebral analgesia for breast cancer surgery. Pain Physician 2014; 17:E589–E598.

14 O'Scanaill P, Keane S, Wall V, Flood G, Buggy DJ. Single-shot pectoral plane (PECS I and PECS II) blocks versus continuous local anaesthetic infusion analgesiaor both after non-ambulatory breast-cancer surgery: a prospective, randomised, double-blind trial. Br J Anaesth 2018; 120:846–853.

15 Eldeen HMS. Ultrasound guided pectoral nerve blockade versus thoracic spinal blockade for conservative breast surgery in cancer breast: a randomized controlled trial. Egypt J Anaesth 2016; 32:2935.

16 Razek AA, Abouallo MM, Abdel Hamid Sh A, Osman MD. Ultrasound guided pectoral nerve blocks versus serratus intercostals plane block in breast surgeries. Res Opinion Anesth Intensive Care 2018; 5:162–169.

17 Torre PA, Jones JrJW, Álvarez SL, Garcia PD, Miguel FJ, Rubio EM, *et al.* Axillary local anesthetic spread after the thoracic interfacial ultrasound block-a cadaveric and radiological evaluation. Rev Brasil Anestesiol 2017; 67:555–564.

18 Matsumoto M, Flores EM, Kimachi PP, Gouveia FV, Kuroki MA, Barros AC, *et al.* Benefits in radical mastectomy protocol: a randomized trial evaluating the use of regional anesthesia. Sci Rep 2018; 8:7815.

19 Farran HA, Sawsan GM. Ultrasound guided PECS II block versus thoracic epidural in modified radical mastectomy for post-operative pain relief. Med J Cairo Univ 2019; 87:4433–4439.

20 Manzoor S, Rajeev T, Nishant S, Arun P, Geeta K. Comparative study to assess the quality of analgesia of bupivacaine and bupivacaine with dexmedetomidine in ultrasound-guided pectoral nerve block type I and II in breast surgeries. J Anaesthesiol Clin Pharmacol 2018; 34:227–231.