Dexmedetomidine as an adjunctive analgesic to ropivacaine in pectoral nerve block in oncological breast surgery: A randomized double-blind prospective study

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Abstract

Background and Aims: Pectoral nerve block (Pecs) using local anesthetic (LA) agent is a newer analgesic technique for breast surgeries. This study further evaluates the effect of addition of dexmedetomidine to LA agent on total duration of analgesia and postoperative morphine consumption.

Material and Methods: A total of 60 American Society of Anesthesiologist Grade I and II female patients with age ≥18 years, scheduled for oncological breast surgery, were enrolled in the study. Patients were randomized into two equal groups of 30 each. Group R (n = 30) received ultrasound (US)-guided Pecs block with 30 ml of 0.25% ropivacaine. Group RD (n = 30 patients) received US-guided Pecs block with 30 ml of ropivacaine 0.25% and dexmedetomidine 1 µ/kg body weight. Duration of analgesia and total postoperative morphine consumption was noted in 24 h period. Unpaired t-test and Chi-square test were used for statistical analysis.

Results: A statistically highly significant increase in total duration of analgesia (in minutes) was recorded in Group RD as compared to Group R (469.6 ± 81.5 in Group RD and 298.2 ± 42.3 in Group R) (P = 0.000). Total postoperative morphine consumption in mg was also statistically significantly lower in Group RD as compared to Group R (14.8 ± 2.4 in Group RD and 21.6 ± 3.1 in Group R) (P = 0.000). No patient under study reported any adverse effects.

Conclusion: Addition of 1 µ/kg dexmedetomidine to 0.25% ropivacaine for Pecs block increases the duration of analgesia and decreases postoperative morphine consumption.

Keywords: Dexmedetomidine, nerve block, postoperative pain

Introduction

Oncological breast surgery is frequently associated with postoperative pain, nausea, vomiting, and painful restricted upper limb movements.[¹] Oncological surgery patients are prone to deep vein thrombosis, and pain-related immobility can further accentuate it. Pain leads to pulmonary atelectasis and postoperative hypoxemia. In fact, inadequately managed pain in the acute postoperative phase is a major risk factor for the development of chronic pain syndromes.[²]

Pain targeted preoperatively prevents sensitization of nociceptors, decreases perioperative analgesic requirement, and development of chronic pain syndromes.[³-⁵] Regional analgesia techniques improve acute postoperative pain and reduce the incidence of associated complications.[⁶] These

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techniques provide analgesic effect by blocking nociceptive transmission from peripheral to central neuronal system. However, their analgesic advantage is limited by relatively short duration of action of currently available local anesthetics and especially resolution of block before postoperative period of worst pain. Although the analgesic duration can be prolonged by increasing total dose of local anesthetic, the risk of systemic side effects and potential neurotoxicity also increases. Therefore, ultrasound (US) guidance and adjunct strategy are an attractive alternative to prolong duration, decreases the potential risk of side effects by reducing the total dose of individual local anesthetic agent. 

US-guided pectoral nerve blocks (Pecs 1 and 2) are preferred techniques for providing effective analgesia in breast surgery. Previous studies of Pecs block with sole local anesthetic (LA) agent have been shown to provide good pain relief with significant reduction of opioid consumption and need for rescue analgesia. The present study was planned to evaluate whether the addition of dexmedetomidine, alpha-2 agonist as an adjunct to ropivacaine, LA agent, helps to achieve a significant longer pain relief or not when compared with local anesthetic alone.

Dexmedetomidine, potent alpha-2 adrenergic receptor agonists, is apparently eight times more selective toward alpha-2 adrenoceptors than clonidine which makes it an attractive adjunct option. Dexmedetomidine has been found to be safe in animal models when administered perineural.

**Material and Methods**

After hospital ethical committee approval, the study was carried out as a prospective randomized double-blind study on 60 female American Society of Anesthesiologists (ASA) Grade I and II patients of age 18 years and above, scheduled to undergo oncological breast surgeries. Patients were divided into two equal groups of 30 each by sealed envelope technique.

Group R (n = 30) received US-guided Pecs block with 30 ml of 0.25% ropivacaine. Group RD (n = 30) received US-guided Pecs block with 30 ml of 0.25% ropivacaine and dexmedetomidine 1 µg/kg body weight (bwt). Out of this 30 ml, 10 ml was given at Pecs I site and 20 ml in Pecs II site.

Procedure of block and visual analog scale (VAS) was explained and written informed consent was obtained at preanesthetic checkup. Patients with a history of allergy to local anesthetic and morphine, history of opioid use or addiction, obesity with body mass index ≥35 kg/m², chest wall deformities, and pregnancy were excluded from the study.

Intravenous (IV) line was secured. Standard anesthesia monitoring was established. General anesthesia was induced with IV morphine 0.1 mg/kg, IV propofol 2 mg/kg, and tracheal intubation was facilitated with IV vecuronium 0.1 mg/kg. Anesthesia was maintained with isoflurane and O₂/nitrous mixture with a fraction of 40% inspired O₂.

Pecs block was performed with US (Esaote MyLabOne Model1000) using linear probe of high frequency (6–13 MHz) after sheathing. Preoperative baseline values of patients vitals, i.e., systolic blood pressure (SBP), diastolic blood pressure (DBP), oxygen saturation of arterial blood (Spo₂), and heart rate (HR) were recorded followed by recordings at every 5 min interval till 30 min and then every 10 min till 1 h and thereafter every 15 min till the end of surgery and postoperatively at 1, 2, 6, 12, and 24 h. Adverse events such as hypotension (a 20% decrease in relation to the baseline value), bradycardia (HR <50 bpm), hypoxemia (SpO₂ ≤90%), and perioperative nausea and vomiting were noted.

Morphine 0.05 mg/kg in bolus doses was given IV if the mean blood pressure or HR exceeded 20% of the preoperative value. Neuromuscular blockade was reversed with IV neostigmine (0.05 mg/kg) and IV glycopyrrolate (0.01 mg/kg).

In postanesthetic care unit (PACU), patient perception of pain was assessed at rest using VAS (0–10) every hour till 12 h then at 18 h and 24 h. IV patient-controlled analgesia (PCA) was commenced with morphine (1 mg bolus, lockout time interval of 10 min, and 4 h limit of 0.25 mg/kg without any baseline infusion). IV PCA was continued for 24 h postoperatively. Time to first analgesia request was recorded from the completion of Pecs block to first given morphine dose and counted as duration of analgesia. Total postoperative morphine consumption was also noted in 24 h period.

Nausea lasting >10 min or vomiting was treated with IV ondansetron 0.1 mg/kg (maximum - 4 mg). Inverted observer assessment of alertness sedation scale¹ where: 1 = awake and 5 = asleep and unarousable was used to assess sedation level in the postoperative period on arrival to PACU and at 1, 2, 6, 12, and 24 h. Patient satisfaction score (PSS) regarding postoperative pain relief was recorded at 24 h postoperatively as 5 – excellent, 4 – very good, 3 – good, 2 – fair, and 1 – poor.

This study calculated sample size on the basis of previous studies conducted and extensive literature reviews which reports a baseline requirement of 20 mg morphine. We assumed at least 10%–12% deduction in the requirement.
of morphine to label it clinically significant. Hence, a point estimate of 18 mg was deemed as clinically significant for this study. The dispersion of the values as reported in the literature was set on point estimate ±2.7.

Alpha value and beta value for this study were traditionally set on 0.05 and 0.2. From this, the calculated sample size is approximately 30 participants in each arm of the study. The data from the present study were analyzed by the Statistical Package for the Social Sciences software, Statistics for Windows, version 19.0, IBM Corp., Armonk, NY, USA. Unpaired t-test was applied for demographic data, analgesic efficacy, VAS, and hemodynamic parameters. Chi-square test was applied for sex, ASA grades sedation score, and PSS. P value was considered significant if <0.05.

Results

A total of 60 female patients were enrolled in the study. The demographic data were similar in both groups (P > 0.05) [Table 1]. Duration of analgesia was statistically longer in Group RD as compared to Group R (469.6 ± 81.5 in Group RD and 298.2 ± 42.3 in Group R, P = 0.000) [Table 2]. Total morphine consumption was statistically more in Group R (P = 0.000) as compared to Group RD (14.8 ± 2.4 in Group RD and 21.6 ± 3.1 in Group R, P = 0.000) [Table 2]. VAS scores were persistently low in Group RD as compared to R [Table 3].

Patients in Group RD had significantly higher sedation score on arrival to PACU and at 1 h (P < 0.05) as compared to Group R [Table 4]. A total of 17 patients in Group RD had sedation score of 3 as compared to only one patient in Group R at 1 h. Patients in both the groups showed equally good satisfaction score at 24 h [Table 4], being 23 patients in Group RD and 21 patients in Group R reported excellent PSS. None of the patients in either group had any technique- or drug-related side effects or complications.

We observed a statistically significant difference (P = 0.000) in HR between two groups from 20 min which extended in postoperative period. A statistically significant difference was also observed in SBP and DBP from 20 min that extended into the postoperative period [Table 5]. Both the groups were comparable for SpO2 at each interval.

Discussion

Thoracic epidural and PVBs became the gold standard techniques[14] to achieve pain relief after breast surgery. [10,14,15] However, both techniques may be associated with serious complications such as pneumothorax, total spinal anesthesia, and inadvertent intravascular injection.

As an alternative for these techniques, Blanco et al. designed a novel series of blocks: Pecs I and Pecs II. [9] US-guided Pecs block is a superficial block inspired by the infraclavicular block and transverses abdominis plane block. The administration of Pecs block just requires skill to use US.

Wabba et al.[10] compared PVB and Pecs block for analgesia after breast surgery using levobupivacaine 0.25%. They reported overall less morphine consumption in patients of Pecs group in the 1st 24 h and lower pain scores in 1st 12 h. We compared 0.25% ropivacaine with 0.25% ropivacaine and dexmedetomidine 1 μg/kg in Pecs block. We found statistically highly significant increase in total duration of analgesia (in minutes) in Group RD as compared to

| Table 1: The demographic data |
| Parameters | Group R (n=30) | Group RD (n=30) | P |
| --- | --- | --- | --- |
| Age in years (mean±SD) | 46.2±10.96 | 51.6±10.6 | 0.06* |
| ASA Grade (I/II) | 13/17 | 11/19 | 0.598* |
| Weight in kg (mean±SD) | 70.5±8.1 | 71.9±7.8 | 0.520* |

*P<0.05 (not significant). SD=Standard deviation, ASA=American Society of Anesthesiologist

| Table 2: Analgesic efficacy |
| Analgesic efficacy | Group R (n=30) | Group RD (n=30) | P |
| --- | --- | --- | --- |
| Duration of analgesia in minutes (i.e., time for first analgesic requirement) | 298.2±42.3 | 469.6±81.5 | 0.000 |
| Total postoperative morphine consumption in mg | 21.6±3.1 | 14.8±2.4 | 0.000 |

*P<0.000 (highly significant)

| Table 3: Visual analog score observed at different time intervals |
| Time interval (h) | VAS in Group R (n=30) | VAS in Group RD (n=30) | P |
| --- | --- | --- | --- |
| 1 | 2.4±0.7 | 2.3±0.6 | 0.545 |
| 2 | 2.5±0.6 | 2.3±0.8 | 0.355 |
| 3 | 2.5±0.5 | 2.3±0.6 | 0.226 |
| 4 | 2.9±0.9 | 2.3±0.6 | 0.003* |
| 5 | 3.1±0.8 | 2.4±0.7 | 0.000* |
| 6 | 2.5±0.6 | 2.4±0.6 | 0.682 |
| 7 | 2.5±0.6 | 2.5±0.6 | 0.831 |
| 8 | 3.3±0.6 | 3.1±0.6 | 0.375 |
| 9 | 2.5±0.7 | 2.3±0.7 | 0.268 |
| 10 | 2.5±0.6 | 2.4±0.6 | 0.539 |
| 11 | 2.8±0.6 | 2.5±0.6 | 0.137 |
| 12 | 2.97±0.9 | 2.6±0.6 | 0.078 |
| 18 | 2.5±0.5 | 2.5±0.5 | 0.613 |
| 24 | 2.5±0.5 | 2.4±0.5 | 0.445 |

P<0.000 (highly significant), P>0.05 (not significant). VAS=Visual analog score
Group R (298.2 ± 42.3 in Group R and 469.6 ± 81.5 in Group RD) (P = 0.000). Total postoperative morphine consumption in mg was also statistically significantly lower in Group RD as compared to Group R (14.8 ± 2.4 in Group RD and 21.6 ± 3.1 in Group R) (P = 0.000). Wabba et al. reported lower incidence of postoperative nausea and vomiting (PONV) in Pecs group in comparison with PVB group, probably because of less morphine consumption. We reported comparable PONV in both the groups. VAS scores were persistently lower in Group RD as compared to Group R. First breakthrough pain occurred after around 5 h in Group RD as compared to Group R where first breakthrough pain occurred after around 8 h, which correlates well with early resolution of sensory analgesia in Group R.

Another study[16] reported that pain scores were significantly lower when Pecs block was combined with PVB. In the trial of Sopena-Zubiria et al., patients enrolled in the study had minor breast surgery. They found lower incidence of PONV in Pecs group in comparison with PVB group and lower morphine consumption in Pecs group. One patient in PVB group had bilateral blockade and hypotension due to epidural spread of LA. Therefore, Pecs block is considered to be a technique that is almost devoid of this predicted complication. No patient under study reported any significant complication.

Bashandy and Abbas[17] compared quality of analgesia after modified radical mastectomy surgery using general anesthesia with Pecs block versus general anesthesia alone. They reported lower pain score, lower fentanyl consumption in intraoperative period. Postoperative morphine consumption was lower in the first 12 h, associated with reduced episodes of nausea and vomiting as well as reduced sedation score in Pecs group than in the control group. Sedation score observed in the present study showed that more number of patients had sedation score of 3, i.e., patient asleep but arousable to loud/repeated verbal stimulation on arrival to PACU and at 1 h in Group RD as compared to Group R; however, sedation score was comparable after that (P = 0.573 at 2 h and 0.718 at 6 h).

Dexmedetomidine has more selective affinity for alpha-2 receptor (α2: α1) (1620: 1), which permits its application in relatively high doses for sedation and analgesia without unwanted vascular effects from activation of α1 receptors. Dexmedetomidine had shown encouraging results when used in regional blocks such as transabdominal plane (TAP) block,[13] upper extremities

### Table 4: Postoperative observations

| Parameters observed                  | Group R (n=30) | Group RD (n=30) | P    |
|--------------------------------------|---------------|----------------|------|
| Sedation score on arrival to PACU (1/2/3) | 6/23/1        | 0/11/19        | 0.000|
| Sedation score at 1 h (1/2/3)        | 8/21/1        | 0/13/17        | 0.000|
| Sedation score at 2 h (1/2/3)        | 8/22/0        | 10/20/0        | 0.573*|
| Sedation score at 6 h (1/2/3)        | 5/25/0        | 4/26/0         | 0.718*|
| Sedation score at 12 h (1/2/3)       | 0/30/0        | 0/30/0         | -    |
| Sedation score at 24 h (1/2/3)       | 0/30/0        | 0/30/0         | -    |
| Postoperative nausea (yes/no)        | 4/26          | 5/25           | 0.718*|
| Patient satisfaction score (4/5)     | 9/21          | 7/23           | 0.559*|

**P<0.000 (highly significant), P>0.05 (not significant). PACU=Postanesthetic Care Unit**

### Table 5: Intraoperative and postoperative hemodynamic parameters

| Time (min) | HR (beats/min) | SBP (mm of Hg) | DBP (mm of Hg) |
|------------|----------------|----------------|----------------|
|            | Group R (n=30) | Group RD (n=30) | P              | Group R (n=30) | Group RD (n=30) | P              | Group R (n=30) | Group RD (n=30) | P              |
| 0          | 73.4±6.9       | 73.7±5.7       | 0.871          | 119.3±8.7      | 121.2±10.2      | 0.440          | 73.8±5.4       | 72.9±5.3       | 0.517*          |
| 5          | 74.9±5.2       | 76.1±4.7       | 0.368          | 123.97±5.2     | 125.9±7.5       | 0.120          | 75.3±4.3       | 76.8±5.4       | 0.237*          |
| 10         | 75.7±5.8       | 72.3±14.0      | 0.226          | 123.0±7.98     | 126.8±7.4       | 0.065          | 74.9±5.1       | 75.5±5.5       | 0.647*          |
| 15         | 74.7±4.7       | 71.4±4.3       | 0.006          | 123.3±6.99     | 121.5±6.9       | 0.327          | 74.9±4.3       | 71.9±3.9       | 0.008           |
| 20         | 75.7±5.8       | 67.8±4.9       | 0.000          | 123.3±6.99     | 114.3±6.7       | 0.000          | 74.9±4.3       | 71.8±3.6       | 0.004           |
| 25         | 74.7±4.7       | 67.5±4.7       | 0.000          | 123.3±6.99     | 114.3±6.7       | 0.000          | 74.9±4.3       | 71.8±3.6       | 0.004           |
| 30         | 72.7±4.1       | 67.1±4.4       | 0.000          | 124.3±7.8      | 113.1±5.7       | 0.000          | 74.8±4.3       | 69.6±3.2       | 0.000           |
| 40         | 71.97±3.9      | 67.2±4.5       | 0.000          | 124.3±7.8      | 111.1±5.5       | 0.000          | 74.8±4.3       | 69.6±3.2       | 0.000           |
| 50         | 71.97±3.9      | 67.3±4.1       | 0.000          | 123.3±7.2      | 110.5±5.1       | 0.000          | 75.4±3.9       | 67.4±3.2       | 0.000           |
| 60         | 71.97±3.9      | 67.3±3.999     | 0.000          | 123.3±7.2      | 109.5±5.9       | 0.000          | 75.4±3.9       | 66.4±3.4       | 0.000           |
| 75         | 71.97±3.9      | 67.3±3.999     | 0.000          | 124.6±6.5      | 110.8±4.7       | 0.000          | 75.9±3.7       | 67.0±3.6       | 0.000           |
| 90         | 71.97±3.9      | 67.3±3.7       | 0.000          | 124.6±6.5      | 115.5±6.0       | 0.000          | 75.9±3.5       | 69.1±3.0       | 0.000           |
| Postoperative at 1 h                 |                |                |                | 127.0±7.7      | 118.1±4.6       | 0.000          | 77.5±3.5       | 68.9±2.6       | 0.000           |
| Postoperative at 2 h                 |                |                |                | 127.0±7.7      | 117.2±5.6       | 0.000          | 77.5±3.5       | 69.3±3.8       | 0.000           |
| Postoperative at 6 h                 |                |                |                | 126.6±7.2      | 123.6±6.5       | 0.094          | 78.2±4.1       | 72.3±3.7       | 0.000           |
| Postoperative at 12 h                |                |                |                | 124.9±7.6      | 123.8±6.5       | 0.551          | 78.2±4.099     | 76.1±5.6       | 0.104*          |
| Postoperative at 24 h                |                |                |                | 123.4±6.3      | 126.7±6.8       | 0.056          | 78.5±4.1       | 76.8±5.4       | 0.185*          |

*P>0.05 (not significant), *P<0.000 (highly significant). HR=Heart rate, SBP=Systolic blood pressure, DBP=Diastolic blood pressure.
blocks,[18,19] lower extremities block,[20] epidural block,[21] and caudal block[22] without undue side effects. Dexmedetomidine when used in dose of 0.5 µg/kg along with bupivacaine in TAP block increased the total duration of analgesia and decreased the total morphine consumption.[13]

Dexmedetomidine may lead to side effects such as hypotension and bradycardia with increased dosage, along with its effects such as sedation and anxiolysis. In the present study, HR was statistically significantly lower in Group RD as compared to Group R after 20 min of induction, but none of the patients required any active treatment for the same. Similarly, SBP and DBP were also statistically significantly lower in Group RD as compared to Group R after 20 min of induction, but none of the patients required any active treatment for the same.

Limitations of this study are that we could not evaluate effect of Pecs block on chronic postsurgical pain and metastasis or recurrence of carcinoma breast. Assessment of dynamic VAS scores at limb movements could have further added to the significance of this study.

Conclusion

In conclusion, the addition of 1 µg/kg bw dexmedetomidine to ropivacaine in Pecs block is associated with a significantly prolonged duration of postoperative analgesia and decreased postoperative analgesic (opioid) requirement.

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Conflicts of interest

There are no conflicts of interest.

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