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Original Research Article

Efficacy of Dexmedetomidine as an Adjuvant with Ropivacaine in Paravertebral Block in Surgery for Breast Cancer - A Study of 50 Cases

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Abstract

Background: Effective postoperative pain control after breast cancer surgery is essential to reduce morbidity, opioid consumption, and patient discomfort. Thoracic paravertebral block (TPVB) is an established regional anesthesia technique that provides unilateral analgesia with minimal systemic effects. Ropivacaine is commonly used for TPVB due to its favorable safety profile. Dexmedetomidine, a highly selective α_2-adrenergic agonist, has been increasingly used as an adjuvant to local anesthetics to enhance analgesic efficacy. This study evaluated the efficacy of dexmedetomidine as an adjuvant to ropivacaine in TPVB for patients undergoing modified radical mastectomy.

Material and Methods: This prospective, randomized, controlled study was conducted on 50 female patients aged ≥18 years, belonging to ASA physical status I–III, scheduled for modified radical mastectomy. Patients were randomly allocated into two groups: Group PR received TPVB with 0.5% ropivacaine, while Group PRD received TPVB with 0.5% ropivacaine plus dexmedetomidine (1 µg/kg). TPVB was performed at T1, T3, and T5 levels before induction of general anesthesia. Primary outcomes included duration of analgesia and total postoperative opioid consumption. Secondary outcomes included onset of sensory block, hemodynamic parameters, and postoperative pain scores using the Visual Analogue Scale (VAS), Ramsay Sedation Scores, patient satisfaction, and adverse effects.

Results: Group PRD demonstrated a significantly faster onset of sensory block, prolonged duration of analgesia, lower postoperative VAS scores at all time intervals, and significantly reduced tramadol consumption compared to Group PR ($p < 0.001$). Hemodynamic parameters showed a controlled and stable reduction in heart rate and blood pressure in the dexmedetomidine group without clinical instability. Patient satisfaction was higher in Group PRD, with no significant increase in adverse effects.

Conclusion: Dexmedetomidine as an adjuvant to ropivacaine in TPVB significantly improves postoperative analgesia, reduces opioid requirement, and enhances patient satisfaction without increasing complications.

Keywords: Dexmedetomidine, Ropivacaine, Thoracic Paravertebral Block, Breast Cancer Surgery, Postoperative Analgesia.

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Introduction

Postoperative pain following breast cancer surgery is a major clinical concern, often leading to delayed recovery, increased opioid consumption, and reduced patient satisfaction. Inadequate pain control may also contribute to the development of chronic post-mastectomy pain syndrome.

Although general anesthesia remains the standard technique for breast surgeries, it provides limited postoperative analgesia and is associated with opioid-related adverse effects. [1] Thoracic paravertebral block (TPVB) has emerged as an effective regional anesthesia technique for breast surgeries. It provides unilateral sensory and sympathetic blockade, resulting in superior postoperative analgesia, reduced opioid consumption, decreased postoperative nausea and vomiting, and improved recovery profiles.

Ropivacaine, a long-acting amide local anesthetic, is favored for TPVB due to its lower cardiotoxicity and reduced motor blockade compared to

bupivacaine. [2,3] Dexmedetomidine, a highly selective α_2-adrenergic agonist, possesses analgesic, sedative, and sympatholytic properties. When used as an adjuvant to local anesthetics, it has been shown to prolong the duration of analgesia and reduce analgesic requirements. However, limited prospective data are available regarding its efficacy as an adjuvant to ropivacaine in TPVB for breast cancer surgery. This study was therefore undertaken to evaluate the analgesic efficacy, hemodynamic effects, and safety of dexmedetomidine added to ropivacaine in TPVB. [4]

Material and Methods

This prospective, randomized, controlled study was conducted at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants. Fifty female patients aged ≥18 years, belonging to ASA physical status I, II, or III, scheduled for elective modified radical mastectomy under general anesthesia were enrolled.

Inclusion criteria comprised adult female patients undergoing modified radical mastectomy. Exclusion criteria included patient refusal, allergy to local anesthetics or dexmedetomidine, coagulopathy, local infection at the block site, significant cardiovascular, respiratory, or renal disease, and sepsis. Patients were randomly allocated into two equal groups using a computer-generated randomization sequence. Group PR received TPVB with 0.5% ropivacaine (0.3 ml/kg) and normal saline, while Group PRD received TPVB with 0.5% ropivacaine (0.3 ml/kg) plus dexmedetomidine 1 μg/kg.

TPVB was performed at T1, T3, and T5 levels prior to induction of general anesthesia. Data collected included onset of sensory block, intraoperative hemodynamic parameters, postoperative VAS scores, duration of analgesia, total tramadol consumption over 24 hours, sedation scores, patient satisfaction, and adverse effects. Statistical analysis was performed using unpaired Student's t-test and Chi-square test, with $p < 0.05$ considered statistically significant.

Results

A total of 50 female patients undergoing modified radical mastectomy were enrolled and equally allocated into two groups (n = 25 each). All patients completed the study and were included in the final analysis. The two groups were comparable with respect to demographic characteristics including age, weight, ASA physical status, and duration of surgery, with no statistically significant differences observed ($p > 0.05$). The onset of sensory block was significantly faster in Group PRD compared to Group PR (3.4 ± 0.70 min vs. 4.76 ± 0.71 min; $p < 0.001$). Hemodynamic parameters, including heart rate and blood pressure, were similar between groups during the initial intraoperative period. From 20 minutes onward, Group PRD demonstrated a statistically significant reduction in heart rate, systolic, diastolic, and mean arterial pressures compared to Group PR; however, these changes remained clinically stable and did not require intervention.

Postoperative pain assessment using the Visual Analogue Scale revealed significantly lower scores in Group PRD at all measured time intervals up to 24 hours ($p < 0.05$). The duration of analgesia was significantly prolonged in Group PRD compared to Group PR (944 ± 608.11 min vs. 433.6 ± 98.99 min; $p < 0.001$). Correspondingly, total tramadol consumption during the first 24 postoperative hours was significantly lower in Group PRD (0.88 ± 0.71 mg/kg) than in Group PR (2.84 ± 0 mg/kg; $p < 0.001$).

Sedation scores assessed using the Ramsay Sedation Scale were comparable between groups and did not indicate excessive sedation. Patient satisfaction scores were higher in Group PRD. The incidence of adverse effects was minimal and comparable between groups, with no serious complications reported.

Discussion

Effective postoperative pain control is a cornerstone of enhanced recovery following breast cancer surgery. Thoracic paravertebral block has gained popularity due to its ability to provide unilateral analgesia with minimal systemic effects. In the present study, the addition of dexmedetomidine to ropivacaine significantly improved analgesic outcomes in patients undergoing modified radical mastectomy. [5,6]

The onset of sensory block was significantly faster in the dexmedetomidine group. This may be attributed to the synergistic action of dexmedetomidine with local anesthetics, possibly through hyperpolarization of nerve membranes and inhibition of C-fiber transmission. Similar findings have been reported in studies evaluating dexmedetomidine as an adjuvant in peripheral nerve blocks. Hemodynamic parameters demonstrated a controlled reduction in heart rate and blood pressure in the dexmedetomidine group, reflecting its central sympatholytic action. Importantly, these changes were not associated with clinically significant hypotension or bradycardia, indicating hemodynamic safety at the administered dose. [7,8,9]

Postoperative pain scores were significantly lower in the dexmedetomidine group at all measured intervals. This prolonged analgesic effect reduced

the need for rescue analgesia, highlighting the opioid-sparing benefit of dexmedetomidine. Reduced opioid consumption is particularly beneficial in breast cancer patients, as it minimizes opioid-related adverse effects and facilitates early mobilization. The duration of analgesia was markedly prolonged in the dexmedetomidine group, consistent with previous studies demonstrating enhanced block duration with α_2-agonists. This prolonged analgesia improves patient comfort and may reduce the risk of chronic postoperative pain. [10,11]

Patient satisfaction scores were significantly higher in the dexmedetomidine group, likely due to better pain control and reduced need for additional analgesics. The incidence of adverse effects was comparable between groups, confirming the safety of dexmedetomidine as an adjuvant in TPVB.

The study was conducted at a single center with a relatively small sample size. Long-term outcomes such as chronic pain development were not evaluated. [12]

Conclusion

Modified radical mastectomy for breast cancer surgery usually need good pain management intraoperatively as well as post operatively. Conclusion from our study shows that by giving Thoracic paravertebral block with local anesthetic agents along with GA gives good intraoperative hemodynamic stability with good analgesia.

By using adjuvant like dexmedetomidine to ropivacaine for TPVB provides better intra - & post-operative analgesia without major hemodynamic alteration & serious side effects like hypotension and bradycardia.

Time to first analgesic request was longer in dexmedetomidine group & total consumption of tramadol was also less in dexmedetomidine group. So, TPVB with ropivacaine plus dexmedetomidine as adjuvant can be better choice to give good analgesia with intra operative hemodynamic stability without complications and side effects for breast cancer surgery.

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