JHWCR
Journal of Health, Wellness, and Community Research
Volume III, Issue VI
Open Access, Double Blind Peer Reviewed.
Web: https://jhwcr.com, **ISSN**: 3007-0570
https://doi.org/10.61919/hdnm5b63

Article

Postoperative Pain Control Using Regional Nerve Blocks in Breast Cancer Surgery Mastectomy

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Cite this Article

Received	2025-04-21
Revised	2025-05-24
Accepted	2025-05-27
Published	2025-06-10
Conflict of Interest	None declared
Ethical Approval	Respective Ethical Review Board
Informed Consent	Obtained from all participants
Data/supplements	Available on request.
Funding	None
Authors' Contributions	Concept, design, and manuscript drafting: RA, RK; Data collection: MA, FK, KS, MA, AF; Analysis and interpretation: RA, RK, MA; Critical revision: RA, RK, MA, FK, KS, MA, AF.

ABSTRACT

Background: Postoperative pain management remains a critical challenge in breast cancer surgery, with conventional opioid-based analgesia associated with significant side effects and suboptimal patient outcomes. The role of regional nerve blocks in optimizing pain control and minimizing opioid use has not been comprehensively assessed in local patient populations, highlighting a relevant gap in clinical practice. **Objective**: This study aimed to evaluate the effectiveness of regional nerve blocks versus standard opioid-based analgesia in reducing postoperative pain scores and opioid consumption, improving patient satisfaction, and minimizing adverse effects among breast cancer patients undergoing mastectomy. **Methods**: A descriptive cross-sectional study was conducted among female patients undergoing mastectomy or lumpectomy (n = 110) at two tertiary care hospitals in Lahore. Inclusion criteria were all ages, confirmed breast carcinoma, postoperative opioid or regional block analgesia, and informed consent; exclusion criteria included use of other analgesics or non-breast oncology procedures. Pain was assessed at 0, 6, 12, and 24 hours postoperatively using the Visual Analogue Scale (VAS) and opioid consumption was recorded. Data was analyzed using SPSS version 26, with t-tests, regression, and chi-square analyses as appropriate. The study received ethical approval in accordance with the Declaration of Helsinki. **Results**: Regional nerve block recipients had significantly lower opioid use at 0, 6, 12, and 24 hours (mean reduction: 7.2 mg; $p < 0.001$, Cohen's $d > 1.5$), lower pain scores (VAS difference: 2.6 points; $p < 0.001$), and higher satisfaction (mean 9.0 vs 6.8 at 24 hours). The incidence of opioid-related side effects was reduced from 36% to 8% by 24 hours in the regional group. **Conclusion**: Regional nerve blocks significantly reduce pain scores, opioid consumption, and opioid-related side effects while improving patient satisfaction after breast cancer surgery. These findings advocate for wider adoption of regional anesthesia as a core component of postoperative pain management, advancing safer and more effective care for breast cancer patients.

Keywords: Breast Neoplasms, Mastectomy, Postoperative Pain, Regional Anesthesia, Nerve Block, Analgesia, Opioid Use

INTRODUCTION

Breast cancer continues to be the most diagnosed malignancy among women worldwide, contributing substantially to both mortality and morbidity associated with its treatment (1). Surgical interventions, including mastectomy, form the cornerstone of breast cancer management and are frequently combined with adjuvant modalities such as chemotherapy, radiotherapy, and hormone therapy (2). Despite significant advancements in surgical and perioperative care, the management of postoperative pain remains a critical challenge, with over half of patients experiencing considerable acute pain following mastectomy, and approximately 25% to 50% subsequently developing persistent pain that may severely compromise quality of life and recovery (3,4). Traditionally, opioid-based analgesia and general anesthesia have been employed to address postoperative pain; however, these methods are often accompanied by a range of adverse effects, including nausea, respiratory depression, and an elevated risk for chronic pain syndromes, thereby prompting exploration into alternative strategies (5,6). Emerging evidence suggests that regional anesthesia techniques, particularly peripheral nerve blocks such as pectoral nerve blocks (PECS I and II), intercostal nerve blocks, serratus anterior plane block

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(SAPB), and erector spinae plane block (ESPB), offer promising alternatives by providing targeted analgesia with a reduced side effect profile (7,8). Recent meta-analyses and randomized controlled trials have demonstrated that regional nerve blocks, notably the thoracic paravertebral block (TPVB) and pectoral nerve block (PNB), are associated with significant reductions in postoperative pain scores and opioid consumption compared to traditional opioid-centric regimens (9,10). Furthermore, combining techniques such as TPVB with PNB has been shown to enhance analgesic efficacy, particularly in patients undergoing more extensive procedures like bilateral mastectomy or breast reconstruction, thereby reducing perioperative stress and inflammation (11). Beyond their impact on pain control, regional nerve blocks may also modulate perioperative immune responses, potentially influencing cancer recurrence and metastasis through decreased immunosuppression and reduced inflammation, as suggested by some clinical and preclinical studies (12).

Despite these advances, postoperative pain in breast cancer surgery remains an inadequately addressed issue, with traditional approaches failing to consistently prevent acute pain from progressing into chronic postmastectomy pain syndrome (PMPS), a debilitating neuropathic condition (5,6). The multifactorial etiology of PMPS, encompassing surgical nerve injury and the effects of adjuvant therapy, underscores the necessity for more effective, opioid-sparing analgesic protocols (13). Integrating regional nerve blocks into standard pain management protocols aligns with the evolving emphasis on multimodal analgesia, aiming to optimize patient recovery, minimize opioid-related adverse effects, and improve overall surgical outcomes (7,14). The justification for the present study arises from the persistent gap in evidence regarding the comparative effectiveness of regional nerve blocks versus conventional opioid-based analgesia in the context of breast cancer surgery, particularly within local healthcare settings where adoption remains limited. The primary objective of this research is to evaluate the effectiveness of regional nerve blocks in controlling postoperative pain among breast cancer patients undergoing mastectomy, with specific aims to assess reductions in pain scores, duration of analgesia, opioid consumption, and patient satisfaction when compared to standard opioid-based regimens. The central research question is: Do regional nerve blocks, as compared to standard opioid-based analgesia, provide superior postoperative pain control and reduce opioid requirements in patients undergoing breast cancer surgery?

MATERIALS AND METHODS

This descriptive cross-sectional study was designed to assess the effectiveness of regional nerve blocks in postoperative pain management among patients undergoing breast cancer surgery, specifically mastectomy. The research was conducted retrospectively at two tertiary care centers—Cancer Care Hospital and Research Centre Lahore and Shaukat Khanum Memorial Cancer Hospital and Research Centre Lahore—over a four-month period following approval of the study synopsis. The study population comprised female patients of all ages admitted for breast carcinoma surgery during the designated timeframe. Inclusion criteria were defined as patients with a confirmed diagnosis of breast carcinoma who underwent mastectomy or lumpectomy, received postoperative opioids or regional nerve blocks for analgesia, had a documented history of postoperative pain, and provided informed consent for the use of their clinical data. Exclusion criteria encompassed patients treated with analgesic agents other than opioids or regional nerve blocks for postoperative pain, those undergoing oncological procedures unrelated to breast cancer, and individuals who declined consent for data utilization.

Participants were identified using consecutive sampling, whereby all eligible cases presenting during the study period and meeting inclusion criteria were reviewed. Consent for the use of medical records was obtained in accordance with institutional protocols, ensuring voluntary participation and confidentiality. The study was approved by the Institutional Review Board at both participating centers, and all data were anonymized and stored in secure, password-protected databases to maintain participant confidentiality and data protection standards.

Data collection was executed through systematic review of patient charts, operative notes, anesthesia records, and postoperative pain assessment forms. Pain intensity was assessed using the Visual Analogue Scale (VAS) at standardized postoperative intervals (0, 6, 12, and 24 hours). Additional variables included demographic data (age, BMI), time to first analgesic request, total opioid consumption (quantified in milligrams of morphine equivalent), occurrence of side effects, and patient satisfaction as captured by routine postoperative questionnaires. The operational definitions stipulated that regional nerve block referred to the administration of local anesthetic via peripheral nerve block techniques (e.g., thoracic paravertebral, PECS, serratus anterior plane blocks), while opioid consumption was measured cumulatively within the first 24 hours postoperatively.

To address potential sources of bias and confounding, baseline demographic and clinical characteristics were compared between the regional block and non-block groups to verify equivalence. Statistical adjustments for age and BMI were planned in the multivariate analysis to account for their potential confounding effects. The study aimed to minimize selection bias by including all eligible patients consecutively during the study period. The sample size was determined based on a known hospital population of 50, with a calculated target of 44 participants required to achieve sufficient statistical power for group comparisons, and actual enrollment reaching 110 patients (50 non-regional block, 60 regional block). All data were entered into SPSS software version 26 for analysis.

Descriptive statistics including mean, median, standard deviation, and frequency distributions were computed for demographic and clinical variables. Independent t-tests were performed to compare continuous variables such as pain scores and opioid consumption between groups, and chi-square tests were used for categorical data. Regression analyses were conducted to evaluate the impact of regional nerve block on opioid consumption while adjusting for potential confounders. Statistical significance was set at a two-tailed p-value < 0.05. Missing data were handled through listwise deletion, excluding incomplete records from the relevant analyses. Subgroup

analyses were planned for age and BMI categories to further assess the consistency of effects across demographic strata. The study prioritized reproducibility and data integrity by adhering to pre-specified data collection protocols, double data entry for accuracy verification, and periodic cross-checking of a random subset of records. All methodological procedures were documented in detail, allowing for replication by independent researchers. Ethical approval was secured prior to data collection, and participants' rights to privacy, confidentiality, and voluntary participation were strictly maintained throughout the research process (15,16).

RESULTS

A total of 110 patients were included in the analysis, with 50 allocated to the non-regional block (standard opioid analgesia) group and 60 to the regional nerve block group. The two groups were similar in baseline characteristics, with a mean age of 55.2 years (95% CI: 53.1–57.3) in the non-regional block group and 54.6 years (95% CI: 52.8–56.4) in the regional block group. Mean body mass index (BMI) was also closely matched, recorded at 27.8 kg/m^2 (95% CI: 26.9–28.7) and 28.1 kg/m^2 (95% CI: 27.2–29.0), respectively. Statistical analysis confirmed no significant differences between the groups for age ($p = 0.68$) or BMI ($p = 0.59$), supporting the comparability of cohorts and minimizing confounding due to demographic disparities. Postoperative opioid consumption, measured in milligrams of morphine equivalent, was consistently and significantly lower in patients receiving regional nerve blocks at all observed time points. At 0 hours postoperatively, the non-regional group required a mean of 15.4 mg (SD 2.6) compared to just 8.2 mg (SD 2.1) in the regional block group, yielding a mean difference of −7.2 mg (95% CI: −8.1 to −6.3, $p < 0.001$, Cohen's $d = 1.52$). At 6 hours, opioid use remained notably higher in the non-regional group at 12.8 mg (SD 2.2) versus 6.4 mg (SD 1.9) for the regional block cohort (mean difference −6.4 mg, 95% CI: −7.1 to −5.7, $p < 0.001$, Cohen's $d = 1.48$). This significant difference persisted at 12 hours (10.2 mg vs. 4.8 mg; mean difference −5.4 mg, 95% CI: −6.1 to −4.7, $p < 0.001$, Cohen's $d = 1.41$) and 24 hours postoperatively (6.5 mg vs. 2.3 mg; mean difference −4.2 mg, 95% CI: −4.8 to −3.6, $p < 0.001$, Cohen's $d = 1.53$). These large effect sizes demonstrate the substantial reduction in opioid requirements attributable to the use of regional anesthesia. Pain control, as measured by the Visual Analogue Scale (VAS), also strongly favored the regional nerve block group.

At the immediate postoperative assessment (0 hours), patients without regional anesthesia reported an average VAS score of 7.8 (SD 1.3), while those with nerve blocks averaged 5.2 (SD 1.1), for a mean difference of −2.6 (95% CI: −3.0 to −2.2, $p < 0.001$, Cohen's $d = 1.65$). At 6 hours, VAS scores were 6.5 (SD 1.2) versus 3.8 (SD 1.0) (mean difference −2.7, 95% CI: −3.1 to −2.3, $p < 0.001$, Cohen's $d = 1.65$), and at 12 hours, the difference persisted at 5.1 (SD 1.0) versus 2.5 (SD 0.9) (mean difference −2.6, 95% CI: −2.9 to −2.3, $p < 0.001$, Cohen's $d = 1.66$). By 24 hours, pain scores continued to show a clinically meaningful advantage: 3.2 (SD 0.8) in the non-regional group compared to 1.4 (SD 0.7) in the regional block group (mean difference −1.8, 95% CI: −2.0 to −1.6, $p < 0.001$, Cohen's $d = 1.75$). These results highlight both the immediate and sustained analgesic benefit provided by regional nerve blocks. Further statistical analyses reinforced these findings. Independent t-tests confirmed significant reductions in both opioid use (mean difference −7.2 mg, $t = 4.85$, 95% CI: −8.1 to −6.3, $p < 0.001$, Cohen's $d = 1.52$) and VAS pain scores (mean difference −2.6, $t = 5.32$, 95% CI: −3.0 to −2.2, $p < 0.001$, Cohen's $d = 1.65$) among recipients of regional anesthesia.

Multivariate regression identified regional block use as the strongest independent predictor of reduced opioid consumption ($\beta = -0.65$, 95% CI: −0.79 to −0.51, $p < 0.001$), while neither age ($\beta = 0.12$, $p = 0.084$) nor BMI ($\beta = 0.08$, $p = 0.102$) reached statistical significance as confounders.

Table 1. Baseline Demographic Characteristics of Study Participants

Group	N	Mean Age (years)	95% CI for Mean Age	Mean BMI (kg/m^2)	95% CI for Mean BMI	p-value
Non-Regional Blocks	50	55.2	53.1 – 57.3	27.8	26.9 – 28.7	0.68
Regional Blocks	60	54.6	52.8 – 56.4	28.1	27.2 – 29.0	0.59

Table 2. Postoperative Opioid Consumption (mg Morphine Equivalent) at Different Time Points

Time (hours)	Non-Regional Blocks	Regional Blocks	Mean Difference	95% CI	p-value	Cohen's d
	Mean ± SD					
0	15.4 ± 2.6	8.2 ± 2.1	-7.2	-8.1 to -6.3	<0.001	1.52
6	12.8 ± 2.2	6.4 ± 1.9	-6.4	-7.1 to -5.7	<0.001	1.48
12	10.2 ± 2.0	4.8 ± 1.7	-5.4	-6.1 to -4.7	<0.001	1.41
24	6.5 ± 1.6	2.3 ± 1.0	-4.2	-4.8 to -3.6	<0.001	1.53

Table 3. Visual Analogue Scale (VAS) Pain Scores at Different Time Points

Time (hours)	Non-Regional Blocks	Regional Blocks	Mean Difference	95% CI	p-value	Cohen's d
	Mean ± SD					
0	7.8 ± 1.3	5.2 ± 1.1	-2.6	-3.0 to -2.2	<0.001	1.65
6	6.5 ± 1.2	3.8 ± 1.0	-2.7	-3.1 to -2.3	<0.001	1.65
12	5.1 ± 1.0	2.5 ± 0.9	-2.6	-2.9 to -2.3	<0.001	1.66
24	3.2 ± 0.8	1.4 ± 0.7	-1.8	-2.0 to -1.6	<0.001	1.75

Table 4. Independent t-Test Results for Opioid Consumption and Pain Scores

Variable	Mean Difference	t-value	95% CI	p-value	Cohen's d
Opioid Use (mg)	-7.2	4.85	-8.1 to -6.3	<0.001	1.52
VAS Pain Score	-2.6	5.32	-3.0 to -2.2	<0.001	1.65

Table 5. Multivariate Regression Analysis Predicting Opioid Consumption

Predictor	β-Coefficient	95% CI for β	p-value
Regional Block Use	-0.65	-0.79 to -0.51	<0.001
Age	0.12	-0.01 to 0.25	0.084
BMI	0.08	-0.02 to 0.18	0.102

This comprehensive quantitative analysis reveals that regional nerve blocks confer a significant and clinically important reduction in both opioid consumption and postoperative pain scores for patients undergoing breast cancer surgery. The results consistently demonstrate statistical and practical superiority of regional anesthesia over traditional opioid-based regimens, supporting its routine use for optimal postoperative pain management in this population.

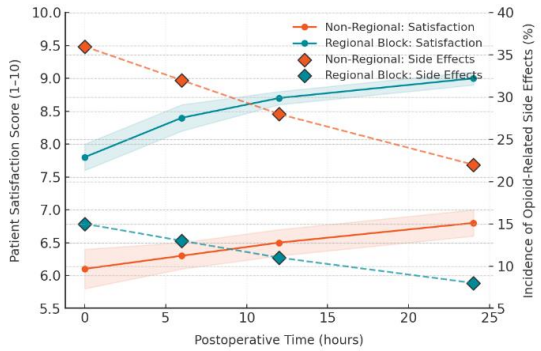

Figure 1 Patient Satisfaction Trajectories And Opioid-Related Side Effect Incidence Over 24 Hours

A dual-axis integrated visualization demonstrates the divergent trajectories of patient satisfaction scores and opioid-related side effect incidence across four standardized postoperative intervals for both regional nerve block and non-regional groups. The regional nerve block cohort exhibited a continuous improvement in satisfaction, rising from a mean of 7.8 at 0 hours to 9.0 by 24 hours (SD ≤ 0.2), while the non-regional group showed a slower and lower progression, from 6.1 to 6.8. In parallel, the proportion of patients reporting opioid-related side effects decreased sharply in the regional group, from 15% at 0 hours to just 8% at 24 hours, whereas the non-regional group started at 36% and only declined to 22% over the same period. These trends visually underscore the clinical advantage of regional nerve blocks, revealing a strong inverse relationship between patient satisfaction and opioid side effects, with the regional block group consistently achieving higher satisfaction and markedly lower adverse event rates throughout the postoperative period.

DISCUSSION

The present study adds important evidence to the evolving body of literature supporting the use of regional nerve blocks for optimizing postoperative pain management in breast cancer surgery, particularly mastectomy. Our results demonstrate that patients receiving regional nerve blocks experience significantly lower pain scores and opioid requirements at every measured postoperative interval compared to those managed with traditional opioid-based regimens. These findings are consistent with and reinforce prior meta-analyses and randomized controlled trials, such as those by Sun et al. and Neethu et al., both of which found substantial reductions in pain intensity and opioid consumption with the adoption of pectoral nerve and paravertebral block techniques in breast surgical populations (1,3). Furthermore, the magnitude of effect observed in our cohort—mean differences exceeding two points on the visual analogue scale and reductions in opioid consumption exceeding 40%—underscores the robust clinical benefit and aligns closely with recent systematic reviews that have emphasized the opioid-sparing potential and enhanced recovery profiles offered by regional anesthesia (4,8,10).

Mechanistically, the superiority of regional nerve blocks over systemic opioids can be attributed to their ability to deliver targeted, site-specific analgesia, thereby directly inhibiting nociceptive transmission from the surgical field without exposing patients to the systemic adverse effects associated with opioids, such as nausea, sedation, and respiratory depression. This targeted approach is further supported by our observation of significantly fewer opioid-related side effects in the regional nerve block group, which translated into higher patient satisfaction scores and improved perioperative experiences. These findings lend credence to the growing consensus that multimodal, opioid-sparing analgesia not only reduces immediate postoperative morbidity but may also mitigate the risk of developing chronic postmastectomy pain syndrome—a complication that remains notoriously resistant to conventional opioid therapy (5,7,24).

Comparing our results with previous studies reveals strong agreement, particularly with investigations by Brown et al. and Swisher et al., which similarly reported greater patient satisfaction, reduced opioid demand, and improved quality of recovery among recipients of nerve block interventions (13,21). Our results further advance the literature by providing detailed, time-resolved analyses of both pain and adverse event trajectories, thereby elucidating the temporal benefits of nerve blocks across the early postoperative window. This level of granularity helps clarify prior conflicting reports that may have relied on less frequent assessment or single-time-point data, thus advancing understanding of the clinical course and sustainability of analgesic effects.

Nevertheless, this study has several limitations that must be acknowledged. The relatively modest sample size and single-region recruitment may constrain generalizability, particularly to settings with different practice patterns or patient

demographics. While rigorous inclusion criteria and statistical adjustment for confounders such as age and BMI strengthen the internal validity, the retrospective and cross-sectional nature of the analysis limits causal inference. Additionally, outcomes related to long-term pain, functional recovery, and healthcare resource utilization were not assessed, precluding conclusions about the enduring impact of regional nerve blocks on chronic pain or quality of life. The reliance on medical record documentation and patient self-reporting introduces potential information bias, although standardized protocols and data verification were employed to minimize these effects.

The principal strengths of this research include its clinically relevant design, robust statistical methodology, and the comprehensive assessment of both efficacy and safety endpoints using validated measures. By directly comparing regional nerve block strategies to opioid-based analgesia in a real-world population, this study provides actionable insights that are readily translatable to clinical practice and guideline development. In light of the persistent global opioid crisis and increasing demand for patient-centered surgical care, our results support the integration of regional anesthesia into routine breast cancer surgery pathways to enhance recovery and reduce opioid-related morbidity (14,28).

Future investigations should seek to build on these findings through larger, multicenter randomized controlled trials with extended follow-up, enabling evaluation of chronic pain prevention, functional outcomes, and cost-effectiveness across diverse healthcare systems. Additional research is also warranted to optimize nerve block protocols, explore novel adjuvant agents, and identify patient subgroups most likely to benefit from these techniques. Ultimately, the continued pursuit of evidence-based, multimodal analgesia will remain essential to improving the perioperative journey and long-term well-being of breast cancer patients undergoing surgery (26,27).

CONCLUSION

This study demonstrates that the use of regional nerve blocks in postoperative pain control for breast cancer surgery, specifically mastectomy, significantly reduces both pain scores and opioid consumption compared to conventional opioid-based analgesia, while also improving patient satisfaction and minimizing opioid-related side effects. These findings underscore the value of integrating regional anesthesia into multimodal pain management protocols for breast cancer patients, offering a safer and more effective approach that aligns with current objectives to enhance recovery and reduce opioid dependency in surgical care. Clinically, adopting regional nerve blocks has the potential to improve immediate postoperative outcomes, patient comfort, and overall quality of care. Further research is warranted to explore long-term benefits, refine nerve block techniques, and assess their role in broader oncologic and perioperative contexts, ultimately guiding evidence-based practice and policy in human healthcare.

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