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Systematic review

Paravertebral Block versus Erector Spinae Plane Block for Prevention of Chronic Pain after Breast Cancer Surgery: A Systematic Review

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Abstract

Background: Chronic postsurgical pain is frequent after breast cancer surgery, and regional analgesia has been proposed to limit its development. Thoracic paravertebral block is established, and erector spinae plane block is more superficial. In this study we aimed to compare their effectiveness in preventing pain persisting for at least three months after breast cancer surgery. **Methods:** PubMed/MEDLINE, Scopus, Web of Science Core Collection, and CENTRAL were searched from inception through August 2026. Randomized trials of adults undergoing oncological breast surgery were eligible when either block was evaluated and pain was measured at three months or later. Outcomes were chronic pain incidence, neuropathic features, severity, functional interference, acute analgesia, and adverse events. Risk of bias was assessed with RoB 2, and certainty through GRADE domains. Heterogeneous definitions and comparators supported narrative synthesis. **Results:** Twelve randomized trials met eligibility criteria. Two compared the blocks, one reported no chronic pain in either group at six months, while another found similar neuropathic-pain scores. Paravertebral trials produced conflicting results, from meaningful reductions to no benefit in the largest placebo-controlled study. Erector spinae trials improved acute analgesia, although the largest placebo-controlled trial found no significant chronic-pain reduction at three or six months. **Conclusion:** Paravertebral block has a larger, inconsistent chronic-pain evidence base; evidence for erector spinae block remains limited and negative.

Keywords: breast cancer surgery; chronic postsurgical pain; erector spinae plane block; mastectomy; postmastectomy pain; regional anesthesia; thoracic paravertebral block

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Introduction

Chronic postsurgical pain (CPSP) develops or increases after an operation, persists beyond healing for at least three months, and is not better explained by another condition (1). A meta-analysis of 187 observational studies involving 297,612 patients estimated a pooled prevalence of 35%, with patient-reported pain of any severity reaching 46% after breast cancer surgery (2). Younger age, preoperative pain, greater acute postoperative pain, axillary lymph-node dissection, and radiotherapy are some of the factors associated with persistent pain (3).

Post-breast-cancer-treatment pain includes scar pain, phantom-breast pain, intercostobrachial neuralgia, sensory loss, allodynia, and movement-related discomfort (4). Surgical nerve injury and intense nociceptive input contribute to peripheral and central sensitization, linking severe acute pain with later persistent pain without proving that short-lived analgesia interrupts chronification (5). The extent of breast and axillary surgery, adjuvant treatment, psychosocial vulnerability, and baseline pain affect the long-term phenotype, which complicates causal attribution to a single perioperative intervention (3).

Thoracic paravertebral block (PVB) deposits local anesthetic adjacent to the thoracic spinal nerves, producing unilateral somatic and sympathetic blockade across involved dermatomes, although pleural, vascular, neuraxial, and block-failure risks require anatomical expertise (6). Erector spinae plane block (ESPB) deposits local anesthetic between the erector spinae muscle and transverse process, offering a more superficial needle path and craniocaudal fascial spread (7). Early ESPB literature reported broad clinical use and few complications, while also identifying heterogeneous outcomes and uncertainty regarding reliable spread into the paravertebral space (8).

Prior PVB meta-analysis found no significant reduction in overall CPSP at three, six, or twelve months, although neuropathic pain at six months was reduced with low-certainty evidence (9). ESPB studies have concentrated on opioid consumption and pain during the first postoperative day, leaving long-term prevention less secure than its acute analgesic role (8). This systematic review compares PVB with ESPB for preventing CPSP after breast cancer surgery.

Methods

This review followed PRISMA 2020 and the Cochrane framework for intervention reviews. The protocol specified the population, interventions, comparators, outcomes, eligible designs, and synthesis plan before full-text assessment.

PubMed/MEDLINE, Scopus, Web of Science Core Collection, and CENTRAL were searched from inception through August 2026 without language restriction. Search concepts combined “breast cancer,” “breast neoplasm,” “mastectomy,” or “breast surgery” with “paravertebral block,” “thoracic paravertebral block,” “erector spinae plane block,” “PVB,” or “ESPB,” and with “chronic pain,” “persistent postsurgical pain,” “postmastectomy pain,” or “neuropathic pain.” Reference lists and trial registrations were checked, and duplicate cohort reports were linked. A reproducible PubMed core string was: ((breast neoplasms OR breast cancer OR mastectom* OR breast surgery) AND (paravertebral block OR thoracic paravertebral block OR erector spinae plane block OR ESPB) AND (chronic pain OR

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persistent pain OR postmastectomy pain OR neuropathic pain)).

Randomized controlled trials enrolling adults undergoing surgery for breast malignancy were eligible when perioperative PVB or ESPB was compared with the other block, placebo, no block, systemic analgesia, or another regional block. A study had to report pain at three months or later; acute-only trials, case reports, reviews, studies treating established chronic pain, non-oncological operations, and reports with follow-up shorter than three months were excluded. The primary outcome was CPSP incidence at the longest reported follow-up. Secondary outcomes were pain intensity, neuropathic pain, pain interference or quality of life, acute opioid consumption, and block-related adverse events.

Two reviewers independently screened records, assessed full texts, and extracted design, sample, surgery, intervention, comparator, follow-up, pain definition, and results into a structured form. Trials were evaluated across RoB 2 domains, supported by randomization, masking, missing data, outcome measurement, and reporting information. Heterogeneity in block technique, surgery, comparator, pain definition, and follow-up precluded defensible pooling; reported relative risks, odds ratios, proportions, means, and P values were synthesized narratively, and GRADE domains informed certainty.

Results

Twelve randomized trials were included, comprising seven PVB-focused trials and five trials containing an ESPB arm (10–21). Two trials compared PVB with ESPB and assessed chronic pain, whereas the remaining compared either technique with saline, general anesthesia, systemic analgesia, or another fascial-plane block (19,20). Follow-up ranged from three to twelve months, and outcome instruments included numerical or visual analogue ratings, the Brief Pain Inventory, the Leeds Assessment of Neuropathic Symptoms and Signs, clinical neuropathic assessment, and pain-related functional measures (10–21).

Early small trials favored PVB: Kairaluoma et al. reported lower pain prevalence at six and twelve months, while Ibarra et al. observed chronic neuropathic pain in 6.7% of PVB recipients versus 50% after general anesthesia among 29 respondents (10,11). In a larger three-arm trial, Karmakar et al. detected no difference in CPSP incidence at three or six months, despite lower chronic-pain severity, fewer neuropathic signs, and better health-related quality of life with PVB (12). Extending a single-injection PVB with a three-day ropivacaine infusion produced no significant three-month difference, although pain-related dysfunction at twelve months occurred in 13% with ropivacaine versus 47% with saline (13).

Qian et al. found CPSP incidences of 34.5% versus 51.2% at three months and 22.1% versus 37.2% at six months, and Lin et al. found 12.5% versus 24.0% at six months (14,15). In contrast, the largest double-blind PVB trial found pain in 52.2% of ropivacaine recipients and 47.7% of saline recipients at three months, with no benefit at six or twelve months despite markedly lower immediate morphine use (16). These divergent findings were clinically heterogeneous because single-level, multilevel, and continuous approaches were combined with different operations, background

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analgesia, thresholds, and neuropathic-pain definitions (10–16).

Park et al. found no significant ESPB effect on pain presence, intensity, or interference at three or six months after mastectomy with immediate reconstruction, despite reduced perioperative fentanyl use (17). Genc et al. reported lower three-month pain scores with ESPB and pectoserratus block than control, with no material difference between the two active blocks (18). In the first direct chronic-outcome comparison, 82 participants received bi-level PVB or ESPB, and no participant in either group reported chronic pain at six months, making relative efficacy inestimable (19).

Amr et al. compared ESPB, PVB, and general anesthesia in 105 women; chronic pain across follow-up assessments occurred in 20.0%, 17.1%, and 28.6%, respectively, while LANSS scores were lower with blocks than control and did not differ between blocks (20). The largest dedicated ESPB prevention trial randomized 198 women and found CPSP in 38.4% versus 43.4% at three months and 23.2% versus 31.3% at six months, differences that were not statistically significant, although 24-hour morphine consumption fell from 18 to 8 mg (21).

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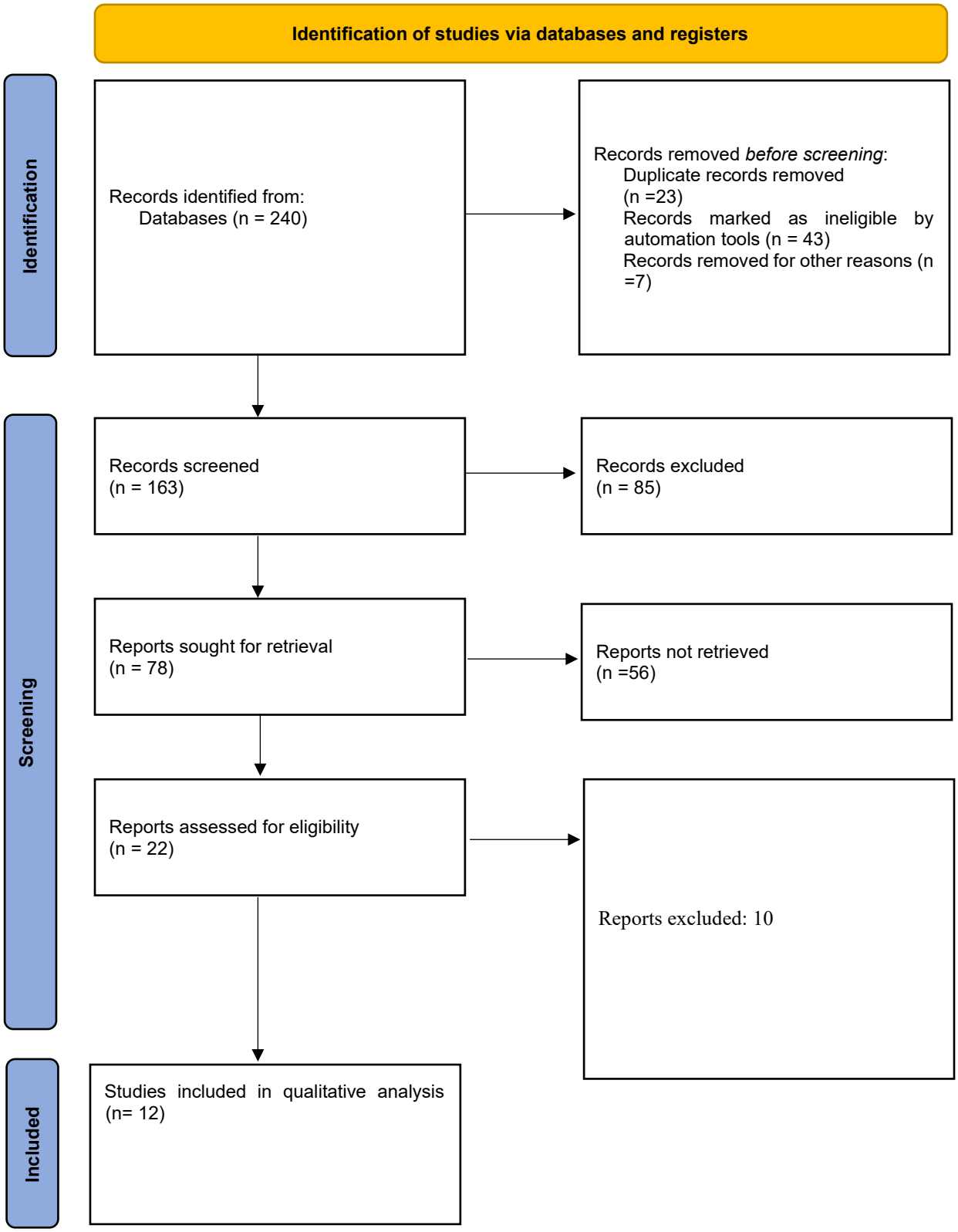
Identification of studies via databases and registers
Identification
Records identified from:
Databases (n = 240)
Records removed *before screening*:
Duplicate records removed (n =23)
Records marked as ineligible by automation tools (n = 43)
Records removed for other reasons (n =7)
Screening
Records screened
(n = 163)
Records excluded
(n = 85)
Reports sought for retrieval
(n = 78)
Reports not retrieved
(n =56)
Reports assessed for eligibility
(n = 22)
Reports excluded: 10
Included
Studies included in qualitative analysis
(n= 12)

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Table 1. Characteristics and chronic-pain findings of included randomized trials

Study	Comparison and sample	Follow-up; measure	Chronic result
Kairaluoma et al., 2006 (10)	Single-shot PVB vs saline; n=60	6, 12 months; NRS symptoms	Pain prevalence lower with PVB at 6 months (P=0.029) and 12 months (P=0.003).
Ibarra et al., 2011 (11)	PVB+GA vs GA; 40 randomized, 29 followed	4–5 months; neuropathic/phantom pain	Neuropathic pain 6.7% vs 50%; P=0.01; attrition limits precision.
Karmakar et al., 2014 (12)	GA vs single-shot vs continuous PVB; n=180	3, 6 months; incidence/severity/HRQOL	Incidence similar; severity, signs, and HRQOL favored PVB.
Ilfeld et al., 2015 (13)	Single-shot PVB plus 3-day ropivacaine vs saline infusion; n=60	3, 12 months; BPI	No 3-month difference; dysfunction 13% vs 47% at 12 months; P=0.011.
Qian et al., 2019 (14)	Multilevel PVB vs saline; 184 randomized, 172 completed	3, 6 months; BPI ≥3	34.5% vs 51.2% at 3 months; 22.1% vs 37.2% at 6 months.
Lin et al., 2020 (15)	Multilevel PVB vs no block; n=218	6, 12 months; CPSP/neuropathic pain	CPSP 12.5% vs 24.0% at 6 months; RR 0.52; neuropathic pain lower later.
Albi-Feldzer et al., 2021 (16)	Single-shot PVB vs saline; 380 randomized, 352 treated	3, 6, 12 months; VAS ≥3	52.2% vs 47.7% at 3 months; OR 1.20; P=0.394; no later benefit.
Park et al., 2021 (17)	ESPB+IV-PCA vs IV-PCA; 58 completed	3, 6 months; BPI-SF	Pain presence 48.0% vs 62.5% and 36.4% vs 62.5%; both nonsignificant.
Genc et al., 2022 (18)	ESPB vs pectoserratus vs control; n=90	3 months; VAS	Both blocks lowered chronic-pain scores versus control; active blocks were similar.
Santonastaso et al., 2023 (19)	Bi-level ESPB vs PVB; n=82	6 months; NRS/interference	Zero chronic-pain events in both groups; no relative effect estimable.
Amr et al., 2024 (20)	ESPB vs PVB vs GA; n=105	1, 3, 6 months; LANSS	Chronic pain 20.0%, 17.1%, and 28.6%; active blocks were similar.
Lin et al., 2026 (21)	ESPB vs placebo; n=198	3, 6 months; CPSP incidence	38.4% vs 43.4%, RR 0.88; 23.2% vs 31.3%, RR 0.74; nonsignificant.

Table 2. Review level risk of bias assessment

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Study	Masking and missing-data	Outcome	Overall
Kairaluoma et al. (10)	Masking details limited	Measurement concerns	Some concerns
Ibarra et al. (11)	29/40 followed	Small telephone sample	High
Karmakar et al. (12)	No sham	Multiple secondary outcomes	Some concerns
Ilfeld et al. (13)	Triple masked; follow-up concerns	Chronic outcome follow-up	Some concerns
Qian et al. (14)	Placebo controlled	Reporting concerns	Some concerns
Lin et al. (15)	No sham	Low concern	Some concerns
Albi-Feldzer et al. (16)	Double-blind placebo	Low concern	Low
Park et al. (17)	Follow-up loss	Chronic outcome secondary	Some concerns
Genc et al. (18)	Single blind; no sham	Chronic outcome secondary	Some concerns
Santonastaso et al. (19)	No sham	Zero-event imprecision	Some concerns
Amr et al. (20)	No sham	Chronic outcome secondary	Some concerns
Lin et al. (21)	Double-blind placebo	Low concern	Low

Discussion

The main finding is that direct randomized studies does not establish a difference between PVB and ESPB for preventing CPSP after breast cancer surgery (19,20). One direct trial observed no chronic-pain events in either arm (19). The other reported close chronic-pain frequencies and similar LANSS scores (20). Indirect PVB study is larger and inconsistent: small studies and selected multilevel trials reported benefit, while Karmakar et al. and the large multicenter placebo-controlled trial found no reduction in CPSP incidence (10–16). A 2016 meta-analysis found nonsignificant risk ratios at three, six, and twelve months and inadequate trial-sequential information (22). A later synthesis found no protection against overall CPSP, although six-month neuropathic pain favored PVB with low-certainty evidence (9).

ESPB studies show the same acute–chronic separation: opioid use and early pain improved, while secure prevention was absent in Park et al. and the 198-patient placebo-controlled trial (17,21). Broad Cochrane study found that regional anesthesia reduces persistent pain in selected operations, although procedural and methodological variation limits transfer to ESPB after breast surgery (23). Acute analgesic success remains valuable, though it is not a validated surrogate for chronic-pain prevention (21,23).

Heterogeneity reflects direct thoracic-root targeting by PVB, variable ESPB spread, and neural territories not uniformly covered during reconstruction or

axillary dissection (6–8). Definitions ranged from any pain to VAS or BPI thresholds and neuropathic questionnaires, producing noninterchangeable event rates (10–21). Background analgesia, block delivery, surgery extent, radiotherapy, baseline pain, attrition, and selective outcomes further weaken indirect comparisons (2–4).

Safety reporting was sparse and trials lacked power for rare complications, so absent serious harm does not prove equivalence (6,19–21). PVB places the needle nearer pleura, neuraxis, and neurovascular structures, while ESPB uses a superficial target (6–8). Procedure-specific guidance supports regional analgesia for acute care after major breast surgery without a chronic-prevention preference between PVB and ESPB (24).

Direct-comparison certainty is low because only two trials reported eligible long-term outcomes, CPSP was secondary in both, one produced zero events, and definitions differed (19,20). A 2026 meta-analysis of 19 head-to-head acute-pain trials found similar pooled opioid and pain outcomes, although those endpoints do not answer the chronic question (25). Future multicenter trials need CPSP as the primary endpoint, standardized assessments, sensory mapping, surgical strata, blinded evaluation, and complete safety reporting (1–3).

Clinical decisions need separate goals, select a block for reliable immediate coverage and opioid sparing, while counseling that neither technique has confirmed chronic-prevention superiority (19–21). For extensive axillary dissection, sensory coverage needs confirmation because an anatomically successful injection does not guarantee coverage of every injured nerve territory (3,6–8). Long-term pain surveillance remains necessary even after excellent early analgesia, particularly in patients with baseline pain or extensive nodal surgery (2,3,5). Strengths include the current search date, strict three-month threshold, and separation of direct from indirect studies, while limitations include no registered protocol, unavailable record-level logs, and heterogeneous outcomes.

Conclusion

Current direct randomized studies do not found superiority of paravertebral block or erector spinae plane block for preventing chronic pain after breast cancer surgery. Paravertebral block has more long-term evidence, although results vary from significant protection to no effect in the largest placebo-controlled trial. Erector spinae plane block improves several acute analgesic outcomes, while the largest prevention trial found no significant chronic-pain reduction. Technique selection rests on acute analgesic requirements, surgical extent, contraindications, operator expertise, and local safety systems. Definitive comparative trials require chronic pain as the primary outcomes and standardized assessment through twelve months for every participant.

List of abbreviations

BPI: Brief Pain Inventory

BPI-SF: Brief Pain Inventory–Short Form

CENTRAL: Cochrane Central Register of Controlled Trials

CI: Confidence interval

CPSP: Chronic postsurgical pain

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ESPB: Erector spinae plane block

GA: General anesthesia

GRADE: Grading of Recommendations Assessment, Development and Evaluation

HRQOL: Health-related quality of life

IV-PCA: Intravenous patient-controlled analgesia

LANSS: Leeds Assessment of Neuropathic Symptoms and Signs

NRS: Numerical rating scale

OR: Odds ratio

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PVB: Paravertebral block

RoB 2: Cochrane Risk of Bias 2 tool

RR: Relative risk

VAS: Visual analogue scale

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