Research Article

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Comparison of Postoperative Pain After Modified Radical Mastectomy Using Erector Spinae Plane Block with Bupivacaine Plus Dexmedetomidine versus Bupivacaine Alone

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Abstract

Background: Modified radical mastectomy (MRM), particularly when accompanied by axillary dissection, can cause substantial acute postoperative pain and may contribute to persistent postsurgical pain. Ultrasound-guided erector spinae plane block (ESPB) is used as a component of multimodal analgesia, and dexmedetomidine has been investigated as an adjuvant to prolong local-anaesthetic effects. Objective: To compare postoperative pain scores and rescue-analgesia requirements after MRM in patients receiving ESPB with bupivacaine plus dexmedetomidine versus bupivacaine alone. Methods: This single-centre randomized controlled trial was conducted in the Department of Anaesthesiology, ICU and Pain Management, Sir Ganga Ram Hospital, Lahore, Pakistan, from March to June 2026. Sixty women with American Society of Anesthesiologists (ASA) physical status I–II who were scheduled for elective MRM under general anaesthesia were allocated by lottery to two equal groups (n=30 each). A unilateral ultrasound-guided ESPB was performed at the T4 level after surgery. Group BD received 20 mL of 0.25% bupivacaine with dexmedetomidine 1 μg/kg, whereas Group B received 20 mL of 0.25% bupivacaine without dexmedetomidine. Pain intensity was assessed using a 10-cm visual analogue scale (VAS) at 1, 12 and 24 hours postoperatively. Results: Mean VAS scores were lower in Group BD than in Group B at 1 hour (1.2 ± 0.4 vs. 2.1 ± 0.5), 12 hours (1.5 ± 0.6 vs. 2.8 ± 0.7) and 24 hours (1.8 ± 0.5 vs. 3.1 ± 0.8); all reported between-group pain comparisons had $p < 0.001$. Rescue analgesia was required by 6 of 30 (20.0%) patients in Group BD and 19 of 30 (63.3%) in Group B (two-sided Fisher's exact p=0.0014, recalculated from the reported frequencies). No clinically significant haemodynamic instability or block-related complications were reported in either group during the observation period. Conclusion: Adding dexmedetomidine to bupivacaine for ESPB was associated with lower pain scores during the first 24 postoperative hours and fewer requests for rescue analgesia after MRM. Interpretation is limited by the modest, single-centre sample and short follow-up; the findings do not establish prevention of chronic postsurgical pain or demonstrate comparative safety for uncommon adverse events.

Keywords: erector spinae plane block, dexmedetomidine, bupivacaine, modified radical mastectomy, postoperative pain, visual analogue scale, regional anesthesia

1. INTRODUCTION

Breast cancer represents a major global health burden and remains one of the most commonly diagnosed cancers among women. Global Cancer Statistics 2022 estimated approximately 2.3 million new female breast cancer cases worldwide, highlighting the importance of both effective oncological treatment and supportive perioperative care [1]. Surgical treatment continues to play an essential role in the management of many patients with breast cancer. Although the choice of procedure depends on tumour characteristics, disease stage and individual treatment considerations, modified radical mastectomy (MRM) remains relevant in settings where removal of breast tissue and management of the axilla are clinically indicated. The operation can produce considerable acute pain because it involves dissection and manipulation of skin, subcutaneous tissue, pectoral fascia and, when indicated, axillary structures. Controlling this pain is an important element of recovery, early mobilization, patient comfort and an appropriately balanced, multimodal analgesic strategy [2, 3].

Pain after breast cancer surgery is not limited to the immediate recovery period. Persistent postsurgical pain, commonly evaluated at least three months after an operation, is a clinically important and multifactorial outcome that may be associated with tissue injury, nerve injury, treatment-related factors and the severity of acute postoperative pain. A systematic review and meta-analysis of observational studies reported a pooled prevalence of persistent postsurgical pain of approximately 35% after breast cancer surgery, although prevalence varied considerably according to definitions, operative procedures and ascertainment methods [4]. These observations provide a rationale for careful acute pain management, while it remains essential to distinguish reduction of short-term pain scores from proven prevention of persistent pain. A study limited to the first postoperative day cannot determine whether an intervention reduces the risk of chronic post-mastectomy pain.

Effective analgesia after MRM may be challenging because sensory input arises from several intercostal and related cutaneous nerve distributions, while axillary dissection can add an additional source of pain. Opioid-based analgesia remains useful, but excessive reliance on systemic opioids may be associated with nausea, vomiting, sedation and other adverse effects. Consequently, regional anaesthetic techniques are increasingly incorporated into multimodal care to reduce the intensity of postoperative pain and potentially limit the need for supplemental analgesics. Techniques studied after breast surgery include thoracic paravertebral block, pectoral nerve blocks, serratus anterior plane block and erector spinae plane block (ESPB) [5–7]. Comparisons among regional techniques should nevertheless be interpreted according to the specific operation, local-anaesthetic formulation, block timing and outcome measured, rather than assuming that any one block is universally superior.

Ultrasound-guided ESPB involves injection into the fascial plane deep to the erector spinae muscle, adjacent to the transverse process. Its potential analgesic action has been attributed to spread within tissue planes and, in some circumstances, involvement of neural structures supplying the thoracic region. This relatively accessible injection plane has contributed to interest in ESPB for thoracic and breast procedures [8]. Evidence syntheses indicate that ESPB can improve early postoperative analgesia compared with no block or selected control conditions after breast surgery, but they also describe variation in block effectiveness across techniques and comparators [9–11]. A randomized comparison with thoracic paravertebral block in non-mastectomy breast surgery illustrates that the analgesic performance of ESPB should not be assumed to equal that of an established regional block in every clinical setting [12]. The 2023 Cochrane review similarly emphasizes differences in evidence certainty and relevant outcomes across surgical populations [13].

Interest has therefore extended beyond the choice of regional block to the pharmacological agents administered with the local anaesthetic. Bupivacaine is used for its relatively prolonged local-anaesthetic action, yet a single-injection block may provide analgesia for a limited period. Dexmedetomidine, a selective α_2-adrenergic agonist, has been studied as an adjunct because it may modify the duration and quality of regional analgesia. Randomized work in thoracotomy patients reported the effects of adding dexmedetomidine to bupivacaine for ESPB [14]. Other randomized studies examined dexmedetomidine with ropivacaine after lumbar spine surgery or with bupivacaine after posterior lumbosacral fixation; these provide supporting but procedure-specific evidence and cannot be treated as direct equivalents of breast surgery [15–17]. A meta-analysis of randomized trials has also evaluated different dexmedetomidine doses added to local anaesthetics in ESPB, providing a broader context for dose selection and the balance between efficacy and adverse effects [18].

Research specific to MRM is particularly pertinent. Wang and colleagues conducted a randomized trial in patients undergoing MRM and compared ESPB with ropivacaine alone against ESPB with ropivacaine plus dexmedetomidine [19, 20]. Their study supports investigation of dexmedetomidine as an adjuvant in this surgical population, but it used ropivacaine rather than the bupivacaine formulation examined here. Other MRM trials have evaluated fentanyl or dexamethasone as adjuvants, or compared ESPB with alternative fascial-plane blocks, illustrating continuing uncertainty about the most appropriate practical regimen [2, 3, 6, 21]. Evidence from a conference abstract comparing dexmedetomidine and dexamethasone for an unrelated fascia iliaca block is less directly applicable and should not be taken as breast-surgery-specific evidence [22].

Despite this expanding literature, the effectiveness of adding dexmedetomidine to bupivacaine for post-MRM ESPB remains a relevant clinical question, especially where locally generated comparative evidence is limited. Outcomes such as

pain intensity at defined postoperative times and the proportion of patients requiring rescue analgesia offer complementary measures of early analgesic performance. At the same time, the interpretation of a short-term trial must acknowledge that it cannot establish prolonged block duration, reduced cumulative opioid consumption, or prevention of persistent postsurgical pain unless those outcomes are measured directly. The present study was therefore designed to compare ultrasound-guided T4 ESPB using 20 mL of 0.25% bupivacaine plus dexmedetomidine 1 μg/kg with the same volume and concentration of bupivacaine alone among women undergoing MRM at a single tertiary-care hospital in Lahore. Its primary objective was to compare mean postoperative VAS pain scores at 1, 12 and 24 hours; its secondary objective was to compare the requirement for rescue analgesia during the early postoperative observation period. The study sought to provide clinically interpretable, locally relevant evidence about the adjunctive regimen while recognizing the need for larger trials with standardized safety and longer-term outcomes.

2. METHODOLOGY

2.1. STUDY DESIGN AND SETTING

This study was reported as a single-centre, parallel-group randomized controlled trial conducted in the Department of Anaesthesiology, ICU and Pain Management, Sir Ganga Ram Hospital, Lahore, Pakistan, between March and June 2026. Women scheduled for elective modified radical mastectomy under general anaesthesia were recruited using non-probability consecutive sampling before assignment to the two intervention groups. The distinction between recruitment and allocation is important: consecutive sampling determined who entered the study, while allocation by lottery determined which treatment each recruited participant received. Sixty women were included, with 30 allocated to Group BD (bupivacaine with dexmedetomidine) and 30 allocated to Group B (bupivacaine alone). The random-allocation method was described as a lottery system; additional information about allocation concealment and blinding was not reported.

2.2. ELIGIBILITY, ETHICS AND PARTICIPANT INFORMATION

Eligible patients were women aged 25–75 years with American Society of Anesthesiologists (ASA) physical status I–II who were scheduled for elective MRM, were able to provide informed consent and agreed to participate. The reported exclusion criteria were ASA physical status III–IV, current beta-blocker use, a heart rate below 60 beats per minute, chronic opioid use, severe mental illness or communication problems that could prevent valid pain assessment. Institutional ethics committee approval and written informed consent were reported in the original study description. The institutional approval identifier was not specified in the study description. Baseline demographic and perioperative information included patient age, body mass index (BMI), ASA classification, relevant comorbidities, tumour stage and duration of surgery.

2.3. GENERAL ANAESTHESIA AND STUDY INTERVENTIONS

The reported general-anaesthesia regimen was standardized and included propofol, nalbuphine, atracurium, isoflurane and nitrous oxide. After completion of MRM, a unilateral ultrasound-guided erector spinae plane block was performed at the fourth thoracic vertebral (T4) level under aseptic precautions. The authors described using a convex ultrasound transducer and an in-plane, cranial-to-caudal needle approach. Correct needle-tip placement and the intended fascial plane were checked by injection of 3 mL of saline. Group BD received 20 mL of 0.25% bupivacaine combined with dexmedetomidine at a dose of 1 μg/kg; Group B received 20 mL of 0.25% bupivacaine alone. Both study groups therefore received the same volume and concentration of bupivacaine, with the addition of dexmedetomidine representing the intended between-group difference. Further detail was not available regarding study-solution preparation, whether the verification saline was included in the total injected volume, and the exact timing of the block relative to emergence from anaesthesia.

2.4. POSTOPERATIVE OUTCOMES AND FOLLOW-UP

Postoperative pain intensity was evaluated using a 10-cm visual analogue scale (VAS) at 1, 12 and 24 hours after surgery. The VAS is presented on its conventional scale from 0 (no pain) to 10 (worst imaginable pain). The primary comparisons were the between-group mean VAS scores at each reported assessment time. The secondary outcome was whether the patient required rescue analgesia during the reported early postoperative period, recorded as a binary variable. The rescue-analgesia agent, administration threshold, dosing regimen and exact observation endpoint were not specified in the available study description. Reported safety observations were clinically significant haemodynamic instability and block-related complications during the observed postoperative period. The absence of recorded events in this sample should not be interpreted as establishing the incidence or absence of uncommon adverse effects.

2.5. STATISTICAL ANALYSIS

Data were reported as analysed using IBM SPSS Statistics, version 25. Quantitative variables, including age, BMI, duration of surgery and VAS pain scores, were summarized using means and standard deviations (SD); categorical variables, including ASA category, relevant comorbidities, rescue analgesia and recorded complications, were described by frequencies and percentages. Between-group comparisons of VAS values at each time point were reported using independent-samples t-tests. The reported statistical comparison involved two independent allocation groups and is therefore described as an independent-samples t-test. The report does not present a repeated-measures model accounting for correlations among serial observations within each participant. Age, BMI, diabetes, hypertension, tumour stage and operative duration were identified as potential stratification variables; subgroup-specific estimates were not reported.

For rescue-analgesia frequencies, a two-sided Fisher's exact test of the aggregate 2-by-2 table yielded p=0.0014. The choice of statistical test matters because an uncorrected Pearson chi-square test of the same counts yields p=0.00066. A conventional two-sided significance threshold of $p < 0.05$ was used. Because no formal multiplicity adjustment or repeated-measures model was described, the three separately reported VAS comparisons are interpreted cautiously as time-specific comparisons.

3. RESULTS

3.1. STUDY POPULATION AND BASELINE COMPARABILITY

A total of 60 women undergoing elective MRM were enrolled, with 30 assigned to bupivacaine plus dexmedetomidine (Group BD) and 30 assigned to bupivacaine alone (Group B). Baseline age, BMI, ASA physical status and operative duration were reported as comparable between the two groups (reported $p > 0.05$). Detailed baseline distributions and numerical estimates were not available for presentation.

3.2. POSTOPERATIVE PAIN INTENSITY

At all three reported postoperative assessment times, mean VAS pain scores were lower in Group BD than in Group B. As summarized in Table 1, the respective mean scores were 1.2 ± 0.4 and 2.1 ± 0.5 at 1 hour, 1.5 ± 0.6 and 2.8 ± 0.7 at 12 hours, and 1.8 ± 0.5 and 3.1 ± 0.8 at 24 hours. The absolute between-group mean differences were 0.9, 1.3 and 1.3 VAS points, respectively, in favour of the dexmedetomidine-containing block. All three between-group comparisons had reported p-values below 0.001, consistent with independent t-tests calculated from the displayed rounded summary statistics.

Table 1. *Comparison of postoperative visual analogue scale pain scores between treatment groups*

Assessment time	Group BD: bupivacaine + dexmedetomidine (n=30)	Group B: bupivacaine alone (n=30)	Reported p-value
1 hour	1.2 ± 0.4	2.1 ± 0.5	< 0.001
12 hours	1.5 ± 0.6	2.8 ± 0.7	< 0.001
24 hours	1.8 ± 0.5	3.1 ± 0.8	< 0.001

Values are mean ± standard deviation on a 0–10 VAS; separate between-group t-tests were described at each time point. No repeated-measures adjustment was reported.

3.3. RESCUE ANALGESIA AND RECORDED ADVERSE EVENTS

Six women in Group BD (20.0%) and 19 women in Group B (63.3%) required rescue analgesia. The absolute difference in the observed proportions was approximately 43.3 percentage points, corresponding to fewer rescue-analgesia events in the dexmedetomidine group. Table 2 presents these frequencies together with the safety outcomes reported by the investigators. The two-sided Fisher's exact test of the reported frequencies gave p=0.0014. The alternative uncorrected Pearson chi-square test yielded p=0.00066, illustrating why the specification of the categorical test is important. No clinically significant haemodynamic instability or complications attributed to the block were reported in either group during the monitored period. With only 30 participants per group, however, zero observed events cannot rule out infrequent complications.

Table 2. *Rescue-analgesia requirements and recorded safety outcomes by treatment group*

Outcome	Group BD: bupivacaine + dexmedetomidine (n=30)	Group B: bupivacaine alone (n=30)	Statistical comparison
Rescue analgesia required	6 (20.0%)	19 (63.3%)	Fisher's exact $p = 0.0014$
No rescue analgesia required	24 (80.0%)	11 (36.7%)	Complementary category
Clinically significant haemodynamic instability	0 (0%)	0 (0%)	Not estimated
Recorded block-related complications	0 (0%)	0 (0%)	Not estimated

The p-value is a recalculated two-sided Fisher's exact test based on reported frequencies. The two rescue-analgesia rows reflect one binary outcome and must not be treated as independent statistical comparisons.

3.4. OVERALL INTERPRETATION OF THE REPORTED RESULTS

Together, the reported results show lower mean postoperative pain intensity at each specified assessment time and a lower proportion of patients requiring rescue analgesia in the dexmedetomidine-containing ESPB group. The findings relate specifically to analgesic outcomes within the first 24 hours after MRM and to the study's reported formulation and block technique. Subgroup analyses by age, BMI and other reported patient factors could not be interpreted because subgroup-specific estimates were not presented; therefore, no conclusion about uniform benefit across subgroups was drawn. Likewise, the data do not establish a longer sensory-block duration, an opioid-sparing dose effect, improved long-term functional outcomes or prevention of persistent postsurgical pain because those outcomes were not directly quantified.

4. DISCUSSION

The principal finding of this single-centre randomized comparison is that adding dexmedetomidine to bupivacaine for ultrasound-guided ESPB was associated with consistently lower early postoperative pain scores after modified radical mastectomy. At 1, 12 and 24 hours, the dexmedetomidine group had lower mean VAS values than the bupivacaine-alone group, and a smaller proportion of participants required rescue analgesia. These observations support the potential clinical utility of the adjuvant regimen in the setting examined. The findings should nevertheless be understood as evidence about acute analgesic outcomes in a modest study sample rather than as definitive evidence about long-term pain, opioid reduction or uncommon adverse effects.

A biologically plausible explanation involves the pharmacological actions of dexmedetomidine as a selective α_2-adrenergic agonist. When used in combination with a local anaesthetic, it has been investigated for its ability to prolong or enhance certain regional analgesic effects, potentially involving peripheral actions, altered neural excitability and systemic absorption. Such mechanisms are not directly measured in this trial, however, and should be described as potential explanations rather than demonstrated pathways. The trial did not collect pharmacokinetic data or directly measure sensory blockade duration, so it cannot distinguish local from systemic contributions to its observed pain-score differences. The broader clinical literature and anatomical reviews of ESPB emphasize that both block spread and its mechanism of action are variable and context dependent [8].

Findings from previous randomized studies provide a useful basis for comparison. Elshal and colleagues studied the addition of dexmedetomidine to bupivacaine for ESPB in thoracotomy patients and reported postoperative analgesic benefits [14]. Similarly, Abu El Hassan and co-authors examined bupivacaine with or without dexmedetomidine during ESPB in patients undergoing posterior lumbosacral fixation and observed improvements in postoperative pain control with the adjuvant [16]. Janwe and colleagues also compared bupivacaine with and without dexmedetomidine in spine fixation surgery [17]. Although these investigations support the rationale for evaluating the adjuvant, thoracotomy and spine procedures differ from MRM in the relevant anatomy, type of nociceptive input, timing of analgesia and other perioperative treatments. Accordingly, effects observed across these surgical settings should not be considered numerically interchangeable or proof of identical clinical efficacy.

The 2022 study by Yi-han Wang and colleagues provides further contextual evidence concerning dexmedetomidine and ESPB after posterior lumbar spine surgery [15]. Importantly, their intervention involved ropivacaine plus dexmedetomidine rather than the bupivacaine preparation used in the present study. Differences in local-anaesthetic pharmacology and surgical field must be considered when comparing postoperative pain and rescue-medication outcomes. Such distinctions are relevant because a favourable response to one local-anaesthetic–adjuvant combination does not automatically determine the optimal formulation or dose for another surgical population.

Evidence from breast surgery is more directly applicable. Wang and colleagues evaluated dexmedetomidine as an adjunct to ropivacaine in ultrasound-guided ESPB for patients undergoing modified radical mastectomy [19]. Their randomized design and surgical population are closely aligned with the present work, even though the local anaesthetic differed. Together, these studies suggest that dexmedetomidine-containing ESPB deserves consideration in the postoperative analgesic strategy for MRM, but the evidence should be interpreted in relation to the actual drug and dose used. The current trial provides a comparison specifically between 20 mL of 0.25% bupivacaine plus dexmedetomidine 1 μg/kg and the same bupivacaine formulation without the adjuvant. The trial does not compare dexmedetomidine with other adjuvants or establish a preferred dose across patient populations.

Other MRM trials reinforce the importance of distinguishing pharmacological choices from block technique. Ahmed and colleagues investigated fentanyl as an adjunct to bupivacaine for ESPB, indicating that multiple adjuvant strategies have been tested in this operative setting [2]. Devrajan and colleagues compared intravenous and perineural dexamethasone in the context of ESPB, directing attention to the route of adjuvant administration [3]. Lally and colleagues examined dexamethasone with levobupivacaine, while Gad and colleagues compared ESPB and serratus anterior plane block with a bupivacaine–dexamethasone combination [7, 21]. Saleh and colleagues likewise evaluated preemptive ESPB against

serratus anterior plane block during MRM [6]. These studies explore different questions and cannot be pooled informally into a single estimate of the benefit attributable to dexmedetomidine. An abstract from another surgical block technique, comparing dexmedetomidine and dexamethasone in fascia iliaca block for knee arthroscopy, is only indirect evidence and cannot establish the effect of either drug for ESPB after mastectomy [22].

The differences in VAS scores in the present study were evident at each reported assessment. The estimated absolute mean between-group difference was 0.9 point at one hour and 1.3 points at both 12 and 24 hours, with lower scores in the adjuvant group. The statistical significance of these contrasts is supported by the reported summary statistics, but interpretation of their clinical magnitude requires attention to baseline pain intensity, patient expectations and any established minimal clinically important difference applicable to the particular VAS protocol. Because the authors did not report a prespecified threshold for a clinically important difference, the data should not be described as proving a particular clinically meaningful threshold. Furthermore, postoperative VAS outcomes measured repeatedly within the same participants are correlated; separate t-tests at each time can describe individual contrasts but do not fully account for the longitudinal structure of the measurements.

The proportion of women requiring rescue analgesia offers a second, clinically relevant perspective on the same early recovery period. In the combination group, 6 of 30 patients required rescue medication, compared with 19 of 30 in the bupivacaine-alone group. The 43.3-percentage-point difference is substantial within the observed sample and aligns with the direction of the VAS findings. However, a categorical analysis should use a clearly specified procedure. A two-sided Fisher's exact test calculated from the reported counts yields p=0.0014, whereas an uncorrected Pearson chi-square test yields p=0.00066. These findings indicate that the reported probability is sensitive to the choice of categorical statistical test, and the Fisher result is stated explicitly. The same binary endpoint should be analyzed once, rather than treating "required rescue analgesia" and "did not require rescue analgesia" as two independent outcomes. In addition, the available description did not specify the rescue medication, dose, administration threshold or consistency of application; differences in rescue protocols could influence interpretation of this endpoint.

The observed reductions in rescue-analgesia frequency are compatible with wider evidence on regional analgesia, but they should not be interpreted as a demonstrated reduction in total opioid dosage. Jiao and colleagues synthesized studies of ultrasound-guided ESPB in adult surgical populations and considered opioid-sparing outcomes [23, 24]. Likewise, Leong and colleagues conducted a systematic review and meta-analysis of ESPB for breast surgery, while Zhang and colleagues analysed early analgesic and opioid outcomes among patients undergoing breast cancer surgery [9, 10]. These reviews help place the present findings in context, but the current investigators did not quantify cumulative opioid consumption and therefore cannot make an equivalent dose-based claim. The findings support fewer recorded rescue-analgesia events, not a measured total opioid-sparing effect.

The broader literature also cautions against regarding ESPB as uniquely effective compared with every alternative regional technique. Huang and colleagues reported analgesic benefits of ESPB relative to non-block conditions in breast and thoracic surgery, while also addressing comparisons with thoracic paravertebral blockade [11]. In a randomized trial of non-mastectomy breast surgery, Swisher and colleagues compared ESPB directly with a paravertebral block and found differences in early analgesic performance relevant to block choice [12]. The Cochrane review by Schnabel and colleagues summarizes ESPB evidence across surgical settings, noting limitations associated with heterogeneous operations, outcome definitions and comparators [13]. These findings reinforce the importance of choosing a regional anaesthetic technique according to the surgical procedure, clinician competence, available ultrasound resources, and patient-specific indications rather than relying on one isolated trial.

A 2024 meta-analysis by Li and colleagues specifically examined dexmedetomidine concentrations and doses added to local anaesthetics in ESPB [18]. Its synthesis provides support for evaluating dose-related analgesic outcomes and potential adverse effects. Nonetheless, a pooled finding across heterogeneous procedures does not establish that 1 μg/kg is optimal for every patient or local-anaesthetic formulation. The present trial included patients with ASA physical status I–II and explicitly excluded patients with bradycardia and those taking beta-blockers. Accordingly, its findings should not be generalized uncritically to patients with greater physiological instability, heart-rate disorders, or significant comorbidity. Decisions about perineural dexmedetomidine should also account for relevant local drug-use policies, monitoring requirements and the institutional protocol for off-label adjuvant administration.

The reported safety observations are reassuring within their limited scope. Neither group had documented clinically significant haemodynamic instability or block-related complications during the observation period. This does not demonstrate equivalence of the two regimens in safety, however, because the trial was small and was not designed to detect uncommon events. The description also does not provide serial blood-pressure or heart-rate measurements, the exact definitions of bradycardia and hypotension, or a complete adverse-event ascertainment schedule. Without these details, stronger assertions concerning haemodynamic neutrality, freedom from toxicity or general safety would exceed the evidence. A larger safety dataset and standardized monitoring would be needed to evaluate these outcomes reliably.

The study has several design features that support interpretability, including the reported random allocation into

equally sized groups, use of a common general-anaesthesia regimen, one block level, consistent bupivacaine concentration and volume, and predefined postoperative pain assessment times. Nevertheless, several methodological uncertainties remain unresolved. Recruitment was consecutive rather than probability-based, and there is no description of allocation concealment or blinding. The study did not provide an a priori sample-size calculation, a trial registration number or the full ethics approval identifier. The interval between completion of surgery, block administration, emergence from anaesthesia and the first pain assessment is also unclear. These details matter because expectation, observation and co-interventions can influence subjective pain scores, particularly when patients or assessors know which adjuvant has been administered.

The statistical analysis is another limitation. The authors reported individual t-tests for three VAS time points but did not describe a method for accounting for repeated observations, assess multiplicity or provide adjusted effect estimates with confidence intervals. Baseline variables were described as similar without supplying the corresponding numerical table, and the report mentioned age, BMI, diabetes, hypertension, tumour stage and operative duration as possible stratification factors without providing subgroup-specific results. For these reasons, statements that the analgesic effect was unchanged across demographic subgroups are not supportable from the submitted results. Future analyses based on the original patient-level dataset could consider an appropriate repeated-measures or mixed-effects model and prespecified subgroup and safety analyses, together with transparent presentation of uncertainty.

Finally, follow-up ended at 24 hours, and the reported endpoints did not include cumulative analgesic consumption, nausea and vomiting measured with standard definitions, length of stay, quality of recovery, functional outcomes, patient satisfaction, or pain beyond the acute postoperative period. The study therefore cannot evaluate persistent post-mastectomy pain syndrome, even though this is an important clinical concern. Persistent pain after breast cancer surgery has multiple determinants and cannot be assumed to be prevented simply because a single-day VAS score is lower [4]. Subsequent multicentre trials with longer follow-up, standardized rescue-analgesia protocols, robust blinding and explicit adverse-event assessment could help determine whether the improvement in acute analgesia is reproducible and whether it translates into sustained patient-centred benefits.

Overall, the present findings support further investigation of dexmedetomidine as an adjunct to bupivacaine for ultrasound-guided T4 ESPB after MRM. The results are directionally compatible with several previous randomized and synthesized studies, but their clinical application should remain conditional on careful review of the original trial methods, patient characteristics, rescue-treatment protocol and local governance of anaesthetic adjuvants. The principal contribution of this work is its specific comparison of early postoperative pain and rescue-analgesia outcomes for the bupivacaine–dexmedetomidine combination in a local MRM population, rather than proof of superiority over other regional techniques or prevention of long-term postsurgical pain.

5. CONCLUSION

In this single-centre randomized comparison of 60 women undergoing modified radical mastectomy, ultrasound-guided T4 erector spinae plane block with 20 mL of 0.25% bupivacaine and dexmedetomidine 1 μg/kg was associated with lower postoperative visual analogue scale pain scores than the same bupivacaine formulation alone. The differences were observed at 1, 12 and 24 hours, with mean scores consistently favouring the combination regimen. Fewer women in the bupivacaine–dexmedetomidine group required rescue analgesia (6/30, 20.0%) than in the bupivacaine-alone group (19/30, 63.3%); recalculation of this binary comparison using a two-sided Fisher's exact test gave p=0.0014. These outcomes together suggest that the addition of dexmedetomidine may improve early analgesic performance during the first postoperative day in the specific population and clinical setting examined.

No clinically significant haemodynamic instability or block-related complications were reported in either group during the stated observation period. Nevertheless, the small group sizes and limited adverse-event details do not establish the comparative safety of these formulations or exclude uncommon harms. Likewise, the trial did not measure sustained block duration, cumulative opioid doses, quality of functional recovery or persistent pain; claims concerning these outcomes cannot be derived from the available results. The use of dexmedetomidine as a regional adjuvant should be considered in light of monitoring requirements, patient-specific factors, medication policy and institutional protocols rather than adopted without further evaluation.

The findings contribute locally relevant data to the growing literature on ESPB adjuvants after breast surgery. Larger multicentre randomized trials, with fully reported allocation procedures, standardized rescue analgesia, clear postoperative timing, repeated-measures analysis, complete safety monitoring and follow-up beyond the first postoperative day, are required to establish the reproducibility of the effects and their importance for longer-term patient-centred recovery.

AUTHOR CONTRIBUTIONS

Ayesha Siddiqa and Muzammil Hussain contributed equally to the conception, development, preparation and revision of the manuscript. Both authors reviewed and approved the final manuscript and accept responsibility for its content.

CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

DATA AVAILABILITY

Aggregate study results are presented in the Results tables. Requests for access to de-identified participant-level data and supporting materials should be directed to the corresponding author and are subject to applicable ethical and institutional permissions.

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