

# The Effectiveness of Paravertebral Block Compared to Erector Spinae Plane Block in Treating Acute Pain Post-Modified Radical Mastectomy Surgery

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## ABSTRACT

**Background:** Breast surgery is one of the most common operations among females. Management of postoperative pain is one parameter of the success of anesthesia and surgery. Therefore, it is important to look for innovations regarding newer anesthetic techniques that can be used to provide analgesia to manage acute or chronic pain. Some of the most popular peripheral nerve blocks are the erector spinae plane (ESPB) block and the paravertebral block (TPVB). The purpose of this systematic review is to measure the effectiveness of the erector spinae plane block, compared with paravertebral block and systemic analgesia in managing acute pain after modified radical mastectomy (MRM) surgery. **Methods:** This systematic review was carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines published by Oxford University Media in the British Journal of Anesthesia. The author has conducted a comprehensive strategy to search and identify the TPVB and ESPB studies in adult female patients (aged > 18 years) who underwent any type of breast surgery. **Results:** Based on the analysis of the four studies that met the inclusion criteria, the author found no significant differences in relation to primary or secondary output from TPVB anesthesia techniques compared to ESPB. **Conclusions:** This review shows that both ESPB and TPVB are effective in reducing pain and opioid use after MRM. ESPB is simpler and faster to perform, making it a practical option.

**Keywords:** paravertebral block; block erector spinae plane; visual analogue score; modified radical mastectomy.

## INTRODUCTION

Breast surgery is the most common operation among females. Cases that often require surgical intervention in breast cancer. Breast cancer is one of the most common malignancies throughout the world. About 12% of women suffer from breast cancer.[1] In the United States, 231,840 new cases of breast cancer were discovered in 2015.

Surgery is a procedure that can cause damage as a result of intentional injury. Surgical injuries can stimulate systemic inflammatory response. This inflammatory response consequences can be assessed using the Neutrophil-Lymphocyte Ratio (NLR), a parameter that is relatively more cost-effective. The neutrophil-lymphocyte ratio is the most accurate marker in predicting the severity and outcome compared to traditional infection markers.[2,3] Research by Turgut et al. (2017), found NLR before surgery can be used as a predictor of the need for postoperative analgesia as the effect of planned surgery.[4]

Management of postoperative pain is one of the parameters of the success of anesthesia and surgery. Decent pain management is proven to reduce

morbidity and complications of the surgery, increase patient comfort and satisfaction, early mobilization and healing, reduce lung and heart complications, and ultimately reduce overall treatment costs.[5,6] Thus, it is important to look for innovations regarding newer anesthesia techniques that can be used to provide analgesia for various surgical procedures and to manage acute or chronic pain. One of them is erector spinae plane block (ESPB).[7] Another well-known technique is a thoracic paravertebral block (TPVB) produced by injecting local anesthetic alongside the thoracic vertebra where the spinal nerve arises from the intervertebral foramen. Paravertebral block with a single injection technique uses a larger dose and its volume distribution cannot be predicted, but with multiple injections technique entering a smaller volume (3-4 ml) at each puncture site depending on the level of thoracic vertebrae, provides more benefits. The mechanism of the gravity-related dispersal effect on the dermatome level is yet to be known.[8] For patients who have a high risk of cardiovascular and respiratory complications and will undergo thoracic area surgery, it can be considered to use the paravertebral block anesthesia technique because of the minimal effect on hemodynamics.[9]

The advantages and disadvantages of the erector spinae plane block and paravertebral block to reduce the level of C - Reactive Protein (CRP), NLR and visual analog scale (VAS) scores have not been much explained.[10,11] The studies on different operations are explained by Hamed et al. (2019), who compared the truncal transversus abdominis plane block with the erector spinae plane block and found that bilateral ESPB provides effective postoperative analgesia and significantly reduced postoperative fentanyl consumption in patients undergoing abdominal hysterectomy [12].

The purpose of this systematic review is to describe the effectiveness of the erector spinae plane (ESBP) block, compared to the paravertebral block (TPVB) and systemic analgesia in managing acute pain after modified radical mastectomy (MRM).

## **METHOD**

This systematic review was carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines published by Oxford University Media in the British Journal of Anesthesia. The author has conducted a comprehensive strategy to search and identify the TPVB and ESBP studies in adult female patients (aged > 18 years) who underwent any type of breast surgery (Supplementary data, Appendix S1). Electronic literature database searches were performed using the ProQuest, Medline, Cochrane, and EBSCO databases until June 2020 using keywords: paravertebral block (TPVB), erector spinae plane block (ESBP), and modified radical mastectomy (MRM). The authors conducted a study that compared the erector spinae plane block with a paravertebral block in dealing with acute pain after MRM surgery. The literature search is limited to a Randomized Controlled Trial (RCT). There are no restrictions on language and literature publication date. From these searches, a total of 37 literatures were obtained, 4 of which met the criteria for further analysis.

## **Studies that meet the criteria**

For studies that meet the criteria, screening is conducted independently by two different authors. Based on the existing protocol, differences in views and opinions of the two researchers will be resolved

through a discussion that can involve a third author if necessary.

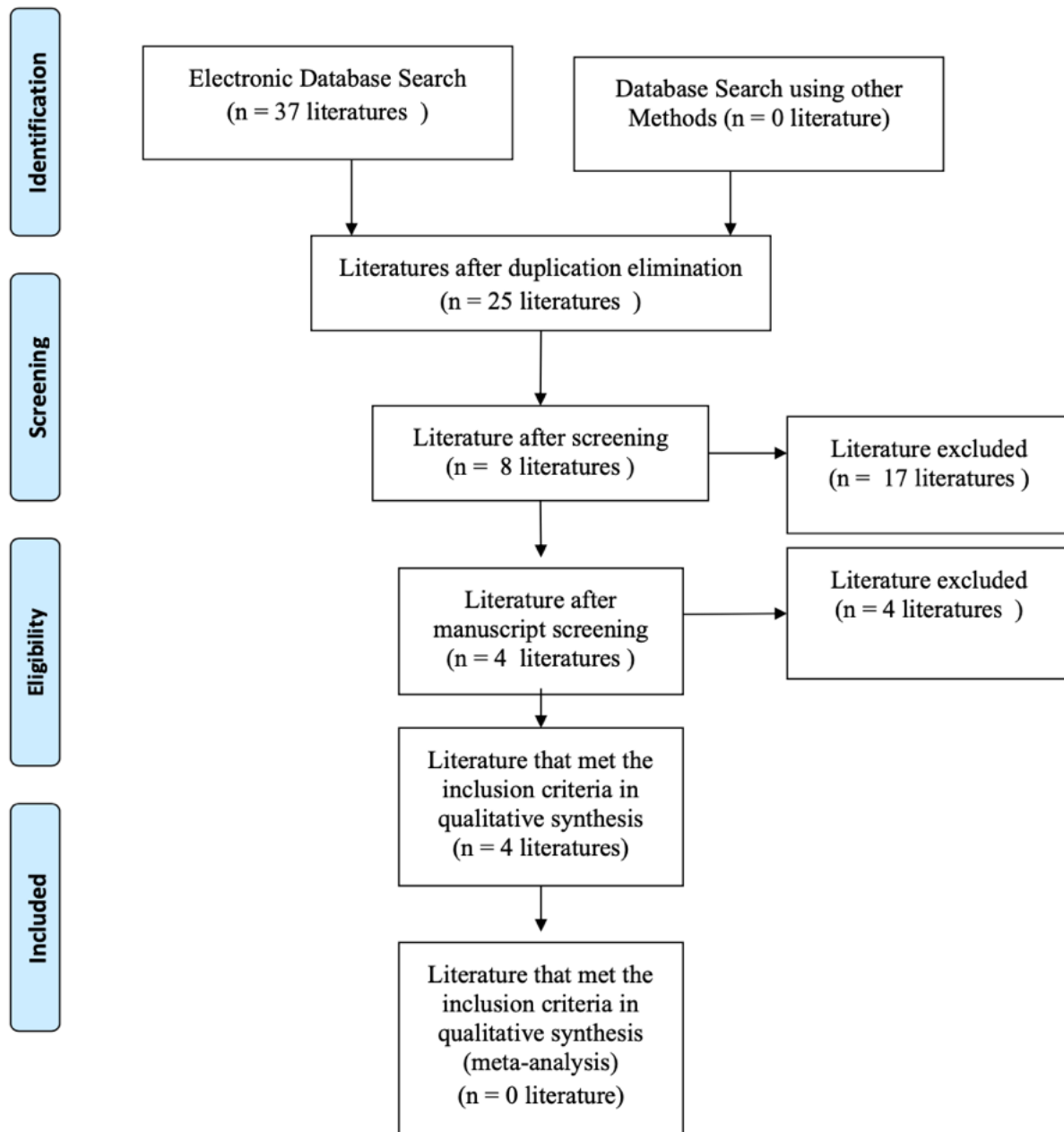
The inclusion criteria in this systematic review are 1) the subjects of the studies are female aged 18 - 65 years, 2) studies using randomized controlled trials (RCTs), 3) studies assessing postoperative pain scores as primary output and/or postoperative analgesic consumption, 4) analgesic effects of TPVB distinguished from ESPB, and 5) the specific type of surgery in the form of modified radical mastectomy. Studies that did not meet the inclusion criteria or the English abstract were not available, were excluded at this stage. The authors excluded all types of retrospective studies, case reports, non-randomized studies, and studies that did not specifically mention the use of TPVB and ESBP anesthesia techniques during MRM surgery.

## **Data extraction**

Data collection and bias risk assessment can be carried out using standardized forms and then analyzed using Microsoft Excel 2016 (Microsoft Corp, Redmond, WA). Data extracted from each study included: patient characteristics, methodology, anesthesia, and analgesic techniques and outcomes obtained. The primary outcome of this systematic review is postoperative pain score accompanied by analgesic use. Secondary outcomes included any side effects, such as nausea and vomiting, vascular puncture, epidural and intrathecal spread, pleural puncture, or pneumothorax.

The methodological bias of each RCT was independently assessed using (focusing on the adequacy of randomization and blinding) and the bias risk assessment tool by the Cochrane Collaboration and tabulated using Review Manager ver. 5.3 (RevMan; Cochrane Collaboration, Oxford, UK).

The authors used the Cochrane Collaboration tool to assess the risk of bias. The risks of selection bias, performance, detection, friction, reporting bias, and other biases are also assessed. Meta-synthesis with meta-aggregation approach that authors collected specifically looked for comparisons between the ESBP and TPVB blocks so that even study categories or literature that did not use blinding sampling were included in this systematic study.

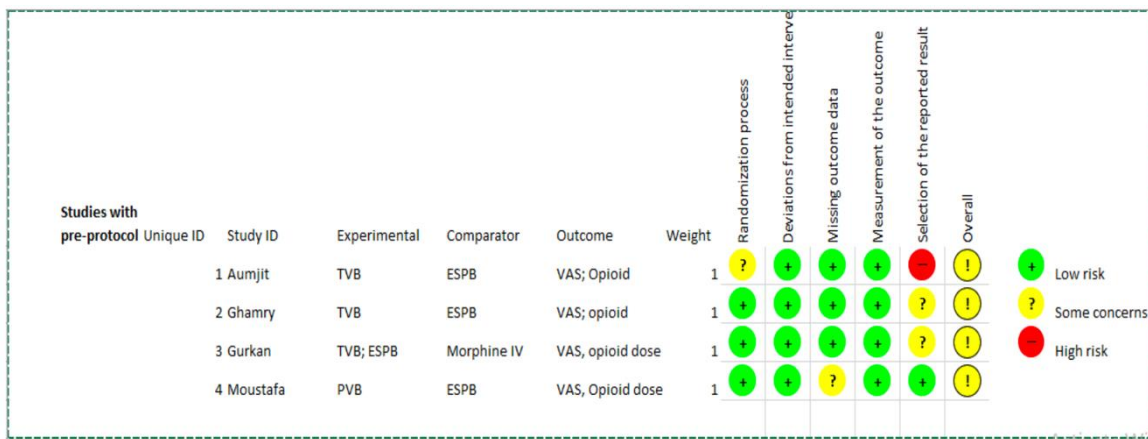


**FIGURE 1:** Literature Selection Diagram [13].

The authors used the Cochrane Collaboration tool to assess the risk of bias. The risks of selection bias, performance, detection, friction, reporting bias, and other biases are also assessed. Meta-synthesis with meta-aggregation approach that authors collected specifically looked for comparisons between the ESBP and TPVB blocks so that even study categories or literature that did not use blinding sampling were included in this systematic study.

## RESULTS

Figure 1 shows the literature search outline. Based on electronic database searching, the authors found 37 works of literature. Out of the 37 works of literature obtained, as many as 25 pieces were deleted due to duplication. The final result is 4 literatures with a total of 325 participants. Meanwhile, the risk assessment bias can be shown in Figure (2). Details of the 4 literatures or studies that the authors have analyzed are explained in detail in Table 1. Three of them applied peripheral nerve block anesthetic techniques in the form of ESBP and TVPB to the treatment group accompanied by the application of general anesthesia. While one literature applies peripheral nerve blocks alone.



**FIGURE 2:** Bias Risk Assessment for studies that met the inclusion criteria.

The results of this systematic review identified 4 randomized controlled trials in evaluating the effectiveness of the erector spinae block compared to other anesthetic techniques namely paravertebral block and systemic analgesia using morphine or fentanyl in resolving acute post-operative pain through suppression against inflammatory response inflicted. The second result that can be assessed from each of these publications relates to the total consumption of opioids during surgery and post-surgery, complications from the nerve block, and nausea and vomiting side effects.

## DISCUSSION

In one study written by El Ghamry et al. (2019), 70 female patients with homogeneous demographic data i.e. women aged 25-65 years divided into two treatment groups, namely the erector spinae plane block, and the paravertebral block and had the hypothesis that ESP could provide effective results to control the post-mastectomy pain; hence it can replace other common anesthetic techniques. Besides being effective, it is also safe and simple. This study aims to compare the analgesic effects of ESPB and TPVB in breast surgery with respect to opioid consumption, duration of analgesia, hemodynamic profile, and complications. The results indicate that morphine consumption 24 hours postoperatively and the time to first analgesic rescue were comparable between the two groups ( $P = 0.32$  and  $P = 0.075$ , respectively). There was no significant difference in intraoperative fentanyl consumption. Additionally, there was no significant difference in VAS scores between the two groups over 24 hours. The incidence of nausea and vomiting was similar between the two groups. All patients exhibited a stable hemodynamic profile. This study concludes that both TPVB and ESPB effectively control post-mastectomy pain and reduce intraoperative and postoperative opioid consumption [14].

The ESPB technique, is acknowledged for being safer and more straightforward to perform given the time required for each procedure. [15,16] In a study by Moustafa et al. (2020), It was demonstrated that performing an ESPB requires significantly less time compared to a paravertebral block, even when undertaken by an anaesthetic resident rather than a consultant or regional anaesthesia specialist.

However, regarding postoperative morphine consumption, the study found no significant difference between the two groups. The strengths of this study include the comprehensive assessment of patients' haemodynamic parameters both intraoperatively and postoperatively for those receiving erector spinae plane blocks and paravertebral blocks [15].

Likewise, with research conducted by Gurkan et al. (2020), it was found that both the erector spinae plane blocks and paravertebral blocks significantly reduced morphine consumption at the 6th hour, 12th hour, and 24th hour postoperative. The comparison of these two blocks to the control group using only systemic analgesic regimens was significantly different with  $p < 0.001$  for each time interval when compared to the control group.[17] The study was conducted on 75 women aged 18 -65 years who suffer from breast malignancy and have ASA 1-2 physical status with prospective research methods, double-blind, and randomized controlled trials. Meanwhile, secondary effects related to complications of nausea and vomiting after the block were found higher in the ESPB group compared to paravertebral block which is 7 patients compared to 2 patients. However, a comparison of fentanyl consumption and assessment of acute pain 24 hours postoperatively using the VAS method did not differ significantly between the two groups [18].

Meanwhile, research conducted by Wittayapiroj et al. (2019), also emphasized that there were no significant differences regarding the effectiveness of TPVB and ESPB in managing acute pain after MRM surgery. This is proved through VAS assessment starting from 1 hour postoperatively to 24 hours postoperatively. This study evaluated the analgesic and sensory effects between the ESPB and TPVB after breast surgery. This retrospective study was performed on patients undergoing breast surgery from June to October 2018 using TPVB block or ESPB postoperative pain control. The results of this study involved 24 patients with 10 patients treated with TPV blocks and 14 patients treated with ESPB. The difference in mean VAS in 24 hours (at rest and in movements) is similar (-9.1, with  $p = 0.263$  and 7, 4 with  $p = 0.387$ ). Block duration is significantly shorter on ESP blocks.

The ESPB and the TPVB describe similar pain responses in postoperative pain and sensory blockade after breast surgery but the ESPB requires a shorter time to perform [16].

Based on the review that has been conducted by authors on the four studies that met the inclusion criteria, no significant differences in relation to primary or secondary output were found between TPVB anesthesia techniques compared to ESBP. The primary output of the study sample, related to acute postoperative MRM pain based on VAS and NRS assessments shows that both the TPVB and ESBP techniques are effective in dealing with acute pain after MRM surgery. Meanwhile, related to the total consumption of analgesic agents such as morphine, was also not significantly different in the 24-hour postoperative period between TPVB and ESBP groups in the four studies. This result is of course frustrating, especially for future researchers who plan to conduct interventional research comparing the effectiveness of TPVB anesthesia to ESBP in dealing with acute pain after MRM surgery. However, related to other secondary outputs such as the procedure duration of the TVPB technique compared to ESBP, ESBP requires a shorter time to obtain the expected sensory block effect [15]. It can be a reference for further researchers to use the ESBP technique other than TVPB in supporting anesthesia in MRM surgery. The ESBP technique is still relatively new in the field of peripheral block anesthesia used in MRM surgery so there are not many studies that explain in detail the advantages and risks of using this technique.

According to the protocol that was made previously, the author conducted a sequential analysis test to evaluate the strength of available evidence despite a high level of heterogeneity. Trial- Sequential analysis is a monitoring representation in a single randomized controlled trial. Some testing increases the risk of type-1 and -2 statistical analysis errors and shifts exist both in the transient analysis and in the single meta-analysis. The sequential test analysis conducted for our main results shows a lack of sufficient strength to draw definitive conclusions that there are no differences, so this is a drawback of this systematic review. In a single trial study, strength analysis is done a priori, usually based on a pilot study or based on data from other experiments. Sequential analysis trials cannot provide a priori estimates of the number of patients needed to get to the conclusion or proof before a meta-analysis is conducted. Each new trial added to the analysis can change the variance between trials and the proportion of events in the meta-analysis control group. These two parameters affect the size of the information needed and the amount needed in a future research study. Although this systematic review cannot apply meta-analysis because of its qualitative nature and inadequate number of studies due to ESBP techniques being relatively new in MRM, but the author's meta-synthetic directly describes the effectiveness of the two anesthetic techniques in overcoming acute post-pain operation.

The authors hope this systematic review can be used as a reference for future studies relating to other primary outputs in addition to postoperative acute pain assessment, one of which is by discussing the anti-inflammatory effects of peripheral nerve block techniques such as ESBP and TPVB in MRM surgery.

## CONCLUSIONS

This systematic review found that both ESPB and TPVB are effective in managing acute postoperative pain after MRM. Both techniques showed comparable results in pain reduction (VAS/NRS scores) and opioid consumption within 24 hours post-surgery. However, ESPB offers the advantage of being simpler and faster to perform compared to TPVB. While the evidence remains limited due to the small number of studies and heterogeneity, ESPB can serve as a promising alternative for pain management in MRM surgery.

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