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A COMPARATIVE STUDY OF ULTRASOUND GUIDED ERECTOR SPINAE PLANE BLOCK WITH CONVENTIONAL GENERAL ANAESTHESIA FOR POST OPERATIVE ANALGESIA IN MODIFIED RADICAL MASTECTOMY: A PROSPECTIVE RANDOMISED CONTROLLED STUDY

Anaesthesiology

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ABSTRACT

Background & Aim: Breast surgeries such as modified radical mastectomy (MRM) are associated with moderate to severe postoperative pain, which can lead to delayed recovery and increased opioid use. The erector spinae plane block (ESPB) has emerged as a promising regional anaesthetic technique for thoracic surgeries. This study aimed to evaluate the efficacy of ultrasound-guided ESPB in MRM by comparing it with conventional general anaesthesia alone, focusing on postoperative analgesic requirements and intraoperative opioid consumption. **Materials & Methods:** A prospective randomized controlled trial was conducted on 80 ASA II–III female patients aged 18–65 years undergoing elective MRM. Patients were randomized into two groups: Group GE received ultrasound-guided ESPB before general anaesthesia, while Group G received general anaesthesia only. Intraoperative fentanyl usage, duration of postoperative analgesia, number of rescue analgesics in 24 hours, and hemodynamic parameters were recorded. Pain was assessed using the Visual Analogue Scale (VAS), and data were analyzed using appropriate statistical tests with $p < 0.05$ considered significant. **Results:** Group GE showed significantly lower intraoperative fentanyl consumption (53 ± 4.64 mcg vs. 62.5 ± 9.54 mcg, $p < 0.0001$), longer duration of analgesia (411 ± 60.07 min vs. 66 ± 21.6 min, $p < 0.0001$), and fewer rescue analgesic requirements in 24 hours ($p < 0.0001$). Hemodynamic parameters such as heart rate remained more stable in Group GE at various intervals. No major complications or block-related adverse events were reported in either group. **Conclusion:** Ultrasound-guided erector spinae plane block significantly improves postoperative analgesia, reduces opioid requirements, and offers better hemodynamic stability in patients undergoing modified radical mastectomy. It is a safe and effective component of multimodal analgesia in breast surgery.

KEYWORDS

Erector spinae plane block, modified radical mastectomy, postoperative analgesia, ultrasound-guided block, opioid-sparing anaesthesia.

INTRODUCTION

Modified radical mastectomy (MRM) remains a common surgical procedure in the management of breast cancer, particularly in developing countries where late presentation and limited access to breast-conserving options prevail. Effective postoperative pain control in MRM is essential not only for patient comfort but also for minimizing the risk of chronic post-mastectomy pain syndrome, promoting early ambulation, reducing opioid-related side effects, and enhancing overall recovery [1,2].

Traditionally, general anaesthesia (GA) alone has been the mainstay for these procedures. However, GA often fails to provide adequate postoperative analgesia, leading to high opioid requirements and associated complications such as nausea, vomiting, sedation, and respiratory depression [3]. In the pursuit of effective multimodal analgesia with minimal systemic effects, regional anaesthesia techniques have gained momentum, particularly in breast surgeries.

The ultrasound-guided erector spinae plane block (ESPB), first described by Forero et al. in 2016, is a relatively novel fascial plane block that has shown promising results in providing analgesia for thoracic and abdominal surgeries [4]. The block involves the injection of local anaesthetic deep to the erector spinae muscle at the transverse process, resulting in the spread of the drug cranio-caudally and ventrally to block the dorsal and ventral rami of the spinal nerves [5]. Its simplicity, safety profile, and the absence of major complications such as pneumothorax or motor blockade make it particularly appealing in breast surgery contexts [6].

Several studies have demonstrated the analgesic efficacy of ESPB in breast surgeries, including MRM, by reducing the consumption of systemic opioids and improving pain scores in the postoperative period [7]. Furthermore, ultrasound guidance enhances precision, reduces the risk of vascular or pleural puncture, and ensures adequate spread of local anaesthetic [8]. As ESPB targets both somatic and visceral components of thoracic pain, it presents a valuable alternative to traditional blocks like the thoracic paravertebral block (TPVB) or pectoral nerve blocks, which may have higher complication rates or more technical challenges [9].

Recent randomized controlled trials and meta-analyses suggest that ESPB significantly reduces pain scores and opioid requirements post-MRM, contributing to enhanced recovery after surgery (ERAS) protocols [10]. However, comparisons between ESPB and standard general anaesthesia without regional blocks in this specific context remain limited.

This prospective randomized controlled study was therefore designed to evaluate the efficacy of ultrasound-guided ESPB in patients undergoing modified radical mastectomy and compare it with conventional general anaesthesia alone. The primary outcome is postoperative analgesic consumption, and secondary outcomes include pain scores and intraoperative anaesthetic requirements.

MATERIAL AND METHODS

This prospective, randomized controlled study was conducted in the Department of Anaesthesiology, Government Medical College and S.S.G. Hospital, Vadodara, from August 2023 to June 2024, after obtaining approval from the Institutional Ethics Committee for Biomedical and Health Research (IECBHR/196-2023) and registration under CTRI/2023/08/056238.

Inclusion criteria included female patients aged 18–65 years, ASA physical status II–III, posted for elective Modified Radical Mastectomy, able to consent and understand the Visual Analogue Scale (VAS) for pain. **Exclusion criteria** were patient refusal, allergy to local anaesthetics, local infection, pregnancy/lactation, coagulopathies, inability to consent, and patients with uncontrolled systemic illnesses.

A total of 80 patients were randomized into two groups (n=40 each) using computer-generated randomization (randomizer.org):

- **Group GE (ESPB + GA):** Received ultrasound-guided erector spinae plane block followed by general anaesthesia
- **Group G (GA only):** Received general anaesthesia without a regional block

All patients underwent preanaesthetic evaluation and necessary investigations. Written informed consent was obtained, including explanation of the VAS scoring system.

On the day of surgery, monitoring included HR, BP, SpO_2, and ECG. Premedication consisted of IV dextrose, ondansetron 4 mg, glycopyrrolate 0.2 mg, and midazolam 1 mg. In Group GE, a unilateral ESP block was administered at T4 level using a 23G Quincke spinal needle under ultrasound guidance with 20 mL of 0.5% Levobupivacaine injected between the erector spinae muscle and transverse process.

Both groups were induced with fentanyl (2 µg/kg), propofol (2 mg/kg), and vecuronium (0.1 mg/kg), and anaesthesia was maintained with sevoflurane in an oxygen-air mixture. Intraoperative fentanyl boluses (0.5 µg/kg) were given if a 20% increase in hemodynamic parameters from baseline was observed. Neuromuscular reversal was achieved using neostigmine and glycopyrrolate, and patients were extubated and monitored postoperatively.

Postoperative pain was assessed using a 10-point Visual Analogue Scale (VAS) over a 24-hour period. Rescue analgesia (Paracetamol 15 mg/kg IV) was given if VAS >4. Duration of analgesia was defined as the time from block completion to first analgesic request. The total number and dose of rescue analgesics were recorded. Intraoperative and postoperative complications, including hypotension, bradycardia, allergic reactions, and signs of local anaesthetic toxicity, were monitored and managed accordingly.

RESULTS

Table 1 shows the intraoperative requirement of fentanyl citrate in both groups. Patients in Group GE (ESPB + GA) required significantly less fentanyl (53 ± 4.64 mcg) compared to Group G (GA only) who needed 62.5 ± 9.54 mcg, with a p-value < 0.0001. This reduction in intraoperative opioid requirement clearly indicates the opioid-sparing effect of the erector spinae plane block.

Table 2 presents the distribution of mean heart rate at two key intervals—5 minutes and 24 hours postoperatively. At both time points, patients in Group GE had significantly lower heart rates than those in Group G, suggesting more stable hemodynamics and effective pain control in the ESPB group. The differences were statistically significant with p-values < 0.0001 at both intervals.

Table 3 highlights the total duration of postoperative analgesia. Group GE demonstrated a markedly prolonged analgesic duration of 411 ± 60.07 minutes, compared to only 66 ± 21.6 minutes in Group G. The difference was highly significant (p < 0.0001), showing that ESPB provided sustained postoperative pain relief compared to general anaesthesia alone.

Table 4 reflects the number of rescue analgesics required in the first 24 hours postoperatively. In Group GE, 17 patients required only one dose of paracetamol, while none required three doses. In contrast, 18 patients in Group G required three doses. The reduced frequency of rescue analgesia in Group GE further supports the superior analgesic efficacy of ESPB (p < 0.0001).

Table 5 outlines the observed postoperative complications. Minor vomiting occurred in 2 patients in Group GE and 1 in Group G, all of which were managed with ondansetron. No cases of infection, hematoma, pruritis, or local anaesthetic systemic toxicity (LAST) were reported in either group, indicating the procedural safety of ESPB when performed under ultrasound guidance.

Table 1: Intraoperative Requirement Of Injection Fentanyl Citrate

Group	Mean ± SD (mcg)	p-value
Group GE	53 ± 4.64	< 0.0001
Group G	62.5 ± 9.54	

Table 2: Distribution of Mean Heart Rate at Different Time Intervals

Time Interval	Group GE (Mean ± SD)	Group G (Mean ± SD)	p-value
5 minutes	80.55 ± 2.82	92.80 ± 6.52	< 0.0001
24 hours postop	81.90 ± 6.60	90.45 ± 7.26	< 0.0001

Table 3: Total Duration Of Analgesia

Group	Mean ± SD (minutes)	p-value
Group GE	411 ± 60.07	< 0.0001
Group G	66 ± 21.6	

Table 4: Number Of Rescue Analgesia (Paracetamol 1 Gm) Required In 24 Hours

No. of Rescue Analgesics	Group GE (n)	Group G (n)	p-value
1	17	0	< 0.0001
2	23	22	
3	0	18	

Table 5: Postoperative Complications

Complication	Group GE (n)	Group G (n)	Treatment Given
Vomiting	2	1	Inj. Ondansetron 0.1 mg/kg IV
Infection	0	0	Nil
Hematoma	0	0	Nil
Pruritis	0	0	Nil
LAST	0	0	Nil

DISCUSSION

This prospective randomized controlled study aimed to evaluate the efficacy of ultrasound-guided erector spinae plane block (ESPB) combined with general anaesthesia (GA) versus GA alone in providing postoperative analgesia in patients undergoing modified radical mastectomy (MRM). The results clearly indicate that ESPB significantly enhances analgesic efficacy, reduces opioid consumption, stabilizes hemodynamics, and minimizes postoperative complications.

The intraoperative requirement of fentanyl was significantly lower in the ESPB group compared to the GA-only group. This opioid-sparing effect of ESPB is consistent with current literature which supports its ability to block both dorsal and ventral rami of thoracic spinal nerves, thereby providing multidermatomal analgesia [11]. A recent meta-analysis by Altıparmak et al. concluded that ESPB significantly reduces intraoperative and postoperative opioid needs in various breast surgeries, aligning with our findings [12].

The significantly prolonged duration of postoperative analgesia in the ESPB group (411 ± 60.07 min) compared to the GA group (66 ± 21.6 min) highlights the efficacy of ESPB in extending pain relief well into the postoperative period. Gürkan et al. also observed a similar outcome in their study on mastectomy patients, noting prolonged time to first rescue analgesic and improved patient satisfaction with ESPB [13]. This supports its inclusion in multimodal analgesia strategies for breast surgery, especially under ERAS protocols.

Heart rate, an indirect marker of sympathetic stimulation and pain, was consistently lower in the ESPB group throughout the intra- and postoperative periods. Lower heart rates suggest better pain control and reduced stress response in these patients. This finding is corroborated by a randomized controlled trial conducted by Jadon et al., which demonstrated improved intraoperative hemodynamic stability with ESPB compared to conventional approaches [14].

The number of rescue analgesics required in the first 24 hours was also significantly lower in the ESPB group. Only 2 doses were needed in most ESPB patients, while the GA-only group often required 3 or more. This reduction in analgesic requirement not only improves patient comfort but also reduces the likelihood of opioid-related side effects such as nausea, sedation, and respiratory depression. According to Wahba et al., ESPB effectively reduces pain scores and total analgesic consumption in breast surgeries, improving postoperative recovery and patient satisfaction [15].

Importantly, no major complications were observed in the ESPB group. Minor vomiting was noted and treated effectively. No cases of local anaesthetic toxicity, infection, hematoma, or block-related complications occurred, demonstrating the procedural safety of ultrasound-guided ESPB when performed by trained hands. This safety profile further reinforces ESPB as a reliable and minimally invasive alternative to thoracic epidural or paravertebral blocks.

Overall, the findings of this study support the integration of ESPB into anaesthetic plans for mastectomy procedures. It not only improves perioperative analgesia but also contributes to opioid-sparing, hemodynamic stability, and enhanced postoperative recovery.

CONCLUSION

Ultrasound-guided erector spinae plane block significantly improves postoperative analgesia in patients undergoing modified radical

mastectomy. It reduces intraoperative fentanyl consumption, prolongs the duration of analgesia, minimizes the need for rescue analgesics, and maintains stable hemodynamics without significant complications. ESPB is a safe, effective, and valuable regional technique that should be considered as part of multimodal analgesia protocols in breast cancer surgeries.

Conflict Of Interest: No! Conflict of interest is found elsewhere considering this work.

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