

Comparison of recovery status, haemodynamic parameter and postoperative analgesia in combined general anaesthesia with pectoral nerve block II and general anaesthesia for modified radical mastectomy

Nasima Sultana¹, Rahnuma Tasnim², Ayesha Sultana³, Shamim Ara Sultana⁴, Mehedi Masud⁵, Sheikh Imran Alam⁶, Abdur Razzaque⁷, Parvin Akter⁸, Mohammad Mominul Haque⁹

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*Corresponding author



ABSTRACT

Background: Modified radical mastectomy is associated with significant postoperative pain requiring effective multimodal analgesia. General anaesthesia alone may not provide adequate pain control, leading to increased opioid consumption and delayed recovery. Ultrasound-guided pectoral nerve block II (PECS II) has emerged as an effective regional technique to improve postoperative analgesia in breast surgery. **Methods & Materials:** This prospective randomized controlled trial was conducted in the Department of Anaesthesia, Analgesia and Intensive Care Medicine and the Department of General Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from September 2021 to October 2022. **Results:** Baseline characteristics including age, weight and ASA grade were comparable between groups ($p > 0.05$). Mean arterial pressure was significantly lower in the PECS II group at 15 minutes intraoperatively ($p < 0.001$), while other time points showed no difference. Postoperative VAS scores were significantly lower in Group B both in recovery (1.2 ± 0.4 vs 4.3 ± 0.7) and at 6 hours ($p < 0.001$). Time to first rescue analgesia was significantly prolonged in Group B (144.0 ± 68.9 vs 38.0 ± 13.5 min), with reduced pethidine consumption (72.5 ± 7.9 vs 120.0 ± 10.0 mg). Higher Modified Aldrete Scores > 9 were observed in Group B (76.7% vs 20%). PONV and opioid-related complications were also lower in Group B. **Conclusion:** PECS II block combined with general anaesthesia provides superior postoperative analgesia, reduces opioid requirement, improves recovery profile and maintains hemodynamic stability in patients undergoing modified radical mastectomy.

Keywords: Modified radical mastectomy, PECS II block, general anaesthesia, postoperative analgesia, opioid consumption, recovery status.

1. Assistant Professor, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0002-8290-227X)
2. Assistant Professor, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0003-0412-4078)
3. Assistant Professor, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0009-6614-6073)
4. Assistant Professor, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0000-0001-6125-2023)
5. Assistant Professor, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0009-9106-8011)
6. Medical Officer, Directorate General of Health Services (DGHS), Dhaka, Bangladesh (ORCID: 0009-0007-2449-4518)
7. Anaesthesiologist, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Dhaka Medical College Hospital, Dhaka, Bangladesh (ORCID: 0009-0000-4511-9695)
8. Medical Officer, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0006-3493-3863)
9. Assistant Professor, Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University, Dhaka, Bangladesh (ORCID: 0009-0004-8509-7223)

INTRODUCTION

Breast cancer remains one of the most common malignancies affecting women worldwide and represents a significant cause of morbidity and mortality [1]. In Bangladesh, the burden of breast cancer is steadily increasing, with a considerable proportion of patients presenting at a relatively younger age and often at more advanced stages of disease [2]. Modified radical mastectomy continues to be one of the most frequently performed surgical procedures for operable breast cancer in resource-limited settings [3]. Although effective in disease control, it is associated with substantial postoperative pain due to extensive tissue dissection, including skin, breast tissue, axillary dissection and chest

wall trauma [4].

Effective perioperative pain management is therefore essential not only for patient comfort but also for early mobilization, reduced postoperative complications and improved overall recovery [5]. Traditionally, general anaesthesia (GA) has been the standard technique for breast cancer surgery [6]. However, GA alone is often associated with inadequate postoperative analgesia, increased opioid requirement and opioid-related adverse effects such as nausea, vomiting, sedation and respiratory depression. These factors may delay recovery and discharge from the post-anaesthesia care unit [7]. In recent years, regional anaesthetic techniques have gained increasing

importance as components of multimodal analgesia. Among these, the pectoral nerve block type II (PECS II) has emerged as a promising ultrasound-guided fascial plane block for breast surgeries [8]. PECS II block provides analgesia to the anterolateral chest wall by blocking the pectoral nerves, intercostobrachial nerve and lateral branches of intercostal nerves, thereby covering both the pectoral and axillary regions involved in modified radical mastectomy [9]. Several studies have demonstrated that the addition of PECS II block to general anaesthesia can significantly reduce postoperative pain scores, decrease opioid consumption, prolong time to first analgesic request and improve patient

satisfaction [10,11]. Furthermore, improved analgesia may contribute to better haemodynamic stability during the perioperative period by attenuating the surgical stress response, as well as enhancing recovery profiles in the immediate postoperative phase [12]. Despite growing global evidence supporting PECS II block, variations in patient characteristics, perioperative practices and analgesic protocols necessitate further evaluation in different clinical settings. In particular, optimizing postoperative analgesia while minimizing opioid use is highly relevant in contemporary anaesthetic practice, where enhanced recovery after surgery (ERAS) principles are increasingly emphasized. Therefore, this study aimed to compare the effects of combined general anaesthesia with PECS II block versus general anaesthesia alone on recovery status, haemodynamic parameters and postoperative analgesia in patients undergoing modified radical mastectomy.

METHODS & MATERIALS

This prospective randomized controlled trial was conducted in the Department of Anaesthesia, Analgesia and Intensive Care Medicine and the Department of General Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from September 2021 to October 2022. The study included women aged 30–60 years with American Society

of Anesthesiologists (ASA) physical status I–II, Mallampati grade I–II, diagnosed with breast cancer and scheduled for elective modified radical mastectomy under general anaesthesia with controlled ventilation. Patients with hypersensitivity to study drugs, chest wall deformity, coagulopathy, anticoagulant therapy, infection at the block site, coronary artery disease, psychiatric or neurological illness, uncontrolled hypertension or diabetes, pregnancy, cardiac disease, or previous breast surgery were excluded. A total of 60 patients were enrolled by purposive sampling and randomly allocated using computer-generated random numbers into two groups: Group A (general anaesthesia only, n=30) and Group B (general anaesthesia combined with pectoral nerve block II, n=30). The study was single-blinded and informed written consent was obtained from all participants. All patients received standardized general anaesthesia with fentanyl, propofol, suxamethonium, vecuronium, halothane and an oxygen–nitrous oxide mixture. Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation and electrocardiography were monitored throughout surgery. In Group B, ultrasound-guided PECS II block was performed after induction of anaesthesia using 30 mL of 0.25% bupivacaine injected into the fascial planes between pectoralis major and minor

muscles and between pectoralis minor and serratus anterior muscles. Recovery status was assessed using the Modified Aldrete Score at 5 and 10 minutes after surgery. Postoperative pain was evaluated using the Visual Analogue Scale (VAS) for up to 6 hours. Rescue analgesia with pethidine (1.5 mg/kg IM) was administered when VAS exceeded 4. Total opioid consumption, time to first analgesic request, patient satisfaction (Likert scale) and postoperative complications were recorded. Data were analyzed using SPSS version 26. Quantitative variables were compared using Student’s t-test, while qualitative variables were analyzed using Chi-square or Fisher’s exact test. A p-value <0.05 was considered statistically significant.

RESULTS

The mean age of the patients in Group A (GA) and Group B (GA+PEC II) were 45.4 ± 7.4 and 46.4 ± 8.4 years respectively. The mean weight of the patients in Group A (GA) and Group B (GA+PEC II) were 58.9±4.9 and 61.1±4.5 kg respectively. According to ASA grade, in Group A (GA), 23 (76.7%) were in grade I while in Group B (GA+PEC II), 24 (80.0%) were in grade I. There was no significant statistical difference between the groups regarding age, weight and ASA grade as p>0.05 (Table I).

Table I
Comparison of age, weight and ASA grade of the patients between the groups (n=60).

Criteria	Group A (GA) n=30	Group B (GA+PEC II) n=30	p-value
Age group (in years)			
30-39	5 (16.7%)	5 (16.7%)	0.691* ns
40-49	16 (53.3%)	13 (43.3%)	
50-60	9 (30.0%)	12 (40.0%)	
Mean ± SD	45.4 ± 7.4	46.4 ± 8.4	0.615** ns
Weight (in kg) (Mean ± SD)	58.9±4.9	61.1±4.5	0.062** ns
ASA grade			
I	23 (76.7%)	24 (80.0%)	0.754* ns
II	7 (23.3%)	6 (20.0%)	

* Chi-square test, ** Independent sample t test, ns=not significant.

At baseline, there was no significant statistical difference between the groups regarding the mean arterial pressure as p=0.907. However, 15 minutes intraoperative, the mean of mean arterial

pressure was significantly higher in Group A (GA) compared to Group A (GA+PEC) (p<0.001). In recovery period and after 6 hours of surgery, there was no significant statistical difference between the groups

regarding the mean of mean arterial pressure (p>0.05) (Table II).

Table II

Mean arterial pressure (mmHg) at different time interval in two groups (n=60).

Different time interval	Group A (GA) n=30	Group B (GA+PEC II) n=30	p value
Baseline	90.6 ± 10.7	90.3 ± 9.9	0.907 ns
After induction	93.5 ± 8.7	91.5 ± 7.5	0.345 ns
15 minutes intraoperative	94.8 ± 8.8	85.0 ± 6.2	<0.001 s
30 minutes intraoperative	88.5 ± 9.1	85.0 ± 6.2	0.107 ns
45 minutes intraoperative	90.1 ± 8.9	88.0 ± 6.6	0.303 ns
60 minutes intraoperative	87.3 ± 10.7	84.4 ± 8.7	0.248 ns
75 minutes intraoperative	85.3 ± 7.5	82.8 ± 6.1	0.163 ns
90 minutes intraoperative	84.1 ± 8.2	85.5 ± 8.3	0.508 ns
105 minutes intraoperative	87.4 ± 8.3	85.9 ± 6.9	0.237 ns
120 minutes intraoperative	88.4 ± 11.8	86.4 ± 6.3	0.608 ns
In recovery period	89.4 ± 8.1	87.1 ± 9.9	0.427 ns
After 6 hours	89.2 ± 9.1	86.4 ± 5.2	0.151 ns

Independent sample t test was used to measure the level of significance, ns=not significant, s=significant.

At baseline, there was no significant statistical difference between the groups regarding pain score in Visual analog scale (VAS) as p=0.276. In recovery period, the

mean of pain score was significantly higher in Group A (GA) compared to Group B (GA+PEC II) (p<0.001). After 6 hours of surgery, the pain score remained

significantly higher in Group A (GA) compared to Group B (GA+PEC II) (p<0.001) (Table III).

Table III

Pain score by Visual analog scale (VAS) at different time interval in two groups (n=60).

Different time interval	Group A (GA) n=30	Group B (GA+PEC II) n=30	p value
Baseline	1.2 ± 0.7	1.0 ± 0.6	0.276 ns
In recovery period	4.3 ± 0.7	1.2 ± 0.4	<0.001 s
After 6 hours	3.0 ± 0.6	1.2 ± 0.4	<0.001 s

Independent sample t test was used to measure the level of significance, ns=not significant s=significant.

Time requirement of first rescue analgesia (min) for Group A (GA) was 38.0 ± 13.5 minutes and for Group B (GA+PEC II) was 144.0 ± 68.9 minutes. This was statistically significant as p value was 0.001. The total Pethidine consumption was 120.0 ± 10.0

mg and 72.5 ± 7.9 mg in Group A (GA) and Group B (GA+PEC II) respectively. Significant statistical difference was observed between the groups regarding total Opioid consumption in first 6 hours. In Group A (GA), 18 (60.0%) patients

required rescue analgesic while in Group B (GA+PEC II), 5 (16.7%) patients required rescue analgesic. The proportion of rescue analgesic was significantly higher in Group A (GA) (p<0.001) (Table IV).

Table IV

First demand of analgesia and Pethidine consumption in two groups (n=60).

Criteria	Group A (GA) n=30	Group B (GA+PEC II) n=30	p value
First demand of analgesia (in minute)	38.0 ± 13.5	144.0 ± 68.9	0.001 s
Pethidine consumption (in mg)	120.0 ± 10.0	72.5 ± 7.9	<0.001 s
Rescue analgesic requirement	18 (60.0%)	5 (16.7%)	<0.001 s

Independent sample t test was used to measure the level of significance, p value was achieved by chi-square test, s=significant.

In Group A (GA), 6 (20.0%) patients had modified Aldrete score >9 while in group B (GA +PEC), majority 23 (76.7%)

patients had modified Aldrete score >9. The proportion of modified Aldrete score of >9 was significantly higher in Group B

(GA+PEC II) compared to group A (GA) (p<0.001) (Table V).

Table V

Comparison of patients recovery by the modified Aldrete score (n=60).

Modified Aldrete score	Group A (GA) n=30	Group B (GA+PEC II) n=30	p-value
9	24 (80.0%)	7 (23.3%)	<0.001 s
> 9	6 (20.0%)	23 (76.7%)	<0.001 s

Chi-square test.

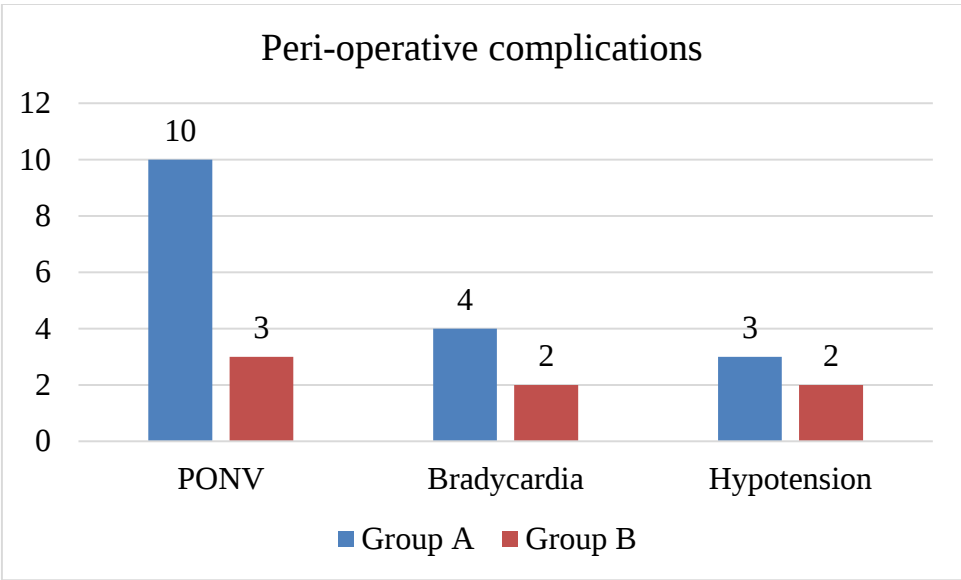


Figure 1 Distribution of patients by Peri-operative complications (n=60).

In Group A (GA), 10 (33.3%) patients had PONV while in Group B (GA+PEC II), 3 (10.0%) patients had PONV. In Group A (GA), 4 (13.3%) patients had bradycardia and 3 (10.0%) patients had hypotension while in Group B (GA+PEC II), 2 (6.7%) patients had bradycardia and 2 (6.7%) patients had hypotension (Figure 1).

DISCUSSION

In the present study, the addition of ultrasound-guided PECS II block to general anaesthesia in patients undergoing modified radical mastectomy resulted in significantly improved postoperative analgesia, reduced opioid consumption, delayed first rescue analgesic demand, better recovery profile and improved haemodynamic stability compared to general anaesthesia alone. Baseline characteristics including age (45.4 ± 7.4 vs 46.4 ± 8.4 years), weight (58.9 ± 4.9 vs 61.1 ± 4.5 kg) and ASA grade distribution showed no significant difference between Group A and Group B, confirming comparability between groups. Postoperative pain scores in this study were significantly lower in the PECS II group. VAS scores in recovery and at 6 hours were markedly reduced in Group B (1.2 ± 0.4 vs 4.3 ± 0.7 in recovery), which is consistent with findings by Akter et al., who reported superior analgesia with PECS II block compared to other regional techniques in modified radical mastectomy [13]. Similarly, Neethu et al. and Tripathy et al., demonstrated significantly lower postoperative pain scores and improved analgesia when PECS block was incorporated into multimodal or opioid-free anaesthesia techniques [14,15]. These findings support the effectiveness of PECS II block in blocking both pectoral and intercostal nerve branches responsible for post-mastectomy pain.

The present study also demonstrated a significant delay in the first rescue analgesic requirement in the PECS II group (144.0 ± 68.9 min vs 38.0 ± 13.5 min in GA group), along with a significant reduction in total pethidine consumption (72.5 ± 7.9 mg vs 120.0 ± 10.0 mg). Similar opioid-sparing effects were reported by Mahabubuzzaman et al., who observed reduced analgesic requirements when PECS block was used as an adjunct to general anaesthesia [16]. Du et al., also found that multiple nerve blocks significantly prolonged analgesia duration and reduced opioid requirements in breast cancer surgery [17]. Hemodynamic stability was generally comparable between groups in the present study, with a transient significant reduction in MAP at 15 minutes intraoperatively in the PECS II group. This finding aligns with Abo-Sabaa and Amr, who reported more stable intraoperative haemodynamics with PECS block compared to other regional techniques due to attenuation of nociceptive stress responses [18]. However, most intraoperative and postoperative time points showed no significant differences, consistent with the findings of Sala-Blanch et al., who also reported stable haemodynamics with fascial plane blocks [19]. Recovery status, assessed using the Modified Aldrete Score, was significantly better in the PECS II group, with 76.7% achieving scores >9 compared to 20% in the GA group. This improved recovery is likely related to reduced opioid consumption and better pain control. Similar findings were reported by Malachauskiené et al., who observed faster recovery room discharge and improved postoperative recovery profiles with PECS II block [20]. Monisha et al., also emphasized that opioid-sparing regional

techniques improve early postoperative recovery and reduce sedation-related delays [21]. The incidence of postoperative nausea and vomiting (PONV) was lower in the PECS II group (10% vs 33.3%), which is consistent with studies by Joshi et al. and Yesiltas et al., where regional techniques significantly reduced PONV due to decreased opioid requirement [22,23]. Similarly, lower rates of bradycardia and hypotension observed in the PECS II group in the present study reflect reduced sympathetic stimulation and better analgesic control.

LIMITATIONS

This study has some limitations. The sample size was relatively small, which may limit the generalizability of the findings. Being a single-blinded study, complete elimination of observer bias was not possible. Additionally, postoperative pain and recovery outcomes were assessed only for a short duration, so long-term analgesic outcomes and chronic pain development could not be evaluated.

CONCLUSION

The addition of ultrasound-guided PECS II block to general anaesthesia in patients undergoing modified radical mastectomy provides superior postoperative analgesia compared to general anaesthesia alone. It significantly reduces pain scores, prolongs time to first rescue analgesia, decreases opioid consumption and improves recovery status while maintaining stable haemodynamic parameters. Therefore, PECS II block can be considered an effective component of multimodal analgesia in breast cancer surgery.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

- Ahmed MA, Elhenawy AM, Awad HG, Ali AH, Elfawy DM. Comparative study between intraoperative and postoperative analgesic effect of ultrasound-guided thoracic paravertebral block versus pectoral nerve block in patients undergoing modified radical mastectomy: a randomized controlled trial. *Ain-Shams Journal of Anesthesiology*. 2022 Feb 2;14(1):13.
- Alam GF, Farhana K, Nimmi NP, Al Azad SU, Akhtar H, Mitra SP, Aziz L. Effectiveness of Pectoral Nerve Blocks (PEC II) for Post Operative Pain Management in Breast Surgery. *Bangladesh Journal of Pain*. 2022 Jul 1;2(1):10-6.
- Shah SB, Chawla R, Pahade A, Mittal A, Bhargava AK, Kumar R. Comparison of pectoralis plane blocks with ketamine-dexmedetomidine adjuncts and opioid-based general anaesthesia in patients undergoing modified radical mastectomy. *Indian Journal of Anaesthesia*. 2020 Dec 1;64(12):1038-46.
- Zhao J, Han F, Yang Y, Li H, Li Z. Pectoral nerve block in anesthesia for modified radical mastectomy: a meta-analysis based on randomized controlled trials. *Medicine*. 2019 May 1;98(18):e15423.
- Yu L, Zhou Q, Li W, Zhang Q, Cui X, Chang Y, Wang Q. Effects of esketamine combined with ultrasound-guided pectoral nerve block type II on the quality of early postoperative recovery in patients undergoing a modified radical mastectomy for breast cancer: a randomized controlled trial. *Journal of pain research*. 2022 Dec 31;3157-69.
- Makkar JK, Dahiya D, Jain D, Kuber A, Kajal K, Singh NP. Effect of balanced anaesthesia with and without modified pectoralis nerve block on postoperative analgesia after breast surgeries: A randomised controlled trial. *Indian Journal of Anaesthesia*. 2021 Sep 1;65(Suppl 3):S110-4.
- Li J, Lyu Q, Su W, Li M, Du Y, Hu Y. A randomised trial: effects of different anesthesia methods on early perioperative pain sensitivity and cellular immune function in patients undergoing radical mastectomy. *Gland Surgery*. 2021 Jul;10(7):2246.
- Jindal R, Meena S, Bhati S, Patel P, Gulati C, Singh S. Postoperative analgesic efficacy of intraoperative pectoral nerve block for modified radical mastectomy: a double-blind prospective randomised interventional study. *Indian Journal of Surgical Oncology*. 2023 Mar;14(1):215-21.
- Kumar S, Goel D, Sharma SK, Ahmad S, Dwivedi P, Deo N, Rani R. A randomised controlled study of the post-operative analgesic efficacy of ultrasound-guided pectoral nerve block in the first 24 h after modified radical mastectomy. *Indian Journal of Anaesthesia*. 2018 Jun 1;62(6):436-42.
- Wu Y, Kang Y, Li Y, Fu B. Impact of ultrasound-guided deep serratus anterior plane block combined with dexmedetomidine as an adjuvant to ropivacaine inpatient quality of recovery scores undergoing modified radical mastectomy: a randomized controlled trial. *Frontiers in Oncology*. 2022 Mar 31;12:858030.
- Zhao Y, Jin W, Pan P, Feng S, Fu D, Yao J. Ultrasound-guided transversus thoracic muscle plane-pectoral nerve block for postoperative analgesia after modified radical mastectomy: a comparison with the thoracic paravertebral nerve block. *Perioperative Medicine*. 2022 Jul 27;11(1):39.
- Altıparmak B, Tokar MK, Uysal Aİ, Turan M, Demirbilek SG. Comparison of the effects of modified pectoral nerve block and erector spinae plane block on postoperative opioid consumption and pain scores of patients after radical mastectomy surgery: a prospective, randomized, controlled trial. *Journal of Clinical Anesthesia*. 2019 May 1;54:61-5.
- Akter A, Khan S, Kamal MM, Chhana CS, Boby N, Akter S, Begum M, Begum H. Effectiveness of ultrasonography guided pectoral nerve block and paravertebral block for post-operative analgesia in modified radical mastectomy. *Bangladesh Journal of Pain*. 2022 Dec 30;2(2):10-7.
- Neethu M, Pandey RK, Sharma A, Darlong V, Punj J, Sinha R, Singh PM, Hamshi N, Garg R, Chandralekh C, Srivastava A. Pectoral nerve blocks to improve analgesia after breast cancer surgery: a prospective, randomized and controlled trial. *Journal of clinical anesthesia*. 2018 Mar 1;45:12-7.
- Tripathy S, Mandal I, Rao PB, Panda A, Mishra T, Kar M. Opioid-free anesthesia for breast cancer surgery: a comparison of ultrasound guided paravertebral and pectoral nerve blocks. A randomized controlled trial. *Journal of Anaesthesiology Clinical Pharmacology*. 2019 Oct 1;35(4):475-80.
- Mahabubuzzaman M, Kabir MH, Islam MS, Bhowmick LK, Sheikh MZ, Kumar D. The Analgesic Effect of Dexamethasone and Magnesium Sulphate (MgSO4) as an adjuvant to 0.25% Bupivacaine in ultrasound guided Pectoral Nerve Block (PEC Block) for unilateral Modified Radical Mastectomy: A Comparative Study. *Community Based Medical Journal*. 2022 Jun 16;11(1):4-13.
- Du H, Liu X, Li F, Xue Z, Li Y, Qian B. Anesthetic effect of ultrasound-guided multiple-nerve blockade in modified radical mastectomy in patients with breast cancer. *Medicine*. 2021 Feb 19;100(7):e24786.
- Abo-Sabaa MA, Amr YA. Comparative study between ultrasound guided pectoral nerves block and thoracic paravertebral block as postoperative analgesia in breast surgeries. *The Egyptian Journal of Hospital Medicine*. 2019 Jul 1;76(4):3997-4006.
- Sala-Blanch X, Cohen AS, López-Pantaleón LA, Cubero M. Analgesic efficacy of modified pectoral block plus serratus plane block in breast augmentation surgery: a randomised, controlled, triple-blind clinical trial. *Revista Española de Anestesiología y Reanimación (English Edition)*. 2019 Feb 1;66(2):62-71.
- Malachauskienė L, Bhavsar RP, Waldemar J, Strøm T. Effect of interpectoral-pectoserratus plane (PECS II) block on recovery room discharge time in breast cancer surgery. *Medicina*. 2023 Dec 25;60(1):41.
- Monisha B, Papireddy SM, Sreeramulu PN, Tarigonda S. A comparative study of placebo versus opioid-free analgesic mixture for mastectomies performed under general anesthesia along with erector spinae plane block. *Cureus*. 2023 Jan 31;15(1).
- Joshi R, Singh M, Battacharjee S. Ultrasound guided paravertebral block vs. modified PecS block for modified radical mastectomy. *Anaesthesia, Pain & Intensive care*. 2019 Jun 1;23:172-7.
- Yesiltas S, Türköz A, Çalim M, Yılmaz S, Esen AS, Daşkaya HA, Karaaslan K. Comparison of serratus plane block alone and in combination with pectoral type 1 block for breast cancer surgery: a randomized controlled study. *Hippokratia*. 2021 Jan;25(1):8.