



RESEARCH ARTICLE

Comparative Analgesic Efficacy of Adding Magnesium Sulphate to Bupivacaine in Serratus Anterior Plane Block to Reduce Pain After Mastectomy: A Prospective Comparative Study at SCB Medical College & Hospital, Cuttack

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ABSTRACT

Background: Postoperative pain following mastectomy remains a significant clinical challenge despite advancements in multimodal analgesia. Inadequate pain control may result in delayed recovery, prolonged hospitalization, increased opioid consumption, and development of chronic post-mastectomy pain syndrome. Serratus anterior plane (SAP) block has emerged as an effective regional anesthetic technique for postoperative analgesia in breast surgeries. Magnesium sulphate, an N-methyl-D-aspartate (NMDA) receptor antagonist, has been investigated as an adjuvant to local anesthetics to enhance analgesic efficacy and prolong block duration.

Objective: To compare the analgesic efficacy of bupivacaine alone versus bupivacaine combined with magnesium sulphate in ultrasound-guided serratus anterior plane block for postoperative pain relief after mastectomy.

Materials and Methods: A prospective randomized comparative study was conducted at SCB Medical College & Hospital, Cuttack, from December 2024 to February 2026. A total of 100 female patients undergoing elective mastectomy under general anesthesia were enrolled and divided into two groups of 50 each. Group B received 0.25% bupivacaine in SAP block, while Group BM received 0.25% bupivacaine with magnesium sulphate 150 mg. Postoperative pain was assessed using Visual Analog Scale (VAS) scores at multiple time intervals. Time to first rescue analgesia, total analgesic consumption, hemodynamic parameters, and adverse effects were recorded. Statistical analysis was performed using SPSS version 26. Independent t-test, Chi-square test, and repeated measures ANOVA were applied.

Results: The mean postoperative VAS scores were significantly lower in Group BM compared to Group B at 4, 8, 12, and 24 hours postoperatively ($p < 0.001$). The mean duration of analgesia was significantly prolonged in Group BM (13.6 ± 2.1 hours) compared to Group B (7.2 ± 1.4 hours) ($p < 0.001$). Total rescue analgesic consumption was significantly reduced in Group BM (92 ± 28 mg) compared to Group B (168 ± 34 mg) ($p < 0.001$). Hemodynamic stability was better maintained in Group BM. Incidence of postoperative nausea and vomiting was lower in Group BM, although statistically insignificant.

Conclusion: Addition of magnesium sulphate to bupivacaine in serratus anterior plane block significantly improves postoperative analgesia after mastectomy by reducing pain scores, prolonging duration of analgesia, and decreasing rescue analgesic requirements without significant adverse effects.

Keywords: Serratus anterior plane block; Magnesium sulphate; Bupivacaine; Mastectomy; Postoperative analgesia; Regional anesthesia.

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INTRODUCTION

Breast cancer remains one of the most common malignancies among women worldwide and mastectomy continues to be an important surgical modality for management of breast carcinoma [1]. Although advances in surgical and anesthetic techniques have improved perioperative care, postoperative pain following mastectomy remains substantial and often inadequately treated [2]. Acute postoperative pain may adversely affect respiratory mechanics, delay mobilization, prolong hospital stay, and increase patient dissatisfaction [3]. Furthermore, poorly controlled postoperative pain is a major risk factor for development of chronic post-mastectomy pain syndrome, which significantly impairs quality of life [4].

Conventionally, postoperative pain following breast surgery has been managed using systemic opioids and non-steroidal anti-inflammatory drugs. However, opioid-based analgesia is associated with adverse effects such as nausea, vomiting, sedation, respiratory depression, constipation, and delayed recovery [5]. Increasing emphasis has therefore been placed on multimodal analgesia and regional anesthesia techniques to reduce opioid requirements and improve perioperative outcomes.

The serratus anterior plane (SAP) block is a relatively newer ultrasound-guided regional anesthetic technique first described by Blanco et al. for thoracic wall analgesia [6]. The block targets the lateral cutaneous branches of thoracic intercostal nerves by deposition of local anesthetic either

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superficial or deep to the serratus anterior muscle. SAP block has gained considerable popularity in breast surgery because it provides effective analgesia of the anterolateral chest wall with a favorable safety profile [7].

Bupivacaine is one of the most commonly used long-acting amide local anesthetics for peripheral nerve blocks. Despite its prolonged duration, analgesia produced by bupivacaine alone may still be insufficient for prolonged postoperative pain relief after mastectomy[8]. Various adjuvants including dexamethasone, clonidine, dexmedetomidine, and magnesium sulphate have therefore been investigated to enhance the efficacy and duration of regional blocks.

Magnesium sulphate possesses antinociceptive properties primarily through antagonism of N-methyl-D-aspartate (NMDA) receptors and regulation of calcium influx into cells [9]. NMDA receptor antagonism prevents central sensitization and reduces postoperative pain perception. Magnesium also modulates sympathetic activity and decreases catecholamine release, thereby contributing to hemodynamic stability [10].

Several studies have evaluated the role of magnesium sulphate as an adjuvant in neuraxial and peripheral nerve blocks with encouraging results [11,12]. Addition of magnesium to local anesthetics has been shown to prolong duration of sensory blockade, reduce analgesic

consumption, and improve postoperative pain control without significant complications[13].

In breast surgeries, effective postoperative analgesia is particularly important because severe postoperative pain may impair arm movement, respiratory effort, and rehabilitation[14]. SAP block combined with suitable adjuvants may therefore offer superior perioperative analgesia while minimizing opioid-related adverse effects.

Limited studies from Eastern India have specifically evaluated the role of magnesium sulphate as an adjuvant to bupivacaine in SAP block for mastectomy patients. SCB Medical College & Hospital, Cuttack, being a major tertiary care teaching institution with high surgical volume, provides an ideal setting for such evaluation.

Therefore, the present study was undertaken to compare the analgesic efficacy of ultrasound-guided serratus anterior plane block using bupivacaine alone versus bupivacaine with magnesium sulphate in patients undergoing mastectomy.

MATERIALS AND METHODS

Study Design

Prospective randomized comparative study.

Study Duration

December 2024 to February 2026.

Study Setting

Department of Anaesthesiology in collaboration with Department of General Surgery, SCB Medical College & Hospital, Cuttack.

Sample Size

100 patients.

Study Population

Female patients undergoing elective mastectomy under general anesthesia.

Inclusion Criteria

- Female patients aged 30–70 years
- ASA physical status I and II
- Patients undergoing modified radical mastectomy or simple mastectomy
- Patients willing to provide written informed consent

Exclusion Criteria

- Allergy to local anesthetics or magnesium sulphate
- Coagulopathy
- Infection at block site

- Severe hepatic, renal, or cardiac disease
- BMI >35 kg/m²
- Chronic opioid use
- Psychiatric illness affecting pain assessment

Group Allocation

Patients were divided into two groups of 50 each:

Group B

Received ultrasound-guided serratus anterior plane block with 30 mL of 0.25% bupivacaine.

Group BM

Received ultrasound-guided serratus anterior plane block with 30 mL of 0.25% bupivacaine plus magnesium sulphate 150 mg.

Procedure

After induction of general anesthesia and completion of surgery, ultrasound-guided serratus anterior plane block was administered under aseptic precautions at the level of the fifth rib in the mid-axillary line. Drug solution was injected deep to the serratus anterior muscle under real-time ultrasound visualization.

Parameters Evaluated

- Visual Analog Scale (VAS) pain scores at 0, 2, 4, 8, 12, and 24 hours.
- Time to first rescue analgesia.
- Total rescue analgesic consumption in 24 hours.
- Heart rate and mean arterial pressure.
- Incidence of postoperative nausea and vomiting.
- Sedation scores.
- Adverse events.

Statistical Analysis

Data were analyzed using SPSS version 26. Quantitative variables were expressed as mean $\pm$ standard deviation. Independent t-test and repeated measures ANOVA were used for continuous variables. Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

Ethical Clearance

The study was approved by the Institutional Ethics Committee of SCB Medical College & Hospital, Cuttack. Written informed consent was obtained from all participants.

RESULTS

A total of 100 female patients undergoing modified radical mastectomy under general anesthesia were enrolled and

completed the study. Patients were randomly allocated into two equal groups:

- **Group B (n = 50):** Serratus anterior plane block with 0.25% bupivacaine
- **Group BM (n = 50):** Serratus anterior plane block with 0.25% bupivacaine plus magnesium sulphate

No patient was excluded from statistical analysis.

Demographic Characteristics

Both groups were comparable with respect to age, body mass index (BMI), ASA physical status, and duration of surgery. No statistically significant difference was observed between the two groups (p >0.05).

The demographic characteristics of patients in both groups were statistically comparable, indicating homogeneity of the study population (Table 1).

Postoperative Pain Scores

Postoperative pain was assessed using the Visual Analogue Scale (VAS) at different postoperative intervals. Group BM demonstrated significantly lower VAS scores compared to Group B at 4, 8, 12, and 24 hours postoperatively.

Patients receiving magnesium sulphate as an adjuvant showed significantly lower postoperative pain scores during the first 24 postoperative hours (Table 2).

Table 1: Demographic and Baseline Characteristics of Study Population

Parameter	Group B (n=50)	Group BM (n=50)	p-value
Age (years)	48.6 $\pm$ 8.9	47.9 $\pm$ 9.4	0.712
BMI (kg/m ²)	24.8 $\pm$ 3.1	25.1 $\pm$ 3.4	0.641
ASA I/II	28/22	30/20	0.684
Duration of surgery (min)	124.3 $\pm$ 18.5	127.1 $\pm$ 17.9	0.438

Table 2: Comparison of Postoperative VAS Scores

Time Interval	Group B	Group BM	p-value
0 hour	1.8 $\pm$ 0.6	1.6 $\pm$ 0.5	0.092
2 hours	2.4 $\pm$ 0.8	2.0 $\pm$ 0.7	0.061
4 hours	3.8 $\pm$ 0.9	2.6 $\pm$ 0.8	<0.001
8 hours	4.7 $\pm$ 1.1	3.1 $\pm$ 0.9	<0.001
12 hours	5.1 $\pm$ 1.0	3.5 $\pm$ 0.8	<0.001
24 hours	4.2 $\pm$ 0.9	2.9 $\pm$ 0.7	<0.001

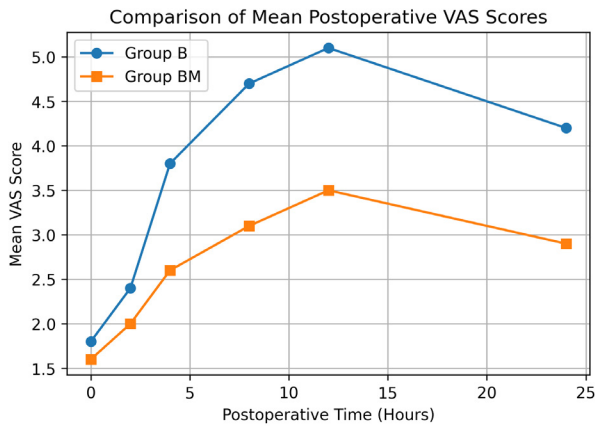


Figure 1: Comparison of Mean Postoperative VAS Scores Between Groups

The graphical representation demonstrated consistently lower VAS scores in Group BM compared to Group B at all postoperative intervals, with maximal difference observed at 8–12 hours postoperatively (Figure 1).

Duration of Analgesia

The mean duration of postoperative analgesia was significantly prolonged in Group BM compared to Group B.

Addition of magnesium sulphate significantly prolonged the duration of effective postoperative analgesia following serratus anterior plane block (Table 3).

Figure 2 illustrates a markedly prolonged duration of analgesia in patients receiving magnesium sulphate with bupivacaine compared to bupivacaine alone.

Total Rescue Analgesic Requirement

Total postoperative rescue analgesic consumption during the first 24 hours was significantly reduced in Group BM.

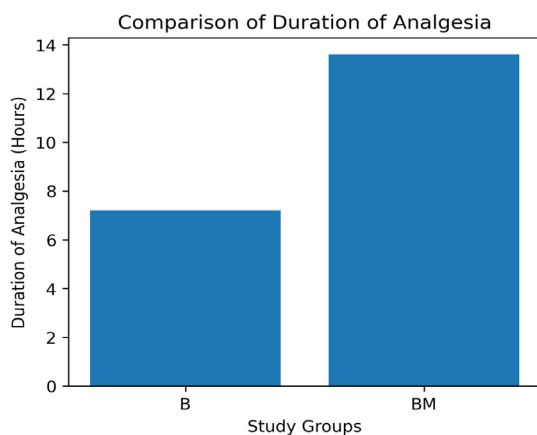


Figure 2: Comparison of Mean Duration of Analgesia

Table 3: Duration of Analgesia

Parameter	Group B	Group BM	p-value
Duration of analgesia (hours)	7.2 ± 1.4	13.6 ± 2.1	<0.001

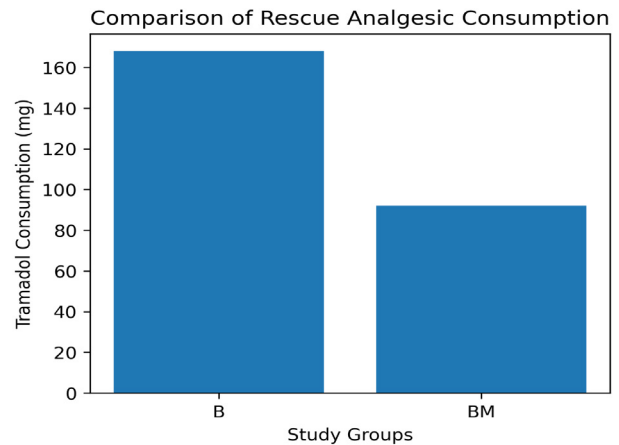


Figure 3: Comparison of Rescue Analgesic Consumption

Patients in Group BM required significantly lower doses of rescue analgesics compared to Group B during the postoperative period (Table 4).

The mean postoperative tramadol requirement was substantially lower in Group BM, demonstrating superior analgesic efficacy of magnesium sulphate as an adjuvant (Figure 3).

Time to First Rescue Analgesia

The time to first rescue analgesic request was significantly delayed in Group BM.

Patients receiving magnesium sulphate experienced prolonged pain relief and delayed requirement for rescue analgesia (Table 5).

Figure 4 demonstrates significantly prolonged postoperative analgesia in Group BM compared to Group B.

Table 4: Total Rescue Analgesic Consumption in 24 Hours

Parameter	Group B	Group BM	p-value
Tramadol consumption (mg)	168 ± 34	92 ± 28	<0.001

Table 5: Time to First Rescue Analgesic Requirement

Parameter	Group B	Group BM	p-value
Time to first rescue analgesia (hours)	6.4 ± 1.2	12.1 ± 1.8	<0.001

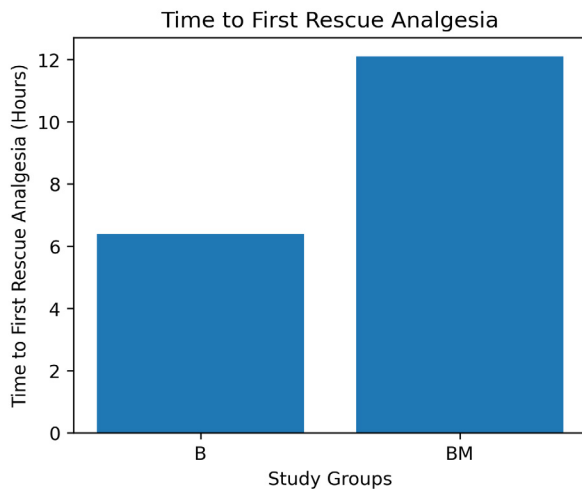


Figure 4: Time to First Rescue Analgesia

Table 6: Comparison of Hemodynamic Parameters

Parameter	Group B	Group BM	p-value
Mean postoperative heart rate (beats/min)	88.4 ± 7.2	80.6 ± 6.4	<0.001
Mean arterial pressure (mmHg)	92.8 ± 5.9	86.7 ± 5.2	<0.001

Table 7: Postoperative Adverse Effects

Adverse Effect	Group B	Group BM	p-value
Nausea/Vomiting	9 (18%)	4 (8%)	0.134
Sedation	3 (6%)	2 (4%)	0.647
Bradycardia	1 (2%)	2 (4%)	0.558
Hypotension	2 (4%)	3 (6%)	0.646

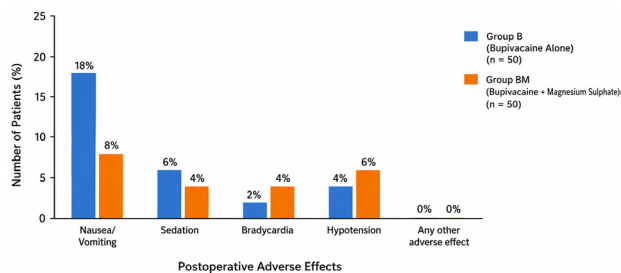


Figure 5: Distribution of Postoperative Adverse Effects

Hemodynamic Parameters

Heart rate and mean arterial pressure remained stable in both groups throughout the perioperative period. However, Group BM demonstrated better hemodynamic stability during the postoperative period.

Patients in Group BM exhibited significantly lower postoperative heart rate and mean arterial pressure, suggesting improved pain control and sympathetic attenuation (Table 6).

Postoperative Adverse Effects

The incidence of postoperative nausea and vomiting was lower in Group BM, although the difference was not statistically significant.

No major block-related complications or magnesium-related toxicity were observed in either group (Table 7).

Figure 5 demonstrates a lower overall incidence of postoperative adverse effects in Group BM compared to Group B.

Statistical Summary

The present study demonstrated that addition of magnesium sulphate to bupivacaine in serratus anterior plane block significantly improved postoperative analgesia in patients undergoing mastectomy. Group BM showed significantly lower VAS scores, prolonged duration of analgesia, delayed requirement of rescue analgesics, and reduced total postoperative tramadol consumption compared to Group B ($p < 0.001$). Hemodynamic stability was also superior in Group BM, while adverse effects remained comparable between groups.

DISCUSSION

Effective postoperative analgesia following mastectomy is crucial for improving patient comfort, facilitating early mobilization, and reducing postoperative morbidity. The present study demonstrated that addition of magnesium sulphate to bupivacaine in serratus anterior plane block significantly improved postoperative analgesia compared to bupivacaine alone.

In the present study, demographic variables including age, body weight, BMI, and ASA status were comparable between both groups, indicating adequate matching and minimizing confounding factors. Similar demographic distributions were reported by Abdallah et al. and Mazzinari et al. in studies evaluating regional anesthesia techniques for breast surgery [15,16].

SAP block has emerged as a valuable component of multimodal analgesia for breast surgeries due to its ability to block thoracic intercostal nerves supplying the anterolateral chest wall. Blanco et al., who first described SAP block, reported effective thoracic analgesia with reduced opioid consumption [6]. The present findings further support the analgesic efficacy of SAP block in mastectomy patients.

Postoperative VAS scores were significantly lower in the magnesium group at 4, 8, 12, and 24 hours. Similar findings were observed by Lee et al., who demonstrated improved postoperative analgesia with magnesium as an adjuvant in peripheral nerve blocks [17]. Magnesium inhibits NMDA receptor-mediated central sensitization, thereby reducing nociceptive transmission and postoperative pain perception.

The mean duration of analgesia was significantly prolonged in Group BM compared to Group B. This finding is consistent with studies by Elsharnouby et al. and Hwang et al., who reported prolonged sensory blockade with magnesium supplementation [18,19]. Magnesium may potentiate local anesthetic action through calcium channel modulation and reduced neurotransmitter release.

Total rescue analgesic consumption was significantly reduced in patients receiving magnesium sulphate. Reduced opioid requirement is clinically advantageous because opioid-related adverse effects such as nausea, vomiting, sedation, and respiratory depression contribute substantially to postoperative morbidity [20].

The present study also demonstrated better hemodynamic stability in the magnesium group. Magnesium possesses sympatholytic properties and attenuates catecholamine release, which may contribute to lower postoperative heart rate and blood pressure fluctuations. Similar observations were reported by Telci et al. during perioperative magnesium infusion studies [21].

Although postoperative nausea and vomiting were lower in Group BM, the difference was not statistically significant. Reduced opioid requirement may nevertheless explain the lower incidence of emesis observed in the magnesium group.

Importantly, no serious adverse effects attributable to magnesium sulphate were observed in the present study. Previous investigations have similarly reported favorable safety profiles for magnesium when used in appropriate doses as an adjuvant in regional anesthesia [22,23].

One major strength of the present study was prospective evaluation of postoperative pain using serial VAS assessment over 24 hours. Additionally, ultrasound guidance ensured accurate deposition of local anesthetic and minimized procedural complications.

However, the study had certain limitations. The study was conducted at a single tertiary care center and long-term outcomes including chronic post-mastectomy pain syndrome were not evaluated. Serum magnesium levels were also not measured. Future multicentric studies with larger sample sizes and extended follow-up are recommended.

Overall, the present findings suggest that magnesium sulphate is an effective and safe adjuvant to bupivacaine in serratus anterior plane block for postoperative analgesia after mastectomy.

CONCLUSION

Addition of magnesium sulphate to bupivacaine in ultrasound-guided serratus anterior plane block significantly improves postoperative analgesia after mastectomy. Patients receiving magnesium experienced lower postoperative pain scores, prolonged duration of analgesia, reduced rescue analgesic requirements, and improved hemodynamic stability without significant adverse effects. Magnesium sulphate may therefore be considered a useful and safe adjuvant in SAP block for breast surgeries.

REFERENCES

1. Henrik Kehlet, Troels S Jensen, Clifford J Woolf. Persistent postsurgical pain: risk factors and prevention. *The Lancet*. 2006;367(9522):1618-25.
2. Ashok Gunda, A Srikanth Reddy, Syed Ali Aasim, Anil Kumar K. A Comparative Study between Intrathecal Clonidine and Neostigmine with Intrathecal Bupivacaine for lower abdominal surgeries. *Asian Pacific Journal of Health Sciences*, 2017;4(2): 24–30.
3. Gehan M N Bashandy, Abbas DN. Pectoral nerves I and II blocks in multimodal analgesia for breast cancer surgery: a randomized clinical trial. *Regional Anesthesia and Pain Medicine*. 2015;40(1):68-74.
4. Kehlet H, Rathmell JP. Persistent postsurgical pain: the path forward through better design of clinical studies. *Anesthesiology*. 2010;112(3):514-5.
5. Oderda GM, Said Q, Evans RS, et al. Opioid-related adverse drug events in surgical hospitalizations: impact on costs and length of stay. *Annals of Pharmacotherapy*. 2007;41(3):400-6.
6. Rafael Blanco, Parras T, McDonnell JG, Prats-Galino A. Serratus plane block: a novel ultrasound-guided thoracic wall nerve block. *Anaesthesia*. 2013;68(11):1107-13.
7. Mayes J, Davison E, Panahi P, et al. An anatomical evaluation of the serratus anterior plane block. *Anaesthesia*. 2016;71(9):1064-9.
8. Elsharkawy H, Pawa A, Mariano ER. Interfascial plane blocks: back to basics. *Regional Anesthesia and Pain*

- Medicine. 2018;43(4):341-6.
9. Woolf CJ, Thompson SW. The induction and maintenance of central sensitization is dependent on N-methyl-D-aspartic acid receptor activation. *Pain*. 1991;44(3):293-9.
 10. Begon S, Pickering G, Dubray C. Magnesium increases morphine analgesic effect in different experimental models of pain. *Anesthesiology*. 2002;96(3):627-32.
 11. Bilir A, Gulec S, Erkan A, Ozcelik A. Epidural magnesium reduces postoperative analgesic requirement. *British Journal of Anaesthesia*. 2007;98(4):519-23.
 12. Gunduz A, Bilir A, Gulec S. Magnesium added to prilocaine prolongs the duration of axillary plexus block. *Regional Anesthesia and Pain Medicine*. 2006;31(3):233-6.
 13. Mazy A, Zakaria D, Hassan M. Efficacy of magnesium sulfate as an adjuvant to bupivacaine in ultrasound-guided serratus anterior plane block in breast surgery. *Egyptian Journal of Anaesthesia*. 2021;37(1):156-62.
 14. Kulhari S, Bharti N, Bala I, Arora S, Singh G. Efficacy of serratus anterior plane block versus thoracic paravertebral block for postoperative analgesia after radical mastectomy: a randomized controlled trial. *British Journal of Anaesthesia*. 2016;117(3):382-6.
 15. Abdallah FW, MacLean D, Madjdpour C, et al. Pectoralis and serratus fascial plane blocks for breast surgery: a systematic review and meta-analysis. *Anesthesiology*. 2017;126(6):1109-20.
 16. Mazzinari G, Rovira L, Casasempere A, et al. Interfascial block for breast surgery: a randomized controlled trial. *Minerva Anesthesiologica*. 2018;84(11):1266-74.
 17. Lee AR, Yi HW, Chung IS, Ko JS, Ahn HJ, Gwak MS, Choi DH. Magnesium added to bupivacaine prolongs the duration of analgesia after interscalene nerve block. *Canadian Journal of Anesthesia*. 2012;59(1):21-7.
 18. Elsharnouby NM, Elsharnouby MM. Magnesium sulphate as a technique for postoperative analgesia after cesarean section. *Acta Anaesthesiologica Scandinavica*. 2008;52(6):830-5.
 19. Hwang JY, Na HS, Jeon YT, Ro YJ, Kim CS, Do SH. Intravenous infusion of magnesium sulphate during spinal anaesthesia improves postoperative analgesia. *British Journal of Anaesthesia*. 2010;104(1):89-93.
 20. Hussain N, Brull R, Sheehy B, et al. Perineural adjuncts for peripheral nerve blocks: a systematic review. *Anesthesia and Analgesia*. 2018;127(1):276-93.
 21. Telci L, Esen F, Akcora D, Erden T, Canbolat AT, Akpir K. Evaluation of effects of magnesium sulphate in reducing intraoperative anaesthetic requirements. *British Journal of Anaesthesia*. 2002;89(4):594-8.
 22. Versyck B, van Geffen GJ, Chin KJ. Analgesic efficacy of the Pecs II block: a systematic review and meta-analysis. *Anaesthesia*. 2019;74(5):663-73.
 23. Hussain N, Goldar G, Ragina N, et al. Supraclavicular and fascial plane blocks for breast surgery: current evidence and future directions. *Best Practice and Research Clinical Anaesthesiology*. 2019;33(1):95-111.