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ORIGINAL RESEARCH

THE EFFICACY OF GREATER AURICULAR NERVE (GAN) BLOCK AND AURICULOTEMPORAL NERVE (ATN) BLOCK ON FENTANYL REQUIREMENTS DURING SURGERY AND POSTOPERATIVE PAIN SCALE IN ELECTIVE MASTOIDECTOMY: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT
Background: Postoperative pain management remains challenging in surgical patients. High-dose fentanyl administration causes numerous side effects including respiratory depression, PONV, hypotension, hyperalgesia, and delayed emergence. Regional nerve blocks targeting the greater auricular nerve (GAN) and auriculotemporal nerve (ATN) may reduce fentanyl requirements and provide prolonged analgesia following ear surgeries, potentially minimizing opioid-related complications.
Objectives: This prospective study included 46 ASA PS 1-2 patients undergoing elective mastoidectomy at Dr. Soetomo General Academic Hospital, Surabaya, between November 2024 and January 2025.
Methods: Patients were randomized into two groups: standard general anesthesia (control) versus general anesthesia plus GAN and ATN blocks (intervention). Outcome measures included intraoperative fentanyl consumption and postoperative pain assessment using numeric rating scale (NRS) at 2, 6, and 12 hours. The data was examined by utilizing either an independent T-test or a Mann-Whitney test, depending on the situation.
Result: The GAN and ATN blocks with 0.5% ropivacaine significantly reduced intraoperative fentanyl use ($P<0.001$) and decreased pain scores at 6 hours ($P=0.02$) and 12 hours ($P=0.03$) after surgery.
Conclusion: GAN and ATN blocks with 0.5% ropivacaine in mastoidectomy procedures significantly reduce intraoperative and postoperative fentanyl requirements, accelerate extubation time, decrease PONV incidence, and effectively lower postoperative pain scores.
Keywords**:** Elective Mastoidectomy, GAN and ATN Block, 0.5% Ropivacaine, Fentanyl, NRS

INTRODUCTION

Pain can disrupt the patient's hemodynamics during surgery, result in poor visualization of the surgical field due to excessive bleeding, prolong wound healing, cause discomfort for the patient, and lead to complaints from the surgical operator. The use of strong analgesics such as opioids is still often employed to achieve hypotensive targets in ear and nose surgeries. During the preceding two decades, extensive research has documented apprehensions about opioid effectiveness stemming from their detrimental consequences, such as respiratory depression, hypotension, delayed awakening, delirium, urinary retention, constipation, ileus, pruritus, PONV, and opioid-induced hyperalgesia.[1]
The intensity of postoperative pain in the middle ear also varies between one patient and another. Therefore, effective pain management is crucial in postoperative care. The risk of opioid side effects can be reduced through opioid dose reduction, the use of opioid-sparing agents, or multimodal analgesia.[1] The Enhanced Recovery After Surgery (ERAS) protocol incorporates a variety of anesthesia and pain management methods that do not rely on opioids in order to reduce the amount of opioids used during and after surgery , and these techniques can reduce side effects, reduce length of hospital stay, be free from

pain, wake up and mobilize quickly, feel more comfortable, and improve patient satisfaction.[2] Regional anesthesia is often used with general anesthesia in several surgeries. Nerve blocks in the affected area provide longer-lasting pain relief, aid in avoidance of heightened sensitivity in both the central and peripheral nervous systems, and to lower the likelihood of chronic pain emerging in the future.[3,4] Performing peripheral nerve blocks before or after surgery can help lessen the need for opioids[5], decrease side effects, and enhance patient contentment.[6-8] Localized nerve blockade of the greater auricular nerve (GAN) and auriculotemporal nerve (ATN), as well as local anesthetic infiltration, have been widely used in tympanomastoid surgery.[9–11] Combining peripheral nerve blocks and general anesthesia is more advantageous compared to general anesthesia, such as reducing the need for intraoperative and postoperative analgesia, less bleeding, better pain scores, less postoperative nausea and vomiting, and lower costs.[12] With the presence of peripheral nerve blocks, it is anticipated that it will enhance pain relief before and after surgery, improve the monitoring of heart function, lower the need for painkiller medication during surgery, and minimize bleeding.[5] For this reason, this study attempts to assess the effectiveness of ear blocks on the need for opioid analgesics during surgery in relation to postoperative pain scores in elective middle ear surgery.

MATERIAL AND METHODS

This prospective randomized controlled trial was performed on patients undergoing scheduled mastoidectomy procedures at Dr. Soetomo General Academic Hospital, Surabaya, between November 2024 and January 2025. The research received ethical clearance from the Ethics Committee of Dr. Soetomo General Hospital Surabaya (ethical approval number: 1152/KEPK/XI/2024). This study included 46 patients who were set to undergo elective mastoidectomy surgery, using a randomized controlled approach for enrollment.

The investigation involved 46 patients divided into two equal groups of 23 subjects each. Eligible participants included individuals aged 18-60 years with ASA Physical Status I-II classification, GCS score of 15, and undergoing planned mastoidectomy surgery. Exclusion criteria encompassed patients with cardiovascular abnormalities, severe kidney and liver dysfunction, allergies to local anesthetic drugs, systemic infections, infections at the injection site, autoimmune diseases, obesity, uncontrolled diabetes mellitus and other systemic diseases, uncontrolled hypertension, coagulation disorders, neuromuscular diseases, failed blocks, and peripheral neuropathy.

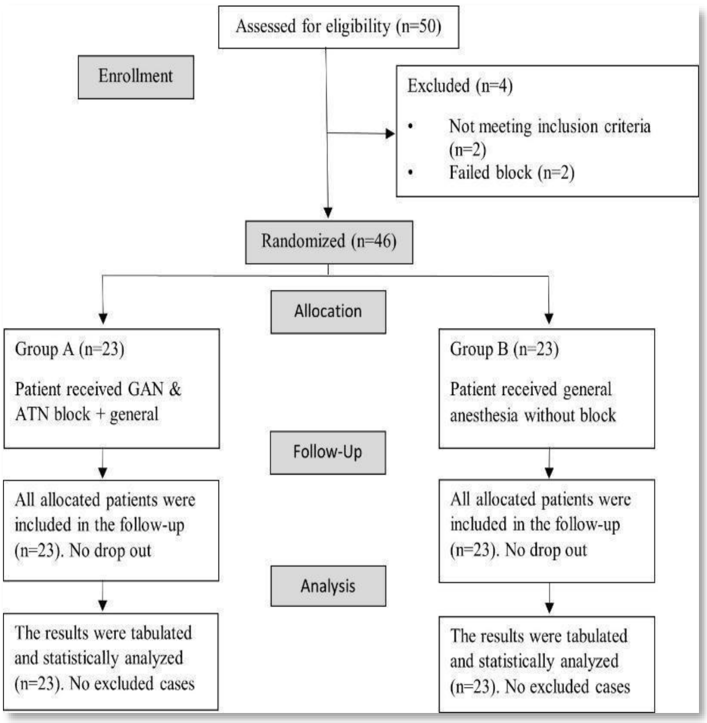

Figure 1. CONSORT flowchart of the studied groups

General anesthesia

Before the operation commences, the patient's identity, diagnosis, and consent for anesthesia are verified once again in the premedication room. The individual is escorted to the surgical theater, where the necessary monitoring devices are applied based on ASA guidelines (including ECG, blood pressure, heart rate, respiratory rate, and oxygen saturation).

General anesthesia was administered using fentanyl 1 mcg/kg, propofol 1 mg/kg, and rocuronium 0.6 mg/kg, followed by intubation of the patient. After induction, 1 gram of intravenous paracetamol was administered to all subjects. In both groups, hemodynamic monitoring was performed during the surgical procedure. Maintenance of anesthesia using sevoflurane at 1 minimum alveolar concentration (MAC) and isotonic fluids. During the operation, if the pulse and blood pressure rises more than 20% in both the block group and the non-block group, rescue analgesia in the form of a 1 mcg/kg IV bolus of fentanyl is administered and recorded on the anesthesia observation sheet.

Greater auricular nerve and auriculotemporal nerve block

In group A, ultrasound-guided ear nerve blocks were performed by a research team member following patient intubation. The greater auricular nerve (GAN) block was executed using 7 ml of 0.5% ropivacaine local anesthetic, while the auriculotemporal nerve (ATN) block utilized 2 ml of 0.5% ropivacaine, both administered via a 50mm stimuflex needle.

Postoperative management

Postoperatively, all research subjects will be observed in the recovery room and assessed for pain on a scale. All subjects will receive continued analgesia with IV paracetamol 1 gram every 8 hours and ibuprofen 400 mg every 8 hours. The pain scale is evaluated 2 hours, 6 hours, and 12 hours postoperatively. If the pain scale exceeds 3, rescue analgesia will be given as a bolus of fentanyl 1 mcg/kg intravenously or tramadol 100mg in 100 ml NaCl 0.9% over 30 minutes. Total fentanyl usage during and after the operation will also be recorded. After theoperation, both groups were given an injection of 10 mg of metoclopramide every 8 hours. In the event that both groups experience postoperative nausea and vomiting (PONV) as a result of fentanyl side effects, an extra dose of 8 mg of ondansetron will be given every 12 hours for 24 hours.

Sample size calculation

Previous research conducted by Deepika et al.13 involving 30 adult patients who had undergone modified radical mastoidectomy, it was found that those in the block group had lower VAS pain scores and consumed fewer pain medications compared to the control group. To achieve 90% power at a 5% significance level, the current study required 23 participants in each group, totaling 46 subjects. The sample size calculation for this study was conducted using PS: Power and Sample Size Calculation Software Version 3.1.2 from Vanderbilt University in Nashville, Tennessee, USA.

Statistical analysis

Statistical analysis was used to collect the data with SPSS 26 (SPSS Inc., Chicago, USA). The independent T-test or Mann-Whitney test will be used to analyze the correlation between fentanyl requirements for ear block intervention and postoperative pain scale, depending on the distribution of the data.

RESULTS

46 people were studied, with the goal of making sure that the two groups were alike in terms of gender, age, weight, BMI, PS ASA, and length of surgery for uniformity. The details of the participants can be found in Table 1.

The study evaluated the efficacy of GAN and ATN blocks on hemodynamic parameters, intraoperative fentanyl requirements, and postoperative pain scores in patients undergoing elective mastoidectomy, which are summarized in Table 2. Two groups were compared: Group A (with blocks) and Group B (without blocks). The preoperative hemodynamic parameters showed similar heart rates (58-84 vs. 60-89 bpm, P=0.361) and mean arterial pressure (65- 99 vs. 65-100 mmHg, p=0.488) between groups, though systolic blood pressure was significantly lower in Group A (90- 124 vs. 100-132 mmHg, P=0.011). During incision, Group A demonstrated markedly more stable hemodynamics compared to Group B, with significantly lower heart rate (62-83 vs. 75-101 bpm, P<0.001), systolic blood pressure (87-116 vs. 123-152 mmHg, P<0.001), diastolic blood pressure (51-78 vs. 75-95 mmHg, P<0.001), and mean arterial pressure (63-90 vs. 91-111 mmHg, P<0.001).

The most striking difference was observed in intraoperative fentanyl consumption, with Group A requiring substantially less fentanyl (25-75 mg) compared to Group B (150-300 mg) (P<0.001). This significant reduction aligns with previous research showing nerve blocks dramatically decrease opioid requirements in middle ear surgeries. Postoperatively, both groups reported no pain at 2 hours (NRS score 0, P=1.000), but Group A demonstrated significantly lower pain scores at 6 hours (1-3 vs 4-6, P=0.017) and 12 hours (0 vs 1-3, P=0.039) postoperatively.

The implementation of nerve blocks also resulted in fewer cases of postoperative nausea and vomiting in Group A (n=0) compared to Group B (n=7) (P=0.009). Additionally, patients in Group A experienced markedly faster extubation times (10-20 minutes) compared to Group B (30-80 minutes) (P<0.001).

Table 1. Demographic characteristics of subjects

Characteristics	Group		P-value
	Group A	Group B	
Genre			
Male	10 (43.5%)	10 (43.5%)	
Female	13 (56.5%)	13 (56.5%)	
Age			
Range (year)	18 – 60	18 - 60	0.582 [b]
Weight			
Range (kg)	61 (50 – 83)	64 (54 – 98)	0.219 [b]
BMI			
Mean ± SD (kg/m²)	23.77 ± 2.24	25.02 ± 2.42	0.064 [a]
ASA			
1	11 (47.8%)	8 (34.8%)	
2	12 (52.2%)	15 (65.2%)	
Duration of Surgery			
Mean ± SD (minutes)	255.56 ± 38.68	255.83 ± 41.80	0.885 [a]

Data are presented as mean ± SD; P <0.05 considered as significant
ASA: American Society of Anesthesiologists; BMI: body mass index a = Independent T-test b = Mann-Whitney test

Table 2. Result data analysis between group A and group B

Characteristics	Group		P value*
	Group A	Group B	
Haemodynamic Change			
Before Incision			
Heart rate (x/minute)	71.96± 7.18	71.35 ± 8.03	0.361
Systolic (mmHg)	103.78± 9.67	110.35 ± 8.93	0.011
Diastolic (mmHg)	66.65 ± 7.89	66.87 ± 7.18	0.727
MAP (mmHg)	79.04 ± 8.91	80.30 ± 7.08	0.488
Incision			
Heart rate (x/minute)	73.70 ± 5.66	93.65 ± 5.35	<0.001
Systolic (mmHg)	104.13 ± 7.32	133.61 ± 6.19	<0.001
Diastolic (mmHg)	65.67 ± 6.37	84.57 ± 5.80	<0.001
MAP (mmHg)	78.57 ± 6.25	101.04 ± 5.18	<0.001
Post Operative			
Heart rate (x/minute)	75.91 ± 5.55	76.00 ± 6.17	0.960
Systolic (mmHg)	112.04 ± 8.83	113.04 ± 5.04	0.640
Diastolic (mmHg)	70.39 ± 7.43	70.35 ± 5.34	0.366
MAP (mmHg)	84.09 ± 8.02	89.35 ± 4.82	0.612
Pain Scale (NRS)			
2h post op	0	0	1.000
6h post op	1-3	4-6	0017
12h post op	0	1-3	0.039
Fentanyl Consumption (mgc)	25 -75	150 - 300	<0.001
PONV	n=0	n=7	0.009
Time to Extubation (minutes)	10 -20	30-80	<0.001

Data are presented as mean ± SD; P <0.05 considered as significant
MAP: mean arterial pressure
PONV: postoperative nausea and vomiting
*Mann-Whitney test

DISCUSSION

The total use of fentanyl during the operation in the non-GAN and ATN block group was significantly higher compared to the GAN and ATN block group with a P-value < 0.001 (P < 0.05). These results are consistent with previous research where the opioid dosage in the control group was greater than the group that underwent GAN and ATN blocks.[11] Scalp nerve block with ropivacaine can weaken nociceptive impulses reaching the central nervous system, and this local effect can result in a decrease in the need for systemic opioids such as fentanyl during surgery.[14,15] The study conducted by Sudono[16] on breast cancer surgery concluded that fentanyl consumption during surgery in the GA + PECS block group was significantly lower (P < 0.001), and the incidence of PONV and Ramsay Sedation Score in the GA + PECS block group was also significantly lower.[16] The possible decrease in the amount of opioids needed during surgery should be taken into account because of the dangers linked to the negative effects of opioids, such as breathing problems and delayed recovery.[17] By effectively targeting the sensory pathways involved in pain transmission, nerve blocks contribute to a more stable intraoperative hemodynamic profile, thereby reducing the need for opioids.[15]

In the ear block group, fentanyl during the operation was used only for anesthesia induction, with five subjects receiving rescue analgesia during the operation, each receiving rescue analgesia once. In the group without ear block, fentanyl was used for induction of anesthesia, maintenance analgesia, and rescue analgesia in all research subjects. The number of patients in the non-GAN and ATN block group who needed more pain medication indicates that the pain felt during surgery was more intense in the non-GAN and ATN block group when compared to the GAN and ATN block group. This conclusion is consistent with previous research, which stated that patients with GAN blocks had a VAS < 3 from the recovery room to 48 hours postoperatively and consumed fewer opioids compared to the control group.[18] The use of lower doses of fentanyl certainly brings benefits to patients in many aspects. The harmful side effects of fentanyl, such as sedation, miosis, respiratory depression, and nausea, can be prevented, making patients more comfortable and expected to have better outcomes as well. In several studies, it is also stated that the use of less fentanyl will shorten the length of ICU stay.[19] Pain assessment in this study utilized the Numeric Rating Scale (NRS) at 2, 6, and 12 hours postoperatively. The intervention group demonstrated significantly reduced NRS scores at 6 and 12 hours post-surgery compared to the control group (P-values = 0.02 and 0.03, respectively). These findings align with prior research indicating that patients receiving GAN blocks exhibited VAS scores < 1 at 4 and 12 hours postoperatively, which were significantly lower than those in the control group.[18] During the first half hour in the recovery room, Swain et al. recorded VAS scores < 4 for all patients in the group who underwent mastoid surgery. In the first hour, VAS > 4 in 17 patients in the control group, although in the GAN and ATN block groups, 4 patients had VAS > 4. At 2 hours post-operation, 10 patients in the control group had a VAS > 4, and 15 patients had a VAS < 4. At the 3rd hour post-operation, the control group had 6 patients with a VAS score > 4, and the remaining 19 patients had a VAS score <4. Meanwhile, in the GAN block and ATN block groups, both at 2 hours and 3 hours post-operation, 25 patients had a VAS score < 4. The highest VAS scores in both groups were observed 1 hour postoperatively. However, the average VAS score of the control group (3.52±1.42) was significantly higher than the GAN block group (1.64±1.22) with a P-value < 0.001.[11] In a hip surgery study using the PENG block by Chung et al[20], after 6 hours post-surgery, the NRS ratings of 1-3 were analyzed in the PENG block group versus the control group. The average score in the PENG block group was 3.80 ± 0.87, while in the control group it was 6.32 ± 1.49, demonstrating a statistically significant difference with a p-value of less than 0.001. The GA + PECS block group showed lower pain scores on the WBFS at 3, 6, 9, and 24 hours post modified radical mastectomy surgery, with a significantly higher use of rescue analgesia with fentanyl compared to the control group.[21]

In a study on ropivacaine for inferior alveolar nerve block in third molar extraction surgery, it was found that the minimum ropivacaine duration to provide effective pain relief is 5.75 hours, while the maximum is 13 hours, with 6 hours of average duration [22]. Pasa et al[23] stated that a scalp nerve block using 0.5% ropivacaine can provide relief from pain for up to 12 hours following a craniotomy procedure, which usually takes around 4.6 hours. To conclude, the ropivacaine can reduce pain for 16.6 hours after injection. The duration of ropivacaine's action in reducing pain appears to vary because pain itself is multifactorial, not only related to pain mediators but also involving many other factors, including psychological factors such as past pain experiences, beliefs about whether one will feel pain or not, fear, or anxiety.[24] The prolonged analgesic effect of ropivacaine can also be caused by its administration before the incision, resulting in a pre-emptive analgesic effect that prevents central sensitization. As discussed in the literature review, postoperative pain includes two aspects: peripheral and central sensitization. Peripheral sensitization results from inflammatory mediators that reduce nociceptor activation thresholds, whereas central sensitization arises from increased neuronal excitability in the spinal cord's dorsal horn, leading to postoperative hyperalgesia.

The administration of pre-emptive analgesia before surgery suppresses central sensitization, preventing postoperative hyperalgesia.[25]

The results of this study demonstrate that Greater Auricular Nerve (GAN) and Auriculotemporal Nerve (ATN) blocks can significantly reduce intraoperative opioid use, particularly fentanyl, compared to the group without blocks. The decrease in opioid consumption has significant implications in medical practice, as it can lower the chances of experiencing harmful side effects like breathing difficulties, extreme drowsiness, pinpoint pupils, and stomach discomfort, thereby improving patient comfort and safety during and after surgery. Additionally, GAN and ATN blocks also play a role in intraoperative hemodynamic stabilization by inhibiting pain impulses that reach the central nervous system, thus reducing surgical stress response and minimizing fluctuations in blood pressure and heart rate. The implementation of these nerve blocks has demonstrated efficacy in delivering effective postoperative pain relief, as evidenced by diminished pain scores at 6 and 12 hours following surgery, thereby supporting decreased requirements for supplemental analgesics and the possibility of accelerated recovery. These findings reinforce the importance of pre-emptive analgesia approaches as a multimodal pain management strategy capable of preventing central sensitization and postoperative hyperalgesia. From a pharmacological perspective, the relatively long duration of action of ropivacaine allows for continuous analgesia without the need for additional systemic analgesic interventions in the short to medium term. Therefore, GAN and ATN blocks can be incorporated as part of standard anesthesia protocols in ear or mastoid surgical procedures to improve quality of care, reduce opioid consumption, and enhance healthcare service efficiency. Implementation of this technique is expected not only to improve patient experience, but also in order to minimize the chances of complications after surgery and alleviate the workload on healthcare workers, as well as decrease the total expenses of care.

CONCLUSION

This study demonstrates that GAN and ATN blocks provide comprehensive benefits in mastoidectomy procedures, including superior haemodynamic stability, dramatically reduced fentanyl consumption, improved postoperative pain control, decreased PONV incidence, and faster recovery times. These advantages suggest that incorporating GAN and ATN blocks into anaesthetic protocols for mastoidectomy procedures represents an effective strategy to enhance perioperative management and improve patient outcomes.

DECLARATIONS

Ethics approval and consent to participate

The study received ethical approval from the Ethics Committee of Dr. Soetomo General Hospital (approval number: 1152/KEPK/XI/2024).

Consent for publication

Not applicable.

Competing interests

The authors declare no conflict of interest.

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REFERENCES

1. Forget P. Opioid-free anaesthesia. Why and how? A contextual analysis. *Anaesth Crit Care Pain Med*. 2019;38(2). doi:10.1016/j.accpm.2018.05.002
2. Echeverria-Villalobos M, Stoicea N, Todeschini AB, et al. Enhanced Recovery after Surgery (ERAS): A Perspective Review of Postoperative Pain Management under ERAS Pathways and Its Role on Opioid Crisis in the United States. *Clin J Pain*. 2020;36(3). doi:10.1097/AJP.0000000000000792
3. Rawal N. Analgesia for day-case surgery. *Br J Anaesth*. 2001;87(1). doi:10.1093/bja/87.1.73
4. Singh Bajwa SJ. Managing acute post-operative pain: Advances, challenges and constraints. *Indian J Anaesth*. 2017;61(3). doi:10.4103/ija.IJA_110_17
5. Christin T, Ali Z, Legiran L, Ferawaty F. Overview Of Peripheral Neuropathy In Chronic Kidney Disease Patients Undergoing Hemodialysis At Dr. Mohammad Hoesin Hospital Palembang. *Pharmacol Med Reports, Orthop Illn Details*. 2023;2(3):1-18. doi:10.55047/comorbid.v2i3.890
6. Syal K, Chandel A, Goyal A, Sharma A. Comparison of ultrasound-guided intermediate vs subcutaneous cervical plexus block for postoperative analgesia in patients undergoing total thyroidectomy: A randomised double-blind trial. *Indian J Anaesth*. 2020;64(1). doi:10.4103/ija.IJA_483_19
7. Wahal C, Kumar A, Pyati S. Advances in regional anaesthesia: A review of current practice, newer techniques and outcomes. *Indian J Anaesth*. 2018;62(2). doi:10.4103/ija.IJA_433_17
8. Budania LS, Bawdekar R, Dwarakanath N, Gaude YK, Chamala V, Berwal A. Comparative evaluation of bupivacaine 0.25% with dexamethasone 2mg versus bupivacaine 0.25% alone in greater auricular nerve block for postoperative analgesia in mastoid surgery. *Sri Lankan J Anaesthesiol*. 2020;28(1). doi:10.4038/slja.v28i1.8445
9. Suresh S, Barcelona SL, Young NM, Heffner CL, Coté CJ. Does a Preemptive Block of the Great Auricular Nerve Improve Postoperative Analgesia in Children Undergoing Tympanomastoid Surgery? *Anesth Analg*. 2004;98(2).

doi:10.1213/01.ANE.0000097171.73374.AD

10. Cregg N, Conway F, Casey W. Analgesia after otoplasty: Regional nerve blockade vs local anaesthetic infiltration of the ear. *Can J Anaesth*. 1996;43(2). doi:10.1007/BF03011255
11. Swain SK, Pradhan C, Mohanty S, Sahu MC. Comparative study between selective nerve blocks and the intravenous opioids in mastoid surgery. *Egypt J Ear, Nose, Throat Allied Sci*. 2017;18(2). doi:10.1016/j.ejenta.2017.05.004
12. Mody RM. Post-operative analgesia following mastoid surgeries: Comparison between selective nerve blocks (greater auricular and auriculotemporal) v/s parenteral opioid (pentazocine). *MedPulse Int J Anesthesiol*. 2020;17(1). doi:10.26611/10151714
13. Deepika V, Ahuja V, Thapa D, Gombar S, Gupta N. Evaluation of analgesic efficacy of superficial cervical plexus block in patients undergoing modified radical mastoidectomy: A randomised controlled trial. *Indian J Anaesth*. 2021;65(15). doi:10.4103/ija.ija_339_21
14. Yang Y, Ou M, Zhou H, et al. Effect of Scalp Nerve Block with Ropivacaine on Postoperative Pain in Patients Undergoing Craniotomy: A Randomized, Double Blinded Study. *Sci Rep*. 2020;10(1). doi:10.1038/s41598-020- 59370-z
15. Duda T, Lannon M, Gandhi P, Martyniuk A, Farrokhyar F, Sharma S. Systematic Review and Meta-Analysis of Randomized Controlled Trials for Scalp Block in Craniotomy. *Neurosurgery*. 2023;93(1). doi:10.1227/neu.0000000000002381
16. Sudono H. Perbandingan Efek Kombinasi Pecs Block Dan General Anesthesia Dengan General Anesthesia Untuk Terhadap Penggunaan Opioid, Ponv Dan Tingkat Sedasi Pada Operasi Kanker Payudara. Published online 2019.
17. Potters JW, Klimek M. Local anesthetics for brain tumor resection: Current perspectives. *Local Reg Anesth*. 2018;11. doi:10.2147/LRA.S135413
18. Liu J, Yuan K, Zhou H, Li L, Wang G, Li T. A randomized controlled trial evaluating the hemodynamic impact of ultrasound-guided great auricular nerve block in middle ear microsurgery. *BMC Anesthesiol*. 2020;20(1). doi:10.1186/s12871-020-01155-y
19. Ananda P, Semedi BP, Waloejo CS, Utariani A. Opioid-Sparring and Multimodal Analgesia as Parts of Enhanced Recovery After Surgery (ERAS) Applied In The Ksatria Airlangga Floating Hospital. *Indones J Anesthesiol Reanim*. 2021;3(1):17-21. doi:10.20473/ijar.v3i12021.17-21
20. Chung CJ, Eom DW, Lee TY, Park SY. Reduced Opioid Consumption with Pericapsular Nerve Group Block for Hip Surgery: A Randomized, Double-Blind, Placebo-Controlled Trial. *Pain Res Manag*. 2022;2022. doi:10.1155/2022/6022380
21. Bashandy GMN, Abbas DN. Pectoral nerves I and II blocks in multimodal analgesia for breast cancer surgery: A randomized clinical trial. *Reg Anesth Pain Med*. 2015;40(1). doi:10.1097/AAP.0000000000000163
22. Mansour NA. Ropivacaine versus Bupivacaine in Postoperative Pain Control. *J Biotechnol Biomater*. 2012;02(03). doi:10.4172/2155-952x.1000137
23. Pasa RMA, Soemartono C, Sulistiawan SS, Utariani A. Effects Of Regional Scalp Block With Ropivacaine 0.5% Preincision As A Preemptive Analgesia After Craniotomy Surgery. *J WIDYA Med*. 2020;6(1).
24. Cohen M, Quintner J, Van Rysewyk S. Reconsidering the International Association for the study of pain definition of pain. *Pain Reports*. 2018;3(2). doi:10.1097/PR9.0000000000000634
25. Rosero EB, Joshi GP. Preemptive, preventive, multimodal analgesia: What do they really mean? *Plast Reconstr Surg*. 2014;134(4). doi:10.1097/PRS.0000000000000671