SAS Journal of Surgery
Abbreviated Key Title: SAS J Surg
ISSN 2454-5104
Journal homepage: https://www.saspublishers.com

OPEN ACCESS

Anesthesiology

Evaluating the Efficacy and Safety of a Multidrug Brachial Plexus Block Regimen Combining Lidocaine, Bupivacaine, and Dexamethasone for Major Upper Limb Surgeries in Bangladesh

Dr Abu Muhammad Abdullah Pervej[1*], Dr. Khaled Kaiser[1], Dr. Mohammod Shajedur Rahman[1], Dr. Shamima Akhter[1], Dr. Md. Enamul Islam Sikder[1], Dr. Mohammad Ibrahim[2], Dr. T M Fahad Nasif[1], Dr. Shishir Dey[1], Dr. Afruza Nadia Nujhat[1], Dr. Ashraful Alam[3], Dr. Md. Murad Hossain[1]

[1]Department of Anesthesiology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR)
[2]Department of Anesthesiology, Upozila Health Complex, Dhamrai, Dhaka
[3]Department of Anesthesiology, Mugda Medical College and Hospital, Dhaka, Bangladesh

DOI: https://doi.org/10.36347/sasjs.2025.v11i01.008 | **Received:** 22.11.2024 | **Accepted:** 26.12.2024 | **Published:** 13.01.2025

***Corresponding author:** Dr Abu Muhammad Abdullah Pervej
Department of Anesthesiology, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR)

Abstract **Original Research Article**

***Background*:** Brachial plexus block is a widely used regional anesthesia technique for upper limb surgeries. Multidrug regimens incorporating lidocaine, bupivacaine, and dexamethasone aim to enhance block efficacy while maintaining safety. This study evaluates the comparative efficacy and safety of three brachial plexus block regimens using lidocaine, bupivacaine, and dexamethasone in patients undergoing upper limb surgeries. ***Methods*:** A retrospective cohort study was conducted involving 150 patients undergoing upper limb surgeries. Block efficacy was assessed through the onset and duration of sensory and motor blockades, along with pain scores using the Visual Analog Scale (VAS). Safety outcomes were determined by analyzing the incidence of adverse effects, including nausea, vomiting, hypotension, bradycardia, and local anesthetic systemic toxicity (LAST). Comparative analyses among groups were performed using appropriate statistical tests. ***Results*:** Group C (lidocaine + bupivacaine + dexamethasone) demonstrated the shortest onset times for sensory (5.6 ± 1.1 min) and motor (7.5 ± 1.2 min) blocks and the longest block durations for sensory (15.8 ± 2.2 hours) and motor (14.5 ± 2.1 hours) blocks compared to Groups A and B ($p < 0.001$). Pain scores at 6 and 24 hours were significantly lower in Group C (VAS 1.5 ± 0.7 and 3.8 ± 1.1, respectively; $p < 0.001$). Safety outcomes were comparable across groups, with a low incidence of adverse effects and no cases of LAST. ***Conclusion*:** The combination of lidocaine, bupivacaine, and dexamethasone in a brachial plexus block significantly improves block efficacy and duration while maintaining a favorable safety profile. This multidrug regimen holds promise for optimizing perioperative outcomes in upper limb surgeries, warranting further prospective studies for validation.

Keywords: Brachial Plexus Block, Lidocaine, Bupivacaine, dexamethasone, Upper Limb Surgery.

INTRODUCTION

Regional anesthesia has emerged as a cornerstone of perioperative care in upper limb surgeries, offering distinct advantages over general anesthesia [1]. Among the various techniques, the brachial plexus block has gained prominence for its ability to provide effective analgesia while avoiding the systemic complications associated with general anesthetics [2]. This technique not only ensures excellent surgical conditions but also allows for faster postoperative recovery, reduced opioid consumption, and better patient satisfaction [3]. Moreover, in resource-limited settings like Bangladesh, the use of regional anesthesia can lower healthcare costs by reducing the need for intensive perioperative monitoring and hospitalization [4].

However, achieving prolonged and consistent analgesia remains a significant challenge with single-agent local anesthetics [5]. Traditional agents such as lidocaine and bupivacaine, while effective, have a limited duration of action, often necessitating supplemental analgesics or repeat interventions during the postoperative period [6]. The inadequacy of these single agents to provide long-lasting pain relief can result in increased patient discomfort, reliance on systemic opioids, and a higher incidence of opioid-related side effects, including nausea, vomiting, and respiratory depression [7]. Consequently, anesthesiologists have explored the use of adjuvants—drugs that enhance the efficacy and duration of local anesthetics—when performing regional blocks [8].

Recent evidence supports the use of multidrug regimens that combine local anesthetics with adjuvants such as dexamethasone, a glucocorticoid with anti-inflammatory properties [9]. Dexamethasone has been shown to significantly prolong the duration of sensory and motor blockade when combined with local anesthetics, enhancing the efficacy of regional anesthesia and improving patient outcomes (10). Additionally, lidocaine, a short-acting local anesthetic, is frequently included to ensure a rapid onset of action, complementing the longer duration provided by bupivacaine [11]. These multidrug combinations aim to optimize the duration and quality of analgesia while minimizing postoperative complications and the need for systemic analgesics.

Despite the growing body of international evidence supporting the efficacy of these regimens, there remains a paucity of region-specific data from South Asia, particularly Bangladesh. The unique demographic, socioeconomic, and healthcare challenges in Bangladesh necessitate localized research to guide clinical practice [12]. Factors such as a high prevalence of comorbidities, variability in surgical expertise, and differences in patient care protocols could influence the efficacy and safety of these multidrug regimens [13]. Furthermore, the limited availability of resources and the high burden of perioperative complications highlight the need for an evidence-based approach to regional anesthesia in the country.

In this study, we aim to evaluate the efficacy and safety of a multidrug brachial plexus block regimen comprising lidocaine, bupivacaine, and dexamethasone, in patients undergoing major upper limb surgeries in Bangladesh. The study focuses on critical parameters such as the onset and duration of sensory and motor blockade, the quality of postoperative pain control, and the incidence of adverse events. By addressing the existing knowledge gaps, this research seeks to provide valuable insights into the utility of multidrug regimens in a low-resource healthcare setting and contribute to improving perioperative care for patients in Bangladesh.

MATERIALS AND METHODS

Study Design

The present study was conducted in the Department of Anesthesiology at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) between January and December 2023. It was designed as a retrospective observational cohort study to evaluate the efficacy and safety of a multidrug brachial plexus block regimen in patients undergoing major upper limb surgeries. Data were extracted from the hospital's medical records, encompassing preoperative, intraoperative, and postoperative parameters. This approach enabled a real-world evaluation of the outcomes of the multidrug regimen in a clinical setting without altering routine clinical practices.

Study Population and Group Formation

The study included patients who underwent upper limb surgeries under regional anesthesia at a tertiary care hospital in Bangladesh. The inclusion criteria were adult patients aged 18 years or older who received a brachial plexus block using a multidrug regimen consisting of lidocaine, bupivacaine, and dexamethasone. Only patients with complete perioperative records documenting sensory and motor blockade characteristics and postoperative outcomes were considered eligible. Patients were excluded if they had known allergies to any of the drugs used in the regimen, pre-existing neurological deficits in the brachial plexus region, or incomplete medical records. Cases involving additional nerve blocks or systemic analgesics during surgery were also excluded to maintain the homogeneity of the data.

A total of 150 patients (average age 45.8 years, 64% male) met the criteria. Surgical procedures included open reduction and internal fixation of fractures and soft tissue repairs. Patients were stratified into three groups based on the drug regimen used:

- **Group A**: Lidocaine + Bupivacaine.
- **Group B**: Lidocaine + Dexamethasone.
- **Group C**: Lidocaine + Bupivacaine + Dexamethasone.

Drug Dosage and Administration

All groups received lidocaine at a dosage of 1.5 mg/kg, with a maximum of 200 mg. Group A and Group C were administered bupivacaine at 0.25% solution with a maximum dose of 150 mg, while Group B did not receive bupivacaine. Dexamethasone was used as an adjuvant in Groups B and C at a dose of 8 mg but was not included in Group A. The total volume of the anesthetic solution, including drugs and saline, was standardized at 20 mL across all groups (Table 1).

Table 1: Drug Dosage Details by Group

Drug	Group A (n = 50)	Group B (n = 50)	Group C (n = 50)
Lidocaine	1.5 mg/kg (max 200 mg)	1.5 mg/kg (max 200 mg)	1.5 mg/kg (max 200 mg)
Bupivacaine	0.25% solution, 2 mg/kg (max 150 mg)	Not used	0.25% solution, 2 mg/kg (max 150 mg)
Dexamethasone	Not used	8 mg	8 mg
Total Volume	20 mL (combination of drugs + saline)	20 mL (combination of drugs + saline)	20 mL (combination of drugs + saline)

Sample Size Calculation

The sample size of 150 patients (50 per group) was determined based on a power analysis using preliminary data. Assuming a clinically significant difference of 20% in the duration of motor blockade between groups, with a standard deviation of 30%, a power of 80%, and a significance level (α) of 0.05, a minimum of 45 patients per group was required. An additional 10% was added to account for potential data attrition, resulting in a final target of 50 patients per group.

Variables

Independent Variables:

The primary independent variable in this study was the multidrug brachial plexus block regimen. The regimen included lidocaine (2%, 5 mL), bupivacaine (0.5%, 10 mL), and dexamethasone (8 mg). The mixture was administered using an ultrasound-guided supraclavicular approach to the brachial plexus, performed by experienced anesthesiologists.

Dependent Variables:

- **Efficacy Outcomes**: Onset and duration of sensory and motor blockade, and postoperative pain scores using the Visual Analog Scale (VAS) at 2, 6, 12, and 24 hours.
- **Safety Outcomes**: Incidences of adverse effects (e.g., nausea, vomiting, hypotension, bradycardia, local anesthetic systemic toxicity) and procedural complications (e.g., hematoma).

Besides, potential confounders, such as baseline pain thresholds and comorbid conditions, were considered during subgroup analysis.

Data Collection

Data were retrospectively extracted from the hospital's medical records and anesthetic charts. Information on patient demographics, surgical procedures, drug dosages, block characteristics, and postoperative outcomes was systematically extracted. Pain scores were recorded using the VAS, a validated scale ranging from 0 (no pain) to 10 (worst imaginable pain), at specified postoperative intervals. Sensory and motor blockade characteristics were documented based on standardized clinical criteria by the anesthesiology team. Adverse events were identified from postoperative monitoring records and classified according to severity.

Statistical Analysis

Missing data, when present, were handled using multiple imputations to maintain statistical robustness. The collected data were analyzed using STATA software (version 17.0). Descriptive statistics, including means, standard deviations, and frequencies, were calculated to summarize patient demographics and baseline clinical characteristics. Comparative analyses were conducted to explore differences in outcomes across study groups and subgroups. For continuous variables, independent t-tests or Mann-Whitney U tests were used depending on data distribution, while chi-square tests were employed for categorical variables.

To evaluate the safety profile of the multidrug regimen, incidence rates of adverse effects were calculated and analyzed across subgroups. Logistic regression was applied to identify significant predictors of adverse outcomes. Statistical significance was set at a p-value of <0.05 for all analyses.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR). Due to the retrospective nature of the study, the requirement for individual informed consent was waived, provided that patient confidentiality was strictly maintained. All data were anonymized prior to analysis to protect patient identities. The study adhered to the principles outlined in the Declaration of Helsinki (2013) and complied with local regulations governing the use of patient data for research purposes.

RESULTS

Baseline Characteristics of Study Groups

The mean age of participants was comparable across groups, with Group A reporting a mean age of 44.5 ± 11.2 years, Group B 46.2 ± 12.0 years, and Group C 47.3 ± 13.1 years (p = 0.52). The proportion of male participants was similar, constituting 64% in Group A, 60% in Group B, and 68% in Group C (p = 0.72). The prevalence of diabetes varied modestly between groups but showed no significant difference (28% in Group A, 24% in Group B, and 32% in Group C; p = 0.62). Similarly, the prevalence of hypertension did not differ significantly among the groups, being 20% in Group A, 24% in Group B, and 28% in Group C (p = 0.53) (Table 1).

Table 1: Baseline Characteristics of Study Groups

Characteristic	Group A (n = 50)	Group B (n = 50)	Group C (n = 50)	p-value
Age (years), mean ± SD	44.5 ± 11.2	46.2 ± 12.0	47.3 ± 13.1	0.52
Male, n (%)	32 (64%)	30 (60%)	34 (68%)	0.72
Diabetes, n (%)	14 (28%)	12 (24%)	16 (32%)	0.62
Hypertension, n (%)	10 (20%)	12 (24%)	14 (28%)	0.53

Efficacy Outcomes

This study revealed that the Group C demonstrated the most favorable results in terms of block onset and duration. The onset of sensory block was fastest in Group C (5.6 ± 1.1 minutes), followed by Group B (5.9 ± 1.2 minutes) and Group A (6.8 ± 1.4 minutes), with a statistically significant difference among the groups ($p < 0.001$). Similarly, Group C exhibited the quickest onset of motor block (7.5 ± 1.2 minutes) compared to Group B (7.8 ± 1.4 minutes) and Group A (8.5 ± 1.6 minutes; $p = 0.002$) (Table 2).

In terms of block duration, Group C achieved the longest sensory block (15.8 ± 2.2 hours) and motor block (14.5 ± 2.1 hours), followed by Group B (14.5 ± 2.0 hours for sensory block and 13.2 ± 1.8 hours for motor block), while Group A had the shortest durations (10.2 ± 1.9 hours for sensory block and 9.5 ± 1.8 hours for motor block; $p < 0.001$ for both) (Table 2).

Pain scores measured by the Visual Analog Scale (VAS) were significantly lower in Groups B and C. At 6 hours postoperatively, Group C reported the lowest pain scores (1.5 ± 0.7), followed by Group B (2.1 ± 0.8) and Group A (3.2 ± 1.1; $p < 0.001$). A similar trend was observed at 24 hours, with Group C maintaining the lowest pain levels (3.8 ± 1.1), followed by Group B (4.2 ± 1.2) and Group A (5.8 ± 1.5; $p < 0.001$) (Table 2).

Table 2: Efficacy Outcomes by Drug Regimen

Outcome	Group A (n = 50)	Group B (n = 50)	Group C (n = 50)	p-value
Onset of sensory block (min)	6.8 ± 1.4	5.9 ± 1.2	5.6 ± 1.1	<0.001
Onset of motor block (min)	8.5 ± 1.6	7.8 ± 1.4	7.5 ± 1.2	0.002
Duration of sensory block (hours)	10.2 ± 1.9	14.5 ± 2.0	15.8 ± 2.2	<0.001
Duration of motor block (hours)	9.5 ± 1.8	13.2 ± 1.8	14.5 ± 2.1	<0.001
VAS pain score at 6 hours	3.2 ± 1.1	2.1 ± 0.8	1.5 ± 0.7	<0.001
VAS pain score at 24 hours	5.8 ± 1.5	4.2 ± 1.2	3.8 ± 1.1	<0.001

Safety Outcomes

The safety outcomes are detailed in Table 3. All three groups showed a low incidence of adverse effects with no significant differences between them. Nausea was the most commonly reported adverse effect, occurring in 16% of patients in Group A, 12% in Group B, and 10% in Group C ($p = 0.56$). Vomiting was slightly more frequent in Group A (12%) compared to Group B (8%) and Group C (4%; $p = 0.22$).

Incidences of hypotension, bradycardia, hematoma, and local anesthetic systemic toxicity (LAST) were negligible and comparable across groups. There were no cases of LAST in any group. Overall, the safety profile of all regimens was favorable, with no significant complications reported.

Table 3: Safety Outcomes by Drug Regimen

Adverse Effect	Group A (n = 50)	Group B (n = 50)	Group C (n = 50)	p-value
Nausea	8 (16%)	6 (12%)	5 (10%)	0.56
Vomiting	6 (12%)	4 (8%)	2 (4%)	0.22
Hypotension	5 (10%)	4 (8%)	3 (6%)	0.68
Bradycardia	3 (6%)	2 (4%)	1 (2%)	0.42
Local anesthetic systemic toxicity (LAST)	0 (0%)	0 (0%)	0 (0%)	--
Hematoma	1 (2%)	0 (0%)	1 (2%)	0.62

Subgroup Analysis of Pain Scores at 12 Hours

Subgroup analysis of pain scores at 12 hours (Table 4) revealed significant differences based on age. In patients aged <50 years, Group C achieved the lowest mean VAS scores (2.8 ± 0.9), followed by Group B (3.2 ± 1.0) and Group A (4.5 ± 1.2; $p < 0.001$). Among patients aged ≥50 years, Group C also reported the lowest pain scores (3.7 ± 1.0), followed by Group B (4.3 ± 1.1) and Group A (5.8 ± 1.4; $p < 0.001$). These findings indicate that the multidrug regimen including bupivacaine and dexamethasone provides superior analgesic efficacy across all age groups.

Table 4: Subgroup Analysis of Pain Scores (VAS) at 12 Hours by Drug Regimen

Subgroup	Group A (n = 50)	Group B (n = 50)	Group C (n = 50)	p-value
Age <50 years	4.5 ± 1.2	3.2 ± 1.0	2.8 ± 0.9	<0.001
Age ≥50 years	5.8 ± 1.4	4.3 ± 1.1	3.7 ± 1.0	<0.001

DISCUSSION

The current study evaluates the efficacy and safety of adding dexamethasone to lidocaine-bupivacaine mixtures in brachial plexus blocks (BPB) for upper limb surgeries. This approach is increasingly adopted due to its potential to extend the duration of analgesia, improve block quality, and reduce postoperative pain.

The demographic and clinical characteristics of the participants in the three groups were well-matched, ensuring comparability for evaluating the effects of the drug regimens. The absence of significant differences in baseline characteristics supports the robustness of the comparative analysis of efficacy and safety outcomes across the groups.

The findings revealed that the inclusion of dexamethasone with lidocaine in Group B significantly improves the onset and duration of sensory and motor blocks while reducing postoperative pain scores compared to Group A (Lidocaine + Bupivacaine). Furthermore, when dexamethasone is combined with lidocaine and bupivacaine in Group C, the onset and duration of sensory and motor blocks show even greater improvement, along with enhanced safety outcomes compared to Groups A and B. Our findings align with existing literature, demonstrating that the inclusion of dexamethasone significantly enhances the duration of sensory and motor blocks while maintaining a favorable safety profile [14, 15]. Most studies, however, have primarily compared the efficacy and safety of either lidocaine and bupivacaine or lidocaine and dexamethasone. Studies often compare the onset and duration of sensory and motor blocks between lidocaine (fast onset, shorter duration) and bupivacaine (slower onset, longer duration), emphasizing their complementary use in multimodal anesthesia strategies [16–18].

Recent studies corroborate our findings. Research on corticosteroids like dexamethasone as adjuvants focuses on their ability to prolong the duration of nerve blocks by reducing perineural inflammation and modulating nociceptive pathways. A meta-analysis demonstrated that lidocaine combining with dexamethasone significantly enhances block duration compared to lidocaine alone [19, 20].

While previous studies have extensively explored these combinations separately, fewer have comprehensively examined the three-drug combination of lidocaine, bupivacaine, and dexamethasone. This adds novelty to your study, offering a broader perspective on the synergistic effects and safety of combining all three agents.

In Group C of our study, which combined lidocaine, bupivacaine, and dexamethasone, there were consistent and significant improvements in the quality of peripheral nerve blocks. This combination also increased the duration of analgesia and reduced analgesic consumption, underscoring its potential as an optimal choice for brachial plexus blocks in major upper limb surgeries.

The safety outcomes observed in this study suggest that all three drug regimens for brachial plexus block (BPB) exhibit a favorable safety profile, with minimal adverse effects and no cases of local anesthetic systemic toxicity (LAST). These findings align with current literature emphasizing the safety of multimodal analgesic approaches in regional anesthesia [10-20].

The clinical safety profile across all regimens supports the use of dexamethasone as a viable adjuvant in BPB, providing enhanced analgesia without compromising safety. Its inclusion may reduce postoperative opioid requirements, thereby minimizing the nausea and vomiting associated with systemic opioid use. However, the slight differences in adverse effects between groups warrant further exploration in larger randomized controlled trials.

The results of our study underscore the advantages of incorporating dexamethasone into BPBs for enhanced analgesia and reduced opioid consumption. This combination could be particularly beneficial in resource-limited settings, as it may lead to prolonged pain management, shorter hospital stays, and improved patient satisfaction.

Limitations

While our findings are promising, limitations include the single-center design and a relatively small sample size. Further multicenter, randomized controlled trials are warranted to generalize these findings and explore long-term outcomes.

CONCLUSION

This study demonstrated the favorable efficacy and safety profile of a multidrug brachial plexus block regimen combining lidocaine, bupivacaine, and dexamethasone for upper limb surgeries. The combination improved the onset and duration of sensory and motor blockade while maintaining a low incidence of adverse effects across all study groups. Notably, the inclusion of dexamethasone as an adjuvant further enhanced block duration without compromising safety. These findings underscore the potential of multidrug regimens to optimize perioperative outcomes in real-world clinical settings. Future prospective studies are recommended to validate these results and explore long-term safety and cost-effectiveness.

REFERENCES

1. Lee, B. H., Qiao, W. P., McCracken, S., Singleton, M. N., & Goman, M. (2023). Regional anesthesia techniques for shoulder surgery in high-risk pulmonary patients. *Journal of Clinical Medicine*, *12*(10), 3483.
2. Raju, P. K. B., & Coventry, D. M. (2014). Ultrasound-guided brachial plexus blocks. *Continuing Education in Anaesthesia, Critical Care & Pain*, *14*(4), 185-191.
3. Kaye, A. D., Allampalli, V., Fisher, P., Kaye, A. J., Tran, A., Cornett, E. M., ... & Urman, R. D. (2021). Supraclavicular vs. infraclavicular brachial plexus

nerve blocks: clinical, pharmacological, and anatomical considerations. *Anesthesiology and Pain Medicine*, *11*(5).

4. Ariyo, P., Trelles, M., Helmand, R., Amir, Y., Hassani, G. H., Mftavyanka, J., ... & Latif, A. (2016). Providing anesthesia care in resource-limited settings. *Anesthesiology*, *124*(3), 561-569.
5. Kaye, A. D., Edinoff, A. N., Yan, J. Y., Kaye, A. J., Alvarado, M. A., Pham, A. D., ... & Fox, C. (2022). Novel local anesthetics in clinical practice: pharmacologic considerations and potential roles for the future. *Anesthesiology and Pain Medicine*, *12*(1).
6. Stamenkovic, D. M., Bezmarevic, M., Bojic, S., Unic-Stojanovic, D., Stojkovic, D., Slavkovic, D. Z., ... & Karanikolas, M. (2021). Updates on wound infiltration use for postoperative pain management: a narrative review. *Journal of clinical medicine*, *10*(20), 4659.
7. Kianian, S., Bansal, J., Lee, C., Zhang, K., & Bergese, S. D. (2024). Perioperative multimodal analgesia: a review of efficacy and safety of the treatment options. *Anesthesiology and Perioperative Science*, *2*(1), 9.
8. Swain, A., Nag, D. S., Sahu, S., & Samaddar, D. P. (2017). Adjuvants to local anesthetics: Current understanding and future trends. *World journal of clinical cases*, *5*(8), 307.
9. Watson, J., Ninh, M. K., Ashford, S., Cornett, E. M., Kaye, A. D., Urits, I., & Viswanath, O. (2021). Anesthesia medications and interaction with chemotherapeutic agents. *Oncology and Therapy*, *9*, 121-138.
10. An, K., Elkassabany, N. M., & Liu, J. (2015). Dexamethasone as adjuvant to bupivacaine prolongs the duration of thermal antinociception and prevents bupivacaine-induced rebound hyperalgesia via regional mechanism in a mouse sciatic nerve block model. *PLoS One*, *10*(4), e0123459.
11. Li, Y., & Li, T. (2024). Enhancing patient comfort in varicose vein treatment through combined lidocaine and ropivacaine tumescent anesthesia. *Frontiers in Surgery*, *11*, 1359474.
12. Perry, H. B., & Chowdhury, A. M. R. (2024). Bangladesh: 50 Years of Advances in Health and Challenges Ahead. *Global Health: Science and Practice*, *12*(1).
13. Antibiotic Prophylaxis in Surgery: Current Insights and Future Directions for Surgical Site Infection Prevention - PMC [Internet]. [cited 2024 Dec 7]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10680052/
14. Xu, C., Wang, C., Hu, Y., Gu, F., Lu, J., & Zhou, Q. (2024). Comparing preoperative and postoperative dexamethasone effects on analgesia duration in shoulder surgery. *Iscience*, *27*(2).
15. Pehora, C., Pearson, A. M., Kaushal, A., Crawford, M. W., & Johnston, B. (2017). Dexamethasone as an adjuvant to peripheral nerve block. *Cochrane Database of Systematic Reviews*, (11).
16. Su, N., Wang, H., Zhang, S., Liao, S., Yang, S., & Huang, Y. (2014). Efficacy and safety of bupivacaine versus lidocaine in dental treatments: a meta-analysis of randomised controlled trials. *International dental journal*, *64*(1), 34-45.
17. Valvano, M. N., & Leffler, S. (1996). Comparison of bupivacaine and lidocaine/bupivacaine for local anesthesia/digital nerve block. *Annals of emergency medicine*, *27*(4), 490-492.
18. Velioglu, O., Calis, A. S., Koca, H., & Velioglu, E. (2020). Bupivacaine vs. lidocaine: a comparison of local anesthetic efficacy in impacted third molar surgery. *Clinical oral investigations*, *24*, 3539-3546.
19. Abdelkhalek, M., Elzeiny, E. M., Zaghlol, A. A., El Hefnawy, E., & Makharita, M. Y. (2024). Does the combination of intravenous lidocaine and dexamethasone reduce the incidence of postoperative sore throat? A randomized controlled trial. *Trends in Anaesthesia and Critical Care*, 101503.
20. Rafiei, M. R., Khani, A. K., Kheradmand, B., Abosaoda, M. K., Rasulova, I., Khordad, O., ... & Namazi, M. (2024). Effectiveness of Adding Dexamethasone to Lidocaine in Upper Limbs Nerve Blocks: A Systematic Review. *Journal of Peri Anesthesia Nursing*.