Section: Anaesthesia

Original Research Article

COMPARISON OF DEXAMETHASONE AND KETOROLAC AS AN ADJUNCT TO 0.5% (H) LEVOBUPIVACAINE IN ULTRASOUND AND PNS GUIDED AXILLARY BRACHIAL PLEXUS BLOCK IN PATIENTS UNDERGOING HAND AND FOREARM SURGERY

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ABSTRACT

Background: Regional anesthesia has become an essential component of modern anesthetic practice, particularly in upper limb surgeries where it provides excellent analgesia, muscle relaxation, reduced opioid consumption, and early mobilization with fewer adverse effects compared to general anesthesia. Among the various regional anesthesia techniques, the axillary brachial plexus block is widely used for hand and forearm surgeries due to its safety, effectiveness, and ease of administration. The objective is to compare dexamethasone and ketorolac as an adjunct to 0.5% hyperbaric levobupivacaine in ultrasound and peripheral nerve stimulator guided axillary brachial plexus block in patients undergoing hand and forearm surgery.

Materials and Methods: This prospective randomized comparative study was conducted in patients undergoing hand and forearm surgeries under axillary brachial plexus block. Patients were divided into two groups receiving levobupivacaine with dexamethasone or levobupivacaine with ketorolac. Sensory block, motor block, duration of analgesia, hemodynamic parameters, and rescue analgesia were recorded and analyzed statistically.

Results: The onset of sensory and motor block was faster in the dexamethasone group compared to the ketorolac group. The duration of sensory and motor block was significantly prolonged in the dexamethasone group. Duration of postoperative analgesia was longer in patients who received dexamethasone as an adjuvant compared to ketorolac. Hemodynamic parameters remained stable in both groups throughout the study period. The number of rescue analgesic doses required was lower in the dexamethasone group compared to the ketorolac group. No significant adverse effects were observed in either group. Overall, dexamethasone provided better block characteristics and longer postoperative analgesia compared to ketorolac.

Conclusion: Dexamethasone and ketorolac are effective adjuvants when added to levobupivacaine for axillary brachial plexus block. However, dexamethasone provides faster onset of block, longer duration of sensory and motor block, and prolonged postoperative analgesia compared to ketorolac. The addition of dexamethasone to levobupivacaine improves the quality of block and reduces postoperative analgesic requirement.

Keywords: Axillary Brachial Plexus Block, Levobupivacaine, Dexamethasone, Ketorolac

INTRODUCTION

Regional anesthesia has become an essential component of modern anesthetic practice, particularly in upper limb surgeries where it offers the benefits of excellent analgesia, muscle relaxation, reduced systemic opioid consumption, early mobilization, and fewer adverse effects compared to general anesthesia. Among the regional techniques available, the axillary brachial plexus block is widely favored for hand and forearm surgeries due to its safety profile, effectiveness, and ease of administration. The block targets the terminal branches of the brachial plexus in the axilla, namely the median, ulnar, radial, and musculocutaneous nerves, ensuring effective anesthesia and analgesia for procedures involving the distal upper limb. With the advent of ultrasound guidance combined with peripheral nerve stimulation, the success rate of axillary brachial plexus blocks has significantly improved, while the incidence of complications such as vascular puncture, intraneural injection, and block failure has markedly decreased. This dual approach allows for precise localization of nerves and optimal spread of the local anesthetic, thereby enhancing the efficacy and safety of the block.[1,2]

Levobupivacaine, the S-enantiomer of bupivacaine, is a long-acting amide local anaesthetic with a favorable pharmacological profile. Compared to racemic bupivacaine, it possesses reduced cardiotoxicity and neurotoxicity while maintaining comparable potency and duration of sensory and motor blockade. At a concentration of 0.5%, levobupivacaine provides effective anesthesia for upper limb procedures with prolonged postoperative analgesia. However, like other local anesthetics, levobupivacaine alone may not always offer sufficient duration of analgesia to cover the postoperative pain period, which is often intense in hand and forearm surgeries.

Dexamethasone, a long-acting corticosteroid, has emerged as one of the most extensively studied and widely used adjuvants in regional anesthesia. Its perineural administration with local anesthetics has consistently been shown to prolong the duration of both sensory and motor blockade, as well as postoperative analgesia. The proposed mechanisms include anti-inflammatory action, suppression of ectopic neuronal discharges, modulation of nociceptive
pathways, and possible vasoconstrictor effects that reduce local anesthetic absorption.

Ketorolac, a potent nonsteroidal anti-inflammatory drug, is another promising adjuvant for regional blocks. It acts by inhibiting cyclooxygenase enzymes, thereby reducing prostaglandin synthesis and producing analgesia through peripheral and central mechanisms. When combined with local anesthetics in peripheral nerve blocks, ketorolac has been reported to extend the duration of analgesia, decrease postoperative opioid requirement, and improve patient satisfaction. Unlike dexamethasone, its mechanism of action is primarily related to attenuation of inflammation and peripheral sensitization, but evidence also suggests a role in modulating central nociceptive processing. Ketorolac is attractive as an adjuvant because of its well-established analgesic efficacy, lack of sedative properties, and favorable safety profile when used in appropriate doses.

The comparison of dexamethasone and ketorolac as adjuvants to local anesthetics in axillary brachial plexus block holds clinical significance because both drugs, though different in pharmacological class and mechanism, share the common aim of improving block characteristics and prolonging postoperative analgesia. While dexamethasone is believed to exert more potent block-prolonging effects through neuronal and anti-inflammatory pathways, ketorolac may provide additional analgesic benefit through peripheral cyclooxygenase inhibition and decreased central sensitization. Investigating their comparative efficacy, onset of action, duration of analgesia, and side effect profiles can help in determining the optimal adjuvant for clinical practice, particularly in patients undergoing hand and forearm surgeries where postoperative pain can be severe and prolonged.[3,4]

The integration of ultrasound and peripheral nerve stimulation guidance further enhances the accuracy of block placement and allows for reduced volumes of local anesthetic with improved efficacy. This ensures that the influence of adjuvants like dexamethasone and ketorolac on block duration and analgesic quality can be more accurately assessed without confounding from block failure or incomplete nerve coverage.[5,6]

From a pharmacological perspective, dexamethasone and ketorolac represent two distinct strategies in block prolongation: the former being a glucocorticoid with genomic and non-genomic neuronal effects, and the latter being a cyclooxygenase inhibitor that modulates peripheral and central nociceptive mechanisms. A head-to-head comparison not only clarifies their relative efficacy but also provides insight into whether targeting neuronal excitability or inflammatory mediators yields superior analgesia. This is especially relevant in hand and forearm surgeries where postoperative functional recovery is closely tied to adequate pain control.[6,7]

The aim of this study was to evaluate the comparison of dexamethasone and ketorolac as an adjunct to 0.5% (h) levobupivacaine in ultrasound and PNS guided axillary brachial plexus block in hand and forearm surgery.

MATERIALS AND METHODS

This prospective, double-blind, randomized, comparative study was conducted in the Department of Anesthesiology at Bombay Hospital, Indore, Madhya Pradesh, India. The total duration of the

study was 16 months, from December 2023 to March 2025. The study population consisted of adult patients scheduled for elective unilateral hand and forearm surgery under axillary brachial plexus block at Bombay Hospital, Indore.

Inclusion Criteria

- Patients belonging to the American Society of Anesthesiologists (ASA) physical status grade I or II.
- Patients of either sex.
- Patients between 18 and 60 years of age.
- Patients scheduled for elective unilateral upper limb surgeries involving the hand and forearm.

Exclusion Criteria

- Patients with a known history of hypersensitivity or allergy to local anesthetic drugs (levobupivacaine), dexamethasone, ketorolac, or other NSAIDs.
- Patients with a significant history of cardiac, respiratory, hepatic, or renal impairment or failure.
- Patients receiving chronic analgesic therapy or medications that could interfere with nerve block assessment (e.g., adrenoreceptor agonists or antagonists, regular opioids, or gabapentinoids).
- Patients with any coagulopathy or bleeding disorder that contraindicated a peripheral nerve block.
- Presence of local infection at the proposed site of needle insertion for the axillary block or any other contraindication to performing a peripheral nerve block.
- Patient refusal to participate in the study.

Consecutive sampling method was employed for patient recruitment.

Study Sample Size: The sample size was calculated based on the primary outcome measure of the duration of analgesia. The formula for estimating a sample size for a comparative study was used: SS = $(Z\text{-score})^2 * p*(1-p) / (e)^2$, where Z-score is 1.96 for a 95% confidence level, 'p' is the expected prevalence or effect size based on previous literature (taken as 0.12 from a referenced previous study), and 'e' is the margin of error (set at 10% or 0.10). The initial calculation yielded a sample size of 40.5 per group. Accounting for a potential 10% attrition rate or loss of data, the sample size was adjusted upward to 45 patients per group. Consequently, the total sample size for the study was 90 patients, with 45 patients allocated to each of the two study groups to ensure adequate statistical power to detect a significant difference between the adjuvants.

Study Groups: Eligible participants who provided consent were randomly allocated into one of two groups using a computer-generated block randomization schedule to ensure an equal distribution of patients in each group.

- Group D (Dexamethasone Group): This group received an ultrasound and PNS-guided axillary brachial plexus block with a mixture of 30 mL of 0.5% hyperbaric levobupivacaine and 8 mg (2 mL) of dexamethasone. The total injectate volume was 32 mL.
- Group K (Ketorolac Group): This group received an ultrasound and PNS-guided axillary brachial plexus block with a mixture of 30 mL of 0.5% hyperbaric levobupivacaine, 30 mg (1 mL) of ketorolac, and 1 mL of 0.9% normal saline. The total injectate volume was 32 mL.

The adjuvants were prepared by an anesthesiologist who was not involved in the subsequent management or assessment of the patient. The study solutions were identical in appearance (clear, colorless liquids) and volume, ensuring effective blinding.

Study Procedure: A standardized protocol was followed for all patients. A day prior to surgery, a pre-anesthetic check-up was conducted, which included a detailed medical history, physical examination, airway assessment, and review of routine investigations as per hospital protocol. No premedication was administered. On the day of surgery, upon arrival in the operating room, an 18- or 20-gauge intravenous cannula was secured in the non-surgical arm. Baseline hemodynamic parameters (HR, NIBP, SpO_2) were recorded.

The patient was positioned supine with the arm to be blocked abducted to 90° and the elbow flexed to 110°. The axillary region was cleaned and draped under strict aseptic precautions. A high-frequency linear ultrasound transducer was placed vertically at the level of the anterior axillary fold to identify the axillary artery. The four major nerves (median, ulnar, radial, musculocutaneous) were identified using the traceback method. A 22-gauge, 50-mm, short-bevel, insulated stimulating needle was advanced under real-time ultrasound guidance towards each nerve using an in-plane technique. The nerve stimulator was initially set at 1.0 mA (2 Hz, 0.1 ms). Once an appropriate motor response (twitch) was elicited at ≤ 0.5 mA, and after negative aspiration for blood, 4-6 mL of the study solution was injected to envelop the nerve, ensuring adequate spread under ultrasound visualization. This process was repeated for all four nerves. The time taken to locate the nerves and the total time to perform the block were recorded.

Hemodynamic monitoring was continued throughout the procedure and surgery. Sensory and motor block assessments were performed at 5, 10, 20, 30, 60, and 90 minutes after the block. Surgery commenced once a satisfactory block was confirmed. Postoperatively, patients were monitored at 10 and 30 minutes, and then at 1, 2, 6, and 12 hours. Pain was assessed using a 10cm Visual Analog Scale (VAS). Rescue analgesia (injection paracetamol 15 mg/kg IV) was administered if the VAS score was ≥4. The time of the first request and total analgesic consumption were noted.

Statistical Analysis: Data were collected using a pre-designed, structured proforma The collected data were compiled into a Microsoft Excel spreadsheet. After appropriate cleaning and validation, the data were exported to the Statistical Package for the Social Sciences (SPSS) software, version 22.0, for analysis.

Descriptive statistics were presented as mean ± standard deviation (SD) for continuous parametric data, median with interquartile range (IQR) for continuous non-parametric data, and numbers with percentages (%) for categorical data. The normality of data distribution was assessed using the Shapiro-Wilk test. For comparing quantitative variables (e.g., duration of analgesia, block onset times) between the two groups, the Student's t-test was used for parametric data, and the Mann-Whitney U test was used for non-parametric data. For comparing categorical data (e.g., ASA grade, incidence of complications) between the groups, the Chi-square test or Fisher's exact test was applied as appropriate. A p-value of less than 0.05 was considered statistically significant for all tests.

RESULTS

Table 1: Baseline Characteristics of patients administered with Dexamethasone (D)/ Ketorolac (K) as an adjunct

Variable	Group D Mean ± SD	Group K Mean ± SD
Age (years)	38.58 ± 13.16	38.2 ± 11.69
Height (cm)	165.8 ± 8.54	164.29 ± 8.55
Weight (kg)	69.31 ± 12.38	70.87 ± 11.15
Baseline SpO_2 (%)	93.56 ± 5.42	92.2 ± 6.32
Baseline Heart Rate (bpm)	79.13 ± 6.00	80.4 ± 6.33
Baseline MAP (mmHg)	97.89 ± 1.68	97.22 ± 1.72
Gender (M/F)	22/23	24/21
ASA Grade I/II	33;12	31;14

Both groups were comparable with respect to age, sex distribution, ASA status, and anthropometric parameters. No statistically significant differences were observed, confirming successful randomization.

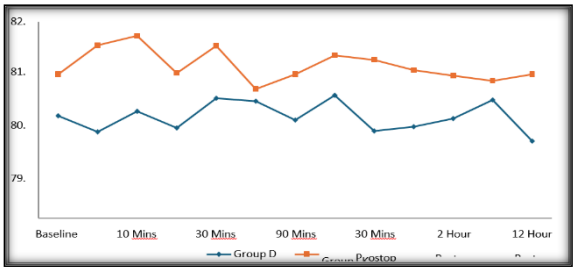

Figure 1: Heart Rate comparison between patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct across Sequential Time Points:

Across all recorded time points, the heart rate values in the dexamethasone and ketorolac groups were comparable, with no statistically significant differences observed between the two groups ($p > 0.05$ at all intervals). The mean heart rate in both groups showed stable trends throughout the perioperative and postoperative periods, indicating that neither adjuvant produced any clinically relevant alteration in heart rate when used with 0.5% levobupivacaine for axillary brachial plexus block.

These findings suggest that both dexamethasone and ketorolac maintain a similar cardiovascular profile and the choice of adjuvant does not influence heart-rate stability during or after the procedure.

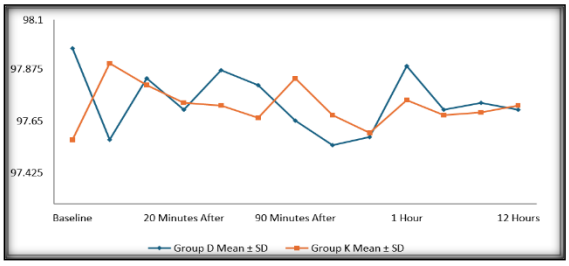

Figure 2: SPO2 measure comparison between patients administered with Dexamethasone (D)/ Ketorolac (K) as an adjunct across Sequential Time Points:

Across all intraoperative and postoperative time points, the oxygen saturation (SpO_2) values remained within normal physiological limits in both the dexamethasone and ketorolac groups. Although Group K showed slightly lower baseline SpO_2 compared to Group D, this difference was not statistically significant. Following block administration, SpO_2 levels in both groups demonstrated minimal variation over time and remained clinically stable.

At no interval did the comparison between the two groups reveal a significant difference (all $p > 0.05$). The absence of statistically meaningful differences suggests that the choice of adjuvant—dexamethasone or ketorolac—did not influence oxygen saturation during the perioperative period. Both drugs maintained comparable respiratory profiles when used with levobupivacaine for axillary brachial plexus block.

Overall, the consistently stable SpO_2 values indicate that both adjuvants are safe from a respiratory standpoint, and neither caused clinically relevant desaturation intra-operatively or postoperatively.

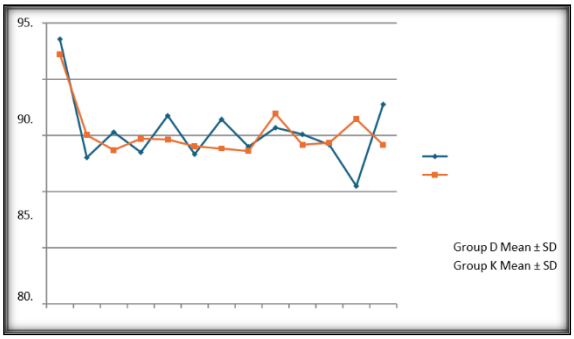

Figure 3. MAP measure comparison between patients administered with Dexamethasone (D)/ Ketorolac (K) as an adjunct across Sequential Time Points:

The MAP findings confirm that the addition of either dexamethasone or ketorolac to levobupivacaine does not compromise hemodynamic stability. The isolated MAP elevation at 6 hours in the ketorolac group did

not translate into clinical concern, reinforcing the safety of both adjuvants.

The time required to identify the nerves and perform the block differed significantly between the dexamethasone and ketorolac groups ($p < 0.05$). However, the number of skin punctures was similar between the groups, indicating comparable procedural difficulty. Patients receiving dexamethasone achieved surgical readiness significantly faster than those receiving ketorolac ($p < 0.001$), suggesting a more rapid onset of block in the dexamethasone group.

Sensory onset was significantly faster in the dexamethasone group across the musculocutaneous, radial, median, and ulnar nerves. Mean onset times were consistently shorter, with p-values < 0.001 for all comparisons, reflecting an earlier establishment of analgesia.

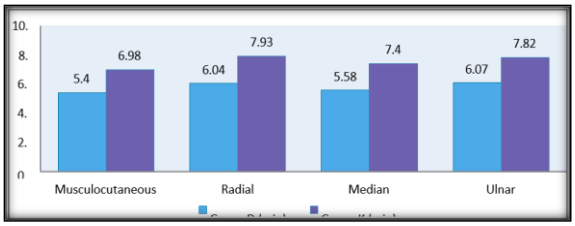

Figure 4: Comparison of Sensory Block Onset in patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct

Motor onset mirrored sensory onset trends, with dexamethasone producing significantly faster initiation of motor blockade across all nerves assessed. These findings suggest more rapid functional blockade with dexamethasone.

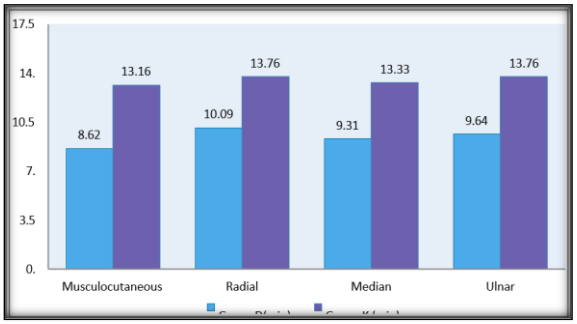

Figure 5: Comparison of Motor Block Onset in patients administered with Dexamethasone (D)/ Ketorolac (K) as an adjunct

The duration of both sensory and motor blocks was markedly longer in the dexamethasone group. The difference exceeded 230 - 270 minutes in some nerves and remained statistically significant across all domains ($p < 0.001$), indicating superior prolongation of anesthesia.

Both effect sizes ($d = 2.28$ and $d = 2.42$) fall in the 'very large' range, demonstrating that dexamethasone produces a significantly longer sensory and motor block compared to ketorolac. The magnitude of these effect sizes highlights the clinical superiority of dexamethasone as an adjuvant in axillary brachial plexus block.

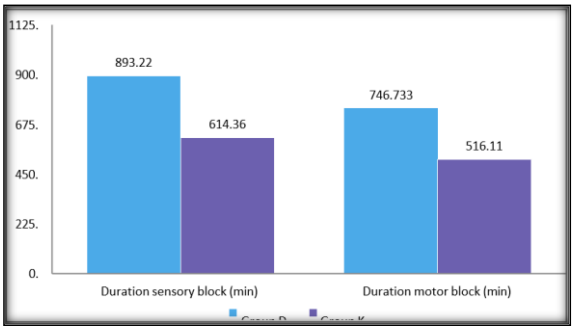

Figure 6: Sensory & Motor Block Duration in patients administered with Dexamethasone (D)/ Ketorolac (K) as an adjunct

Time to first rescue analgesia was substantially prolonged with dexamethasone, demonstrating its efficacy in extending postoperative comfort. Total analgesic requirement within 12 hours was lower in this group, consistent with improved pain control.

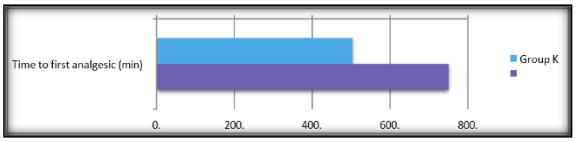

Figure 7: Comparison of Time of first requirement of Rescue analgesic delivered in patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct

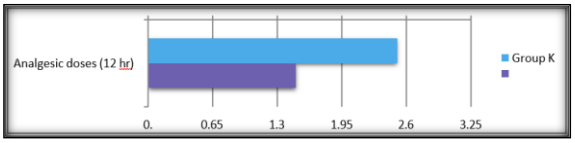

Figure 8: Comparison of Total number of doses/ frequency of dosing (1/2/3 doses) of rescue analgesic delivered in patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct.

Heart rate, mean arterial pressure, systolic and diastolic pressures, and oxygen saturation remained stable throughout the perioperative period in both groups, without statistically significant fluctuations.

Both groups showed low overall adverse event rates. No statistically significant differences were observed in hypotension, bradycardia, nausea/vomiting, or hypoxemia. Fisher's exact test confirmed that event distribution was comparable.

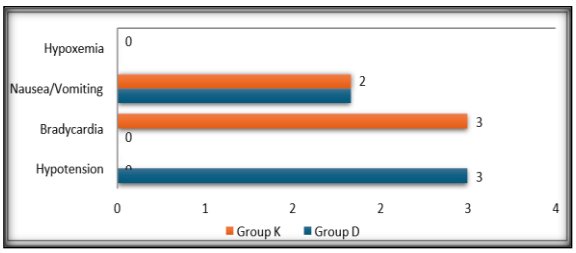

Figure 9: Comparison of Adverse Events in patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct

Predictive analysis: Binary logistic regression demonstrated that dexamethasone significantly increased the likelihood of prolonged analgesia (>600 minutes). The odds ratio exceeded 100 with a narrow confidence interval, highlighting a strong predictive association.

Table 2: Odds Ratio for Prolonged Analgesiain patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct

Outcome	Group D	Group K	Odds Ratio	95% CI
Prolonged analgesia (>600 min)	41/45 (91.11%)	4/ 45 (8.89%)	105.0625	24.6 - 336.61

Cohen's d calculations revealed very large effect sizes for block duration and onset parameters, confirming clinically meaningful superiority of dexamethasone. Motor and sensory onset times showed negative effect sizes, indicating faster onset with dexamethasone.

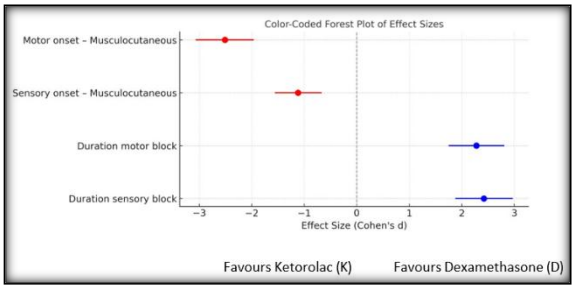

Figure 10: Forest Plot for comparison of effects in patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct

The forest plot visually reinforced these findings, showing confidence intervals that did not cross zero for major parameters. The graphical distribution emphasized the consistent advantage of dexamethasone over ketorolac.

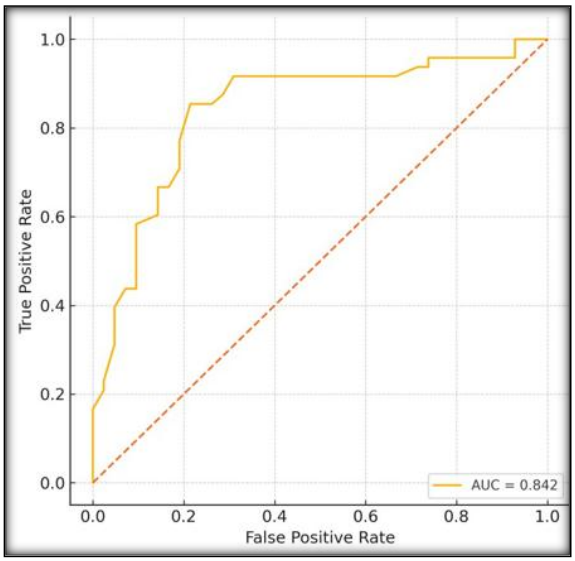

Figure 11: ROC curve for the Combined Predictors of Sensory and Motor Block Duration in Predicting Prolonged Analgesia in patients administered with Dexamethasone (D) / Ketorolac (K) as an adjunct

The combined sensory and motor block durations showed excellent predictive value for prolonged analgesia with an AUC of 0.842. This indicates that these block characteristics are strong determinants of extended postoperative pain relief in both adjunct (dexamethasone more than ketorolac).

DISCUSSION

Similar baseline comparability has been emphasized in earlier randomized brachial plexus block trials. Vieira et al. included 88 patients in a prospective randomized double-blind study and ensured balanced groups before comparing block duration and postoperative pain outcomes.[8]

Heart rate remained stable throughout the perioperative and postoperative periods in both study groups. Similar observations were reported by Ribeiro et al., who found no statistically significant difference in pulse rate between dexamethasone and control groups after pediatric supraclavicular brachial plexus block, despite clear prolongation of analgesia in the dexamethasone group.[9]

SpO_2

Oxygen saturation remained within normal physiological limits in both groups throughout the study. Similar findings were reported by Ribeiro et al., who noted no significant differences in postoperative physiological parameters between dexamethasone and non-dexamethasone groups following supraclavicular block in children, despite significantly prolonged analgesia in the dexamethasone arm.[9]

Mean Arterial Pressure

Mean arterial pressure remained stable and clinically acceptable in both groups during most of the perioperative and postoperative observation period. These findings of our study are comparable to those of Ribeiro et al., who reported no significant difference in mean blood pressure between dexamethasone and control groups at 20, 60, 120, and 180 minutes after supraclavicular block.[9]

Block Performance Parameters: Block performance parameters in the present study showed a statistically significant advantage with dexamethasone over ketorolac, particularly with respect to nerve identification time, block performance time, and readiness for surgery. Similar trends toward faster block establishment with dexamethasone have been reported by Biradar et al., who documented significantly faster onset of both sensory and motor blockade after the addition of dexamethasone to lidocaine for supraclavicular brachial plexus block.[10]

Sensory Block Onset: Sensory block onset was significantly faster with dexamethasone than with ketorolac across all four nerves evaluated in the

present study. Comparable findings were reported by Biradar et al., who documented significantly faster sensory onset when dexamethasone was added to lidocaine with epinephrine for supraclavicular brachial plexus block.[6,7]

Motor Block Onset: Motor block onset in the present study also strongly favored dexamethasone over ketorolac, mirroring the pattern observed for sensory onset and confirming a more rapid establishment of dense functional block with dexamethasone. Biradar et al. reported a similar finding, documenting significantly faster motor block onset when dexamethasone was added to lidocaine in supraclavicular brachial plexus block.[10]

Sensory and Motor Block Duration: The prolongation of block duration was one of the most prominent findings of the present study, and dexamethasone demonstrated clear superiority over ketorolac in extending both sensory and motor blockade. Comparable findings have been widely documented in prior dexamethasone studies. Vieira et al. reported that dexamethasone prolonged median sensory block duration to 1457 minutes compared with 833 minutes in the control group, and also significantly extended motor blockade.[8]

Postoperative Analgesia: Postoperative analgesic outcomes in the present study strongly supported the superiority of dexamethasone over ketorolac. Similar findings were described by Vieira et al., who reported lower pain scores at 24 hours and reduced opioid requirement in patients receiving dexamethasone with interscalene block.[8]

Adverse Events and Predictive Analysis: The present study demonstrated that dexamethasone achieved superior block and analgesic outcomes without increasing clinically significant adverse events, while predictive analyses further underscored its strong efficacy profile. These findings are consistent with Parrington et al., who reported that complications associated with dexamethasone were minor and transient, with no major differences at follow-up.[11]

Time to First Rescue Analgesic: The time to first rescue analgesic requirement is a direct reflection of the clinical usefulness of any adjuvant in peripheral nerve block, and in the present study this parameter strongly favored dexamethasone over ketorolac. Similar findings were reported by Parrington et al., who observed that the median duration of analgesia increased from 228 minutes to 332 minutes after addition of dexamethasone to mepivacaine in supraclavicular brachial plexus block.[11]

Number of Rescue Analgesic Doses: The number of rescue analgesic doses required during the first 12 postoperative hours provides an important measure of the quality and sustainability of analgesia produced by the study drugs. Vieira et al. reported that patients receiving dexamethasone in inter-scalene brachial plexus block experienced lower pain scores and reduced opioid requirement during the first 24 hours after surgery.[8]

Total Analgesic Consumption: Reduction in total postoperative analgesic consumption is an important indicator of the analgesic potency of a regional block adjuvant, and in the present study dexamethasone was clearly superior to ketorolac in this regard.

Prolonged Analgesia More Than 600 Minutes: The proportion of patients achieving prolonged analgesia lasting more than 600 minutes provides a clinically meaningful categorical measure of block success, and the present study showed a striking advantage with dexamethasone. These findings are consistent with earlier dexamethasone studies showing substantial prolongation of analgesia. Vieira et al. demonstrated prolonged sensory block of 1457 minutes with dexamethasone compared with 833 minutes in controls, supporting the concept that dexamethasone markedly increases the likelihood of extended analgesia.[8]

Odds Ratio for Prolonged Analgesia: Binary logistic regression in the present study showed that dexamethasone had a remarkably strong predictive association with prolonged analgesia lasting more than 600 minutes, as reflected by an odds ratio of 105.06 with a 95% confidence interval of 24.6–336.61. Similar strong analgesic advantages of dexamethasone have been reported in earlier literature, although expressed using duration rather than odds ratios.

Effect Size for Sensory Block Duration: The effect size for sensory block duration in the present study was 2.42, with a 95% confidence interval of 1.88 to 2.97, indicating an exceptionally large treatment effect favoring dexamethasone over ketorolac.

Comparable prolonged sensory blockade has been documented in earlier dexamethasone studies. Vieira et al. reported a median sensory block duration of 1457 minutes with dexamethasone compared with 833 minutes in controls.[8]

Effect Size for Motor Block Duration: The effect size for motor block duration in the present study was 2.28, with a 95% confidence interval of 1.75 to 2.81, again demonstrating a very large and clinically important advantage of dexamethasone over ketorolac. In upper-limb surgery, especially hand and forearm procedures, this extended motor block is generally acceptable because it accompanies enhanced sensory block and reduced need for rescue analgesics. Similar findings have been described in previous dexamethasone literature.

Effect Size for Sensory Onset: The effect-size analysis for sensory onset, particularly for the musculocutaneous nerve, further confirmed the superiority of dexamethasone in accelerating block establishment. This is consistent with the actual onset values observed: 5.4 ± 1.30 minutes in Group D compared with 6.98 ± 1.51 minutes in Group K. A large effect size for earlier sensory onset is especially relevant because it reduces the waiting period before adequate anesthesia is achieved and improves operating room efficiency.

Effect Size for Motor Onset: The effect-size analysis for motor onset in the present study showed

one of the strongest treatment differences observed, again favoring dexamethasone over ketorolac. Such a large effect size has direct clinical significance, as rapid motor block establishment facilitates early immobilization of the operative limb and contributes to quicker readiness for surgery. Comparable findings were described by Biradar et al., who observed significantly faster motor block onset when dexamethasone was used as an adjuvant in supraclavicular brachial plexus block.[6,7]

ROC Curve and Overall Predictive Accuracy: The ROC curve analysis in the present study demonstrated that the combined sensory and motor block durations had excellent ability to predict prolonged analgesia, with an AUC of 0.842. This has relevance for postoperative planning, patient counseling and rational analgesic scheduling. The strong predictive performance observed in the present study is consistent with earlier dexamethasone literature showing substantial prolongation of block and analgesia.

CONCLUSION

Dexamethasone is a more effective adjuvant than ketorolac for axillary brachial plexus block with levobupivacaine in hand and forearm surgery, as it provides faster onset, longer duration of block, superior postoperative analgesia, lower rescue analgesic requirement, and comparable safety except for prolong motor blockade. Therefore, dexamethasone may be considered the preferred adjuvant in this clinical setting when the goal is to achieve prolonged and effective perioperative analgesia without compromising patient safety.

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