e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(6); 1691-1698

Original Research Article

A Clinical Comparative Study of Effects of Ropivacaine and Ropivacaine with Dexmedetomidine as an Adjuvant in Ultrasound Guided Axillary Brachial Plexus Block in Forearm and Hand Surgeries

Yogesh Kumar Manik[1], Ravi Kumar Agrawal[2], Anjali Dixit[3], Sarika Gupta[4]

[1]Professor, Department of Anaesthesiology, Lala Lajpat Rai Memorial Medical College, Meerut, Uttar Pradesh, India

[2]Associate Professor, Department of Anaesthesiology, Lala Lajpat Rai Memorial Medical College, Meerut, Uttar Pradesh, India

[3]Assistant Professor, Department of Anaesthesiology, Lala Lajpat Rai Memorial Medical College, Meerut, Uttar Pradesh, India

[4]Junior Resident, Department of Anaesthesiology, Lala Lajpat Rai Memorial Medical College, Meerut, Uttar Pradesh, India

Received: 27-04-2026 / Revised: 26-05-2026 / Accepted: 28-06-2026

Corresponding Author: Dr. Sarika Gupta

Conflict of interest: Nil

Abstract:

Background: For forearm and hand surgeries, ultrasound-guided axillary brachial plexus block (USG-ABPB) is routinely used for its effective intra-operative anaesthesia and prolonged post-operative analgesia. Dexmedetomidine (DEX) (α2-adrenergic agonist) is used as an adjuvant to local anesthetics to improve block characteristics and for prolonged analgesia. The present study compared ropivacaine alone with ropivacaine plus DEX as an adjuvant in USG-ABPB for forearm and hand surgeries.

Methods: Sixty patients were studied in a prospective, randomized, comparative study posted for elective forearm and hand surgeries. Two groups were formed: Group A (received ropivacaine) and Group B (received ropivacaine with DEX). Characteristics of sensory and motor block, duration of postoperative analgesia, hemodynamic parameters, and complications were recorded.

Results: The onset of sensory block was faster in Group B (8.23 ± 1.07 min vs. 12.50 ± 1.28 min; $p < 0.001$). The onset of motor block was earlier in Group B (10.87 ± 1.07 min vs. 15.60 ± 1.67 min; $p < 0.001$). Duration of sensory block (545.33 ± 27.76 min vs. 401.67 ± 31.19 min; $p < 0.001$), motor block (517.00 ± 17.65 min vs. 391.00 ± 37.54 min; $p < 0.001$), and postoperative analgesia (606.67 ± 18.63 min vs. 462.00 ± 40.38 min; $p < 0.001$) were significantly prolonged in Group B.

Conclusion: Dexmedetomidine is an effective and safe adjunct to ropivacaine in USG-ABPB.

Keywords: axillary brachial plexus block; dexmedetomidine; ropivacaine; ultrasound-guided regional anesthesia; postoperative analgesia; upper limb surgery

CTRI No: CTRI/2025/08/092863.

DOI: 10.25258/ijcpr.18.6.273

Introduction

Upper limb surgeries of the forearm and hand are commonly performed under brachial plexus block, which provides effective anesthesia, prolonged analgesia, reduced opioid use, fewer postoperative adverse effects, and faster recovery.[1,2] Ultrasound guidance improves block safety by allowing real-time visualization of nerves, vessels, needle path, and local anesthetic spread, reducing complications.[1, 2] The axillary approach is safer for distal upper limb surgery due to minimal risk of pneumothorax and phrenic nerve palsy.[2] Ropivacaine offers lower cardiotoxicity than bupivacaine [3] but may have limited analgesic duration.[4] Dexmedetomidine enhances and prolongs the effects of the block. [4,5]

Materials and Methods

Research Methodology: This was a randomized, prospective, comparative study conducted in the Anaesthesiology Department at SVBP Hospital, associated with LLRM Medical College, Meerut, Uttar Pradesh, India, over 18 months, from July 2024 to December 2025. The research was conducted under approval from the Institutional Ethics Committee (No. SC-1/2025/2932 dated 23/04/2025). The trial was registered with the

Clinical Trial Registry of India (CTRI/2025/08/092863). Written informed consent was taken before recruitment.

Study Cohort: Sixty patients of either sex, aged 18 to 60 years, with American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective forearm and hand procedures using ultrasound-guided axillary brachial plexus block, were included in the study. Individuals with localized infection at the injection site, coagulopathy, pregnancy, peripheral neuropathy, known hypersensitivity to local anesthetics, first-, second-, or third-degree heart block, ASA grade III or IV classification, and substantial systemic comorbidities were excluded from the trial. Patients who declined to participate were also eliminated.

Sample Size: The sample size was determined using data from a prior study on the duration of sensory block. The calculated pooled standard deviation was 144.1 minutes. Given a clinically meaningful mean difference of 100 minutes, a 95% confidence level, and 80% power, the minimum required sample size was determined to be 30 patients per group. Consequently, the study included 60 patients.

Randomization and Group Assignment: Qualified patients were randomly allocated into two equal groups, each consisting of 30 individuals. Group A (n=30) patients received 19 mL of ropivacaine (0.5%) along with 1 mL of normal saline. Group B (n=30) patients received 19 mL of ropivacaine (0.5%), augmented with DEX at 0.5 µg/kg, and diluted with normal saline to a final volume of 20 mL. Figure 1 provides the CONSORT diagram showing patient enrolment, randomization, allocation, follow-up, and final analysis in the study.

Preoperative Assessment

All patients had a comprehensive pre-anesthetic assessment before surgery. A comprehensive medical history and thorough systemic examination were conducted. An airway assessment was performed, and standard investigations, including hemoglobin levels, total leukocyte count, differential leukocyte count, platelet count, blood glucose, blood urea nitrogen, serum creatinine, bleeding time, clotting time, electrocardiogram, and chest X-ray, were obtained. The baseline heart rate, systolic and diastolic blood pressures, mean arterial pressure, and oxygen saturation were documented before the surgery.

Blocking Technique

Upon the patient's transfer to the operating room, an intravenous line was established, and a Ringer's lactate infusion was initiated. Standard monitoring, comprising electrocardiography, non-invasive blood pressure measurement, and pulse oximetry, was implemented. An ultrasound-guided axillary brachial plexus block was executed in the supine position, adhering to stringent aseptic protocols, with the arm abducted to 90 degrees and the elbow flexed.

The axillary area was disinfected with povidone-iodine solution, followed by the application of a sterile drape. A high-frequency linear ultrasound probe was positioned transversely in the axillary region to locate the axillary artery and adjacent neural structures, including the median, ulnar, radial, and musculocutaneous nerves. A 22-gauge insulated block needle was introduced via an in-plane technique under real-time ultrasonography guidance. Following negative aspiration, the study medication solution was gradually administered around the indicated nerves to achieve a circumferential distribution of local anesthetic.

Evaluation of Block Attributes

Assessments of sensory and motor block were conducted every minute following drug administration until total blockade was attained or for a maximum duration of 20 minutes. The sensory block was evaluated using the pinprick method on a three-point scale: grade 0 indicated normal sensation, grade 1 indicated analgesia, and grade 2 indicated total anesthesia. The modified Bromage scale was used to assess motor blockade in the upper limbs, with grade 0 denoting normal motor function, grade 1 signifying diminished motor strength limited to finger movement, and grade 2 reflecting total motor blockade with inability to move the fingers. Complete sensory and motor blockade was deemed accomplished when grade 2 blockade was noted throughout all nerve regions.

Hemodynamic Surveillance and Postoperative Pain Management

Hemodynamic measures, including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation, were recorded before and at 0, 5, 10, 15, 30, 60, 90, and 120 minutes post-delivery. Patients were observed during and after surgery for adverse events such as nausea, vomiting, hypotension, bradycardia, tachycardia, hypertension, respiratory depression, seizures, and indications of local anesthetic systemic toxicity.

The severity of pain was assessed postoperatively using the Visual Analog Scale (VAS), which ranges from 0 to 10, with 0 indicating no pain and 10 the most severe pain imaginable. The duration of analgesia was defined as the interval between block delivery and either the initial request for rescue analgesia or the VAS score exceeding 4. Seventy-five milligrams of intramuscular diclofenac sodium was provided as a rescue analgesic.

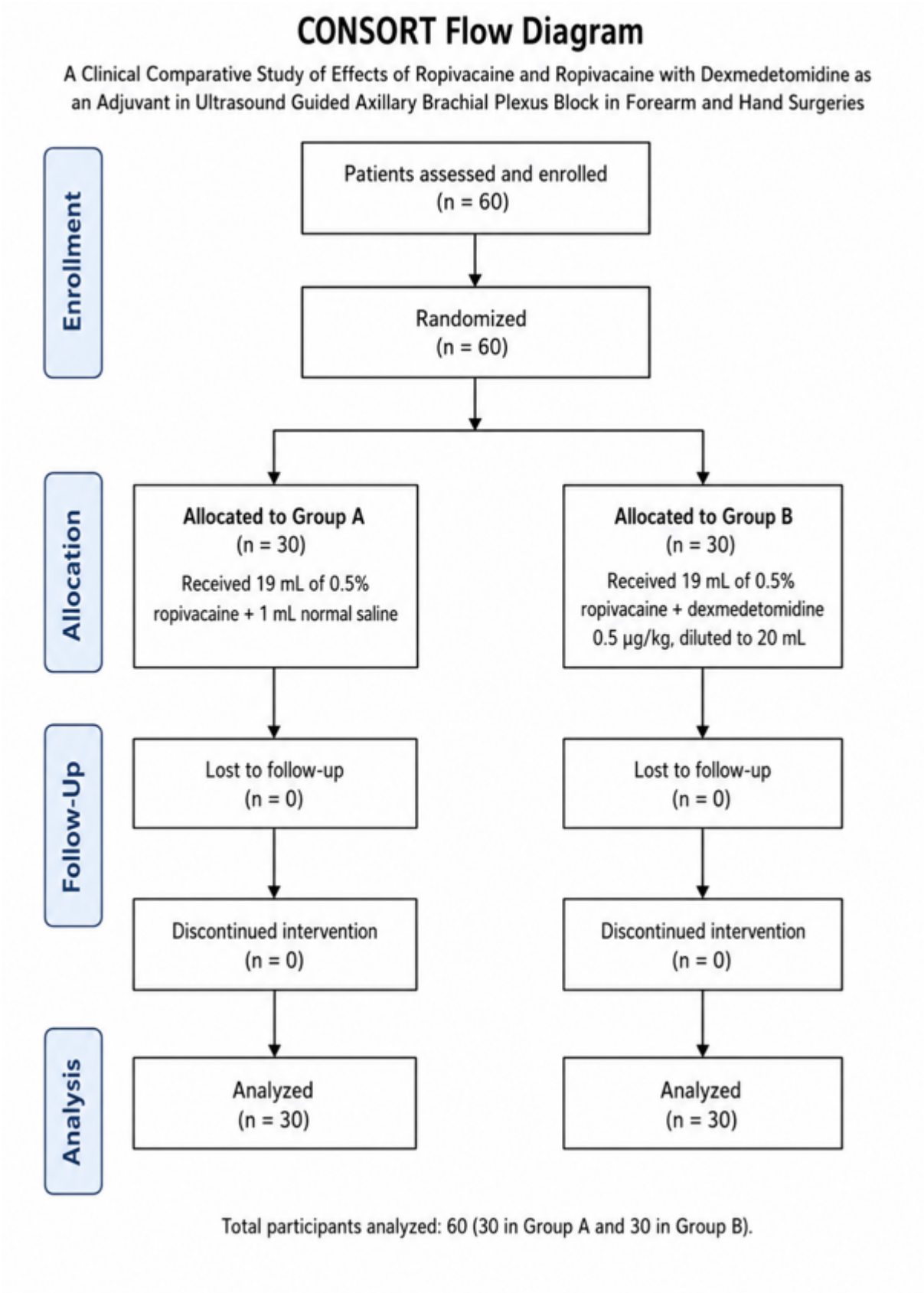

Figure 1: CONSORT Flow Diagram of Patient Enrollment, Randomization, Allocation, Follow-up, and Analysis

Performance Metrics: The principal outcome measures included the onset times of sensory and motor blockade and the duration of motor blockade. Secondary outcome variables included the duration of postoperative analgesia, hemodynamic changes, and the occurrence of complications related to the block or study medications.

Statistical Examination: All collected data were compiled in Microsoft Excel and subsequently analyzed using SPSS software version 28.0 (IBM Corp., Chicago, IL, USA). Quantitative variables were summarized as means with standard deviations, while qualitative variables were expressed as numbers and percentages. Intergroup comparison of normally distributed continuous data was performed using the independent Student's t-test. Associations between categorical variables were assessed using the Chi-square test. Statistical significance was considered at a p-value of less than 0.05.

Results

Baseline Attributes: The demographic profile and perioperative characteristics were analogous between the two groups. The mean age, BMI, sex distribution, ASA physical status, and duration of surgery showed no significant differences ($p > 0.05$), indicating sufficient baseline homogeneity across the study groups (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Group A (n=30)	Group B (n=30)	p-value
Age (years)	33.97 ± 11.91	37.97 ± 12.17	0.203
BMI (kg/m²)	21.26 ± 1.91	20.61 ± 1.45	0.144
Male/Female	23/7	23/7	1.000
ASA I/II	25/5	21/9	0.360
Duration of surgery (min)	96.00 ± 26.89	99.00 ± 25.10	0.657

Independent Student t-test and Chi-square test applied.

Block Characteristics: The incorporation of DEX markedly enhanced block properties. Group B exhibited a markedly faster onset of both sensory and motor blockages compared with Group A ($p < 0.001$). The duration of sensory block, motor block, and postoperative analgesia was markedly extended in Group B (Table 2).

Table 2: Comparison of Block Characteristics

Parameter	Group A Mean ± SD	Group B Mean ± SD	p-value
Onset of sensory block (min)	12.50 ± 1.28	8.23 ± 1.07	<0.001
Onset of motor block (min)	15.60 ± 1.67	10.87 ± 1.07	<0.001
Duration of sensory block (min)	401.67 ± 31.19	545.33 ± 27.76	<0.001
Duration of motor block (min)	391.00 ± 37.54	517.00 ± 17.65	<0.001
Duration of analgesia (min)	462.00 ± 40.38	606.67 ± 18.63	<0.001

Independent Student t-test applied.

The initiation of sensory block was delayed by approximately 4 minutes in the DEX cohort, while the duration of postoperative analgesia was extended by approximately 145 minutes. The results illustrate the synergistic effect of DEX in conjunction with ropivacaine in the axillary brachial plexus block.

Hemodynamic Metrics: Heart rate was consistent across both groups during the intraoperative time, with no statistically significant differences detected at any monitored interval ($p > 0.05$). Nevertheless, systolic and diastolic blood pressure readings were markedly reduced in Group B after DEX administration, indicating the drug's sympatholytic effect. Although statistically significant, all values were within clinically acceptable parameters, and no patient experienced clinically significant (Table 3).

Table 3: Hemodynamic Parameters

Parameter	Observation
Heart Rate	Comparable between groups throughout the study period
Systolic Blood Pressure	Significantly lower in Group B after block administration
Diastolic Blood Pressure	Significantly lower in Group B after block administration
Clinically significant bradycardia/hypotension	Not observed

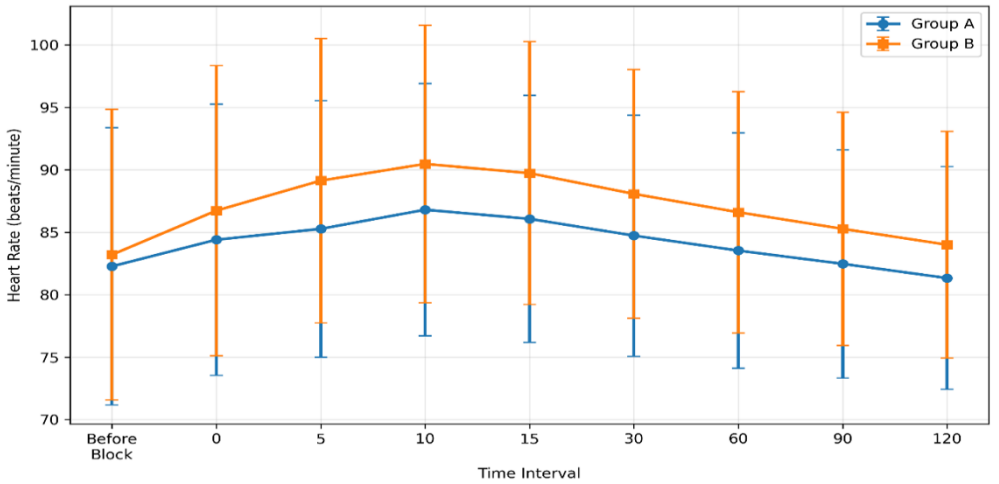

Figure 2: Mean Heart Rate Variation (± SD) Across Study Groups During the Intraoperative Phase. Line graph comparing the mean heart rate (beats per minute) and standard deviation between Group A (ropivacaine alone) and Group B (ropivacaine + DEX) throughout various time intervals.

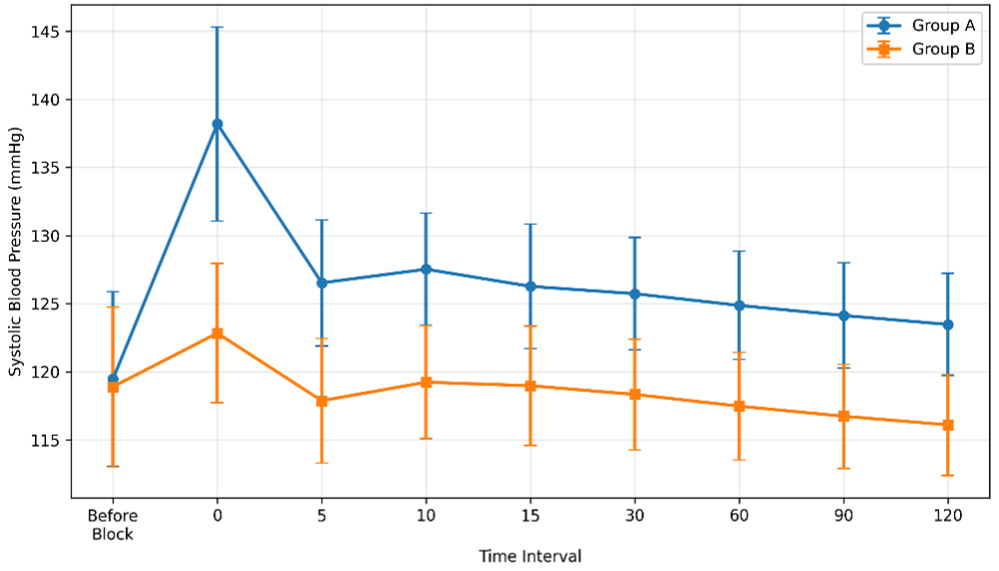

Figure 3: Mean Variation of Systolic Blood Pressure (± SD) Among Study Groups During the Intraoperative Period. Line graph illustrating the comparison of mean systolic blood pressure (mmHg) with standard deviation between Group A and Group B at different intraoperative time intervals.

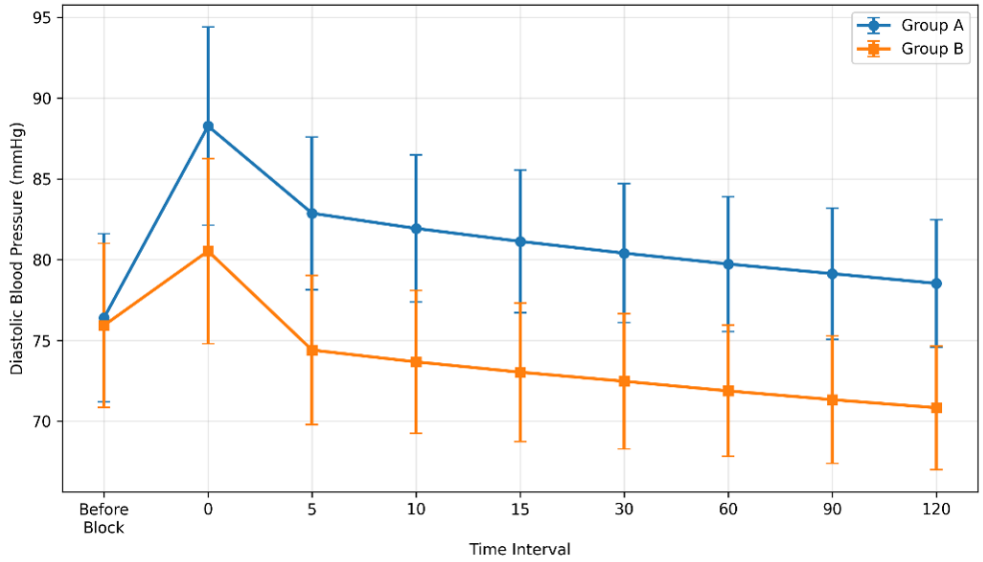

Figure 4: Mean Diastolic Blood Pressure Fluctuation (± SD) Among Study Cohorts During the Intraoperative Phase. Line graph illustrating the comparison of mean diastolic blood pressure (mmHg) with standard deviation between Group A and Group B over various intraoperative time periods.

Complications: Both groups exhibited outstanding safety characteristics. Two patients in Group B exhibited mild nausea, while Group A reported no side events. No patient exhibited vomiting, bradycardia, hypotension, hypertension, tachycardia, or respiratory depression (Table 4).

Table 4: Complications Profile

Complication	Group A	Group B
Nausea	0	2
Vomiting	0	0
Bradycardia	0	0
Hypotension	0	0
Tachycardia	0	0
Respiratory depression	0	0

Discussion

The results of the present study indicated that incorporating DEX into ropivacaine markedly accelerated the onset of sensory and motor block, extended their duration, and prolonged postoperative analgesia without inducing clinically significant adverse effects.

Regional anesthetic techniques have become increasingly favored in upper limb procedures due to their provision of enhanced postoperative analgesia, less narcotic use, expedited ambulation, and heightened patient satisfaction. Ultrasound-guided brachial plexus block enhances the efficacy and safety of the procedure by enabling direct viewing of neural structures and the distribution of local anesthetic. Three. The current investigation demonstrated that ultrasound guidance enabled successful blockage without significant procedural difficulties.

The demographic variables, such as age, BMI, sex distribution, ASA physical status, and surgical duration, were comparable between the two groups, indicating adequate randomization and homogeneity among research participants. Acharya et al. [4] and Das et al. [6] have observed analogous baseline comparability in trials assessing DEX as an adjunct to ropivacaine in brachial plexus blocks.

The initiation of sensory and motor block occurred substantially more rapidly in the DEX group. The average start of the sensory block was 8.23 ± 1.07 minutes in Group B, compared with 12.50 ± 1.28 minutes in Group A. In contrast, the onset of motor block occurred at 10.87 ± 1.07 minutes compared to 15.60 ± 1.67 minutes, respectively. The results align with the observations of Chen et al. [7], who evidenced an expedited onset of sensory and motor blockade with the incorporation of DEX into ropivacaine during axillary brachial plexus block. Likewise, Koraki et al. noted a markedly accelerated onset of both sensory and motor block in patients receiving DEX in conjunction with ropivacaine. [6,7]

The rapid onset of blocking may be ascribed to the synergistic interaction between DEX and local anesthetics. DEX targets α2-adrenergic receptors

and promotes hyperpolarization of neural tissues, thereby enabling rapid blockade of nerve conduction.9

The current investigation revealed a notable extension of sensory and motor blockage in the DEX cohort. The duration of sensory block rose from 401.67 ± 31.19 minutes in Group A to 545.33 ± 27.76 minutes in Group B, whereas the duration of motor blockade increased from 391.00 ± 37.54 minutes to 517.00 ± 17.65 minutes. Comparable results have been documented in prior research. Das et al.6 reported that adding DEX to ropivacaine dramatically extended the duration of both sensory and motor block. Ten Dai et al. reported in a meta-analysis that DEX considerably extends the duration of sensory and motor block in peripheral nerve blocks.[8]

The extended blockade noted in this study may result from peripheral vasoconstriction induced by α2-receptor activation, which hinders local anesthetic absorption, as well as direct inhibitory effects on nerve fiber action potentials. [6-8]

The DEX group exhibited a considerably longer duration of postoperative analgesia, averaging 606.67 ± 18.63 minutes, compared with 462.00 ± 40.38 minutes in the ropivacaine-only group. Comparable extensions of postoperative analgesia have been documented by Kathuria et al., Chen et al., and Mokkarala et al. [4, 7,9]. Extended analgesia reduces postoperative analgesic requirements and enhances patient comfort, ultimately improving overall perioperative outcomes.

Hemodynamic monitoring in this study indicated that heart rate remained consistent between groups during the perioperative time. Nonetheless, systolic and diastolic blood pressure measurements were markedly reduced in the DEX cohort. Notwithstanding statistical significance, all hemodynamic parameters remained within clinically acceptable ranges, and no patient experienced clinically severe hypotension or bradycardia necessitating intervention. These results align with the established sympatholytic properties of DEX and corroborate prior research. [6-9]

The current study showed a few safety-related problems. Two individuals administered DEX had mild nausea, but no significant adverse effects, including respiratory depression, hypotension, bradycardia, or local anesthetic toxicity, were seen. Comparable safety outcomes have been documented in previous studies that assessed DEX as an adjunct to brachial plexus blocks. [5,6-9]

Limitations

The research was conducted at a single tertiary care facility with a modest sample size, which may limit the generalizability of the results. Only a single dose of DEX (0.5 μg/kg) was assessed; hence, dose-response relationships and the ideal adjuvant dosage remain undetermined. Furthermore, postoperative follow-up was confined to the immediate postoperative phase, and long-term outcomes, such as functional recovery and patient satisfaction, were not evaluated. The study evaluated DEX in combination with ropivacaine and did not assess other frequently used adjuvants, such as dexamethasone or clonidine. Moreover, while ultrasound guidance enhances the precision and safety of the block, the operation still relies on the operator, and disparities in technical proficiency may affect the block's features and outcomes.

Conclusion

Dexmedetomidine is a safe and effective adjunct to ropivacaine in USG-ABPB for procedures of the forearm and hand. The use of DEX substantially accelerated the onset of sensory and motor blockade while greatly extending the duration of sensory block, motor block, and postoperative analgesia compared with ropivacaine alone. Moreover, the combination maintained stable intraoperative hemodynamic parameters without clinically significant adverse effects. Consequently, DEX may be considered a significant adjuvant to ropivacaine for enhancing block quality, extending postoperative analgesia, and improving perioperative patient comfort during upper limb procedures.

References

1. Jones MR, Novitch MB, Sen S, Hernandez N, De Haan JB, Budish RA, et al. Upper extremity regional anesthesia techniques: A comprehensive review for clinical anesthesiologists. Best Pract Res Clin Anaesthesiol. 2020;34(1):e13-e29. doi: 10.1016/j.bpa.2019.07.005.
2. Nijs K, Hertogen P', Buelens S, Coppens M, Teunkens A, Jalil H, et al. Axillary Brachial Plexus Block Compared with Other Regional Anesthesia Techniques in Distal Upper Limb Surgery: A Systematic Review and Meta-Analysis. J Clin Med. 2024;13(11):3185. doi: 10.3390/jcm13113185.
3. Alharran AM, Alotaibi MN, Alenezi YY, Alharran YM, Alahmad AA, Alqallaf A, et al. Levobupivacaine versus ropivacaine for brachial plexus block: A systematic review and meta-analysis of randomised controlled trials. Indian J Anaesth. 2025 Feb;69(2):179-190. doi: 10.4103/ija.ija_1156_24.
4. Acharya S, Thapa C, Shrestha N, Hamal PK. Duration of Anesthesia with Dexmedetomidine as Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block: An Observational Study. JNMA J Nepal Med Assoc. 2024 Dec;62(280):823-827. doi: 10.31726/jnma.8841.

5. Chen Z, Liu Z, Feng C, Jin Y, Zhao X. Dexmedetomidine as an Adjuvant in Peripheral Nerve Block. Drug Des Devel Ther. 2023 May 17;17:1463-1484. doi: 10.2147/DDDT.S405294.
6. Li F, Guo L, Huang Z, Lin F, Pan L. Effects of dexmedetomidine as an adjuvant to ropivacaine or ropivacaine alone on duration of postoperative analgesia: A systematic review and meta-analysis of randomized controlled trials. PLoS One. 2023 Oct 11;18(10):e0287296. doi: 10.1371/journal.pone.0287296.
7. Chen JB, Su LM, Zhang XQ, Liu Y, Li XS, Chen ZY. Ropivacaine combined with dexmedetomidine in ultrasound-guided axillary brachial plexus block in children, a randomized controlled trial. Eur J Med Res. 2024 Aug 13;29(1):416. doi: 10.1186/s40001-024-01997-z.
8. Dai W, Tang M, He K. The effect and safety of DEX added to ropivacaine in brachial plexus block: a meta-analysis of randomized controlled trials. Medicine (Baltimore). 2018;97(41):e12573. doi:10.1097/MD.0000000000012573.
9. Mokkarala RR, Badugu JP. Evaluation of DEX as adjuvant to 0.5% ropivacaine in comparison to dexamethasone in the supraclavicular block. Int J Clin Trials. 2022;9(2):89-93. doi:10.18203/2349-3259.ijct20221107.