Original Article

Comparison of Dexmedetomidine and Dexamethasone as Adjuvants to Ropivacaine in Ultrasound-Guided Supraclavicular Brachial Plexus Block: A Prospective Randomised Double-Blind Comparative Trial

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Abstract

Background: Dexmedetomidine and dexamethasone are commonly used as adjuvants to local anaesthetics for prolonging peripheral nerve block, but their comparative efficacy and adverse-effect profiles remain inconsistent across studies. The aim is to compare the efficacy and safety of dexmedetomidine and dexamethasone as adjuvants to ropivacaine in ultrasound-guided supraclavicular brachial plexus block. **Material and Methods:** In this prospective, randomised, double-blind comparative trial, 200 adults aged 18–65 years with ASA physical status I–II undergoing elective upper-limb surgery were randomised equally to receive 0.5% ropivacaine with dexmedetomidine 1 µg/kg (Group D) or dexamethasone 8 mg (Group X). Sensory and motor block characteristics, postoperative NRS pain scores, time to first rescue analgesia, cumulative 24-hour tramadol consumption, haemodynamic parameters, patient satisfaction, and adverse events were evaluated. **Results:** Sensory and motor block onset were faster in Group D than Group X (8.3 ± 1.5 vs 9.5 ± 1.6 minutes and 11.7 ± 1.8 vs 13.1 ± 1.9 minutes, respectively; both P<0.001). Sensory and motor block durations were longer with dexmedetomidine (825 ± 95 vs 718 ± 92 minutes and 682 ± 86 vs 604 ± 82 minutes; both P<0.001). Time to first rescue analgesia was prolonged (1310 ± 150 vs 1102 ± 145 minutes; P<0.001), while cumulative 24-hour tramadol consumption was lower (57.4 ± 14.8 vs 73.1 ± 16.5 mg; P<0.001). Group D also had lower postoperative NRS scores and higher patient satisfaction. Mean arterial pressure and oxygen saturation were comparable, although heart rate was modestly lower with dexmedetomidine. Sedation was more frequent in Group D (16.0% vs 3.0%; P=0.003); other adverse events were comparable. **Conclusion:** Under the study protocol, dexmedetomidine provided faster onset, longer sensory and motor blockade, prolonged postoperative analgesia, and lower rescue analgesic requirement than dexamethasone, but with a higher incidence of sedation.

Keywords: Dexmedetomidine; dexamethasone; ropivacaine; supraclavicular brachial plexus block; ultrasound guidance; postoperative analgesia.

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Introduction

Brachial plexus block is a well-established regional anaesthetic technique for upper-limb surgery, providing reliable surgical anaesthesia together with effective postoperative analgesia, reduced dependence on systemic analgesics, and favourable postoperative recovery.[1] The introduction of ultrasound guidance has further refined regional anaesthesia by enabling direct visualisation of neural structures, the advancing needle tip, adjacent vascular structures, and the pattern of local anaesthetic spread. This allows more accurate drug deposition and reduces dependence on surface anatomy and landmark-based techniques alone.[2]

Ropivacaine is a long-acting amide local anaesthetic that produces neural blockade by reversibly inhibiting voltage-gated sodium channels. Compared with bupivacaine, its lower lipid solubility is associated with greater sensory–motor differentiation and a relatively lower potential for central nervous system and cardiovascular toxicity, which makes it a suitable agent for peripheral nerve blockade.[3]Nevertheless, the duration of analgesia after a single-injection peripheral nerve block remains finite, and this has encouraged the use of adjuvants capable of extending block duration without producing clinically significant adverse effects.

Dexmedetomidine is a highly selective α2-adrenergic receptor agonist with analgesic, sedative, and sympatholytic properties. When administered perineurally, dexmedetomidine has been

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reported to hasten the onset and prolong the duration of both sensory and motor blockade. These effects are thought to result from a combination of peripheral α2-receptor activity, inhibition of hyperpolarisation-activated cation currents, local vasoconstrictive action, and modulation of nociceptive transmission.[4] A systematic review of 18 randomised controlled trials involving 1,092 patients reported that dexmedetomidine shortened the onset of sensory block by approximately 3.2 minutes and motor block by approximately 2.9 minutes, while prolonging sensory block by about 261 minutes, motor block by about 201 minutes, and analgesia by approximately 289 minutes. However, an increased incidence of reversible bradycardia was also observed.[5]

Dexamethasone is a potent glucocorticoid that has likewise been extensively investigated as an adjuvant in peripheral nerve blocks. Proposed mechanisms for its analgesic-prolonging effect include suppression of inflammatory mediators, modulation of nociceptive C-fibre activity, and local vasoconstrictive effects that may delay systemic absorption of the local anaesthetic. A meta-analysis of nine randomised trials involving 801 patients found that dexamethasone substantially prolonged the duration of analgesia when combined with long-acting local anaesthetics and also extended the duration of motor blockade.[6] A subsequent Cochrane review concluded that both perineural and intravenous dexamethasone may prolong sensory blockade and reduce postoperative pain and opioid consumption in patients undergoing upper-limb surgery, although the certainty of evidence varied across the assessed outcomes.[7] The comparative advantage of dexmedetomidine over dexamethasone, or vice versa, remains uncertain. An indirect meta-analysis of 49 trials involving 3,019 patients suggested that dexamethasone prolonged analgesia by approximately 148 minutes more than dexmedetomidine and was associated with lower incidences of hypotension and sedation.[8] In contrast, a later meta-analysis of 13 comparative trials involving 1,126 patients found broadly comparable analgesic duration between the two adjuvants, while dexmedetomidine was associated with a faster onset of sensory and motor blockade but a greater sedative effect.[9] A network meta-analysis involving 100 trials similarly indicated that the relative benefit of these adjuvants varied according to the clinical outcome assessed, the route of administration, and the local anaesthetic used.[10] These variations support the continued relevance of direct clinical comparison, particularly when onset and duration of blockade, postoperative analgesic requirement, haemodynamic effects, and adverse-event profiles are considered together. The present study was therefore undertaken to compare dexmedetomidine and dexamethasone as adjuvants to ropivacaine in ultrasound-guided supraclavicular brachial plexus block, with particular emphasis on sensory and motor block characteristics, postoperative analgesia, rescue analgesic requirement, haemodynamic parameters, patient satisfaction, and adverse events.

Aim:

To compare the efficacy and safety of dexmedetomidine and dexamethasone as adjuvants to ropivacaine in ultrasound-guided supraclavicular brachial plexus block.

Objectives:

1. To compare the onset and duration of sensory and motor blockade and the duration of postoperative analgesia between dexmedetomidine and dexamethasone groups.
2. To compare postoperative pain scores, rescue analgesic requirement, haemodynamic parameters, patient satisfaction, and adverse events between the two groups.

Materials and Methods

Study Design and Setting: This prospective, randomised, double-blind, parallel-group comparative clinical trial was conducted in the Department of Anaesthesiology, Sri Balaji Medical College Hospital and Research Institute, Airport Road, Renigunta, Tirupati, Andhra Pradesh, India.

The study was conducted from January 2025- June 2026, after obtaining approval from the Institutional Ethics Committee of Sri Balaji Medical College Hospital and Research Institute. Written informed consent was obtained from all participants before enrolment.

Sample-Size Justification: The adequacy of the sample size was assessed with reference to published comparative data on dexmedetomidine and dexamethasone used as adjuvants to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block. In a comparable study, the mean sensory-block onset times were 12.8 ± 3.6 minutes with dexmedetomidine and 14.4 ± 3.9 minutes with dexamethasone. Based on this difference, a pooled standard deviation of approximately 3.75 minutes, a two-sided alpha error of 0.05, 80% statistical power, and equal group allocation, approximately 87 patients were required in each group. After allowing approximately 10% for possible failed blocks, exclusions, or incomplete observations, the estimated requirement was approximately 97 patients per group. Accordingly, 100 patients were included in each group, giving a total sample size of 200.

Study Population: A total of 200 adult patients aged 18–65 years, scheduled for elective upper-limb surgery under ultrasound-guided supraclavicular brachial plexus block, were enrolled.

Patients were allocated in a 1:1 ratio to two groups:

- Group D (n=100): 0.5% ropivacaine with dexmedetomidine 1 µg/kg.
- Group X (n=100): 0.5% ropivacaine with dexamethasone 8 mg.

Eligibility Criteria

Patients aged 18–65 years with American Society of Anesthesiologists (ASA) physical status I or II who were scheduled for elective upper-limb surgery suitable for supraclavicular brachial plexus block and who provided written informed consent were included.

Patients were excluded if they declined participation; had known hypersensitivity to any study drug; had coagulopathy or were receiving anticoagulant therapy; had infection at the proposed block site; had pre-existing neurological deficit or peripheral neuropathy involving the operative limb; had significant cardiac, respiratory, hepatic, or renal disease; had uncontrolled diabetes mellitus or hypertension; had chronic

opioid use or chronic pain syndrome; were pregnant or lactating; or had psychiatric or cognitive impairment that could interfere with reliable assessment of study outcomes.

Randomisation, Allocation Concealment and Blinding:

After confirmation of eligibility, patients were randomised using a computer-generated random-number sequence. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes, which were opened only at the time of preparation of the study solution.

Study solutions were prepared by an anaesthesiologist who was not involved in performance of the block or postoperative assessment. The patient, the anaesthesiologist performing the block, and the investigator recording postoperative outcomes remained unaware of treatment allocation.

Participant Flow and CONSORT Reporting:

Participant recruitment, randomisation, allocation, follow-up, and final analysis were documented in accordance with the CONSORT framework. The flow of participants through each stage of the trial, including assessment for eligibility, exclusions before randomisation with reasons, allocation to the dexmedetomidine and dexamethasone groups, follow-up, and final analysis, is summarised in the CONSORT flow diagram (Figure 1).

A total of 200 patients were randomised equally into two groups, with 100 patients allocated to the dexmedetomidine group (Group D) and 100 patients allocated to the dexamethasone group (Group X). All randomised participants received the allocated intervention and were included in the final analysis. No losses to follow-up, treatment discontinuations, or protocol deviations resulting in exclusion were recorded.

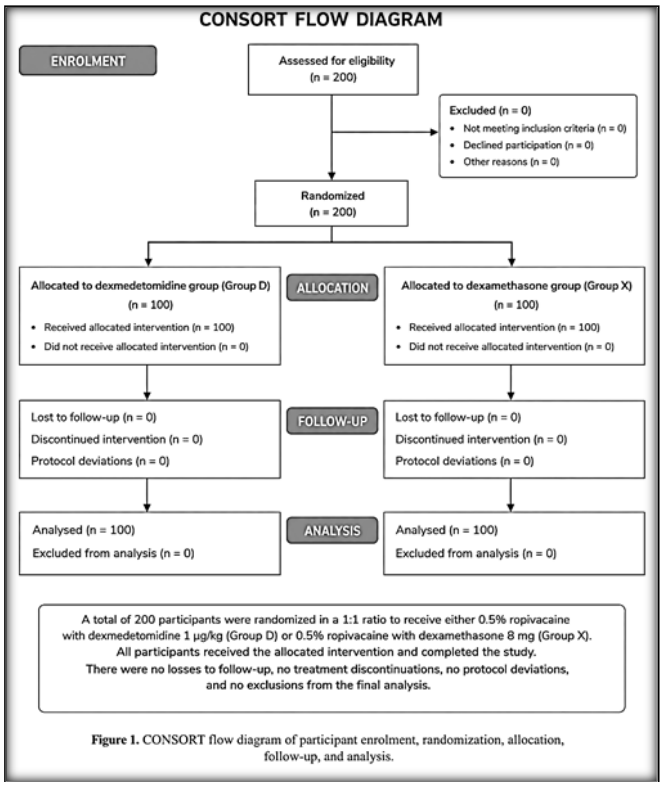
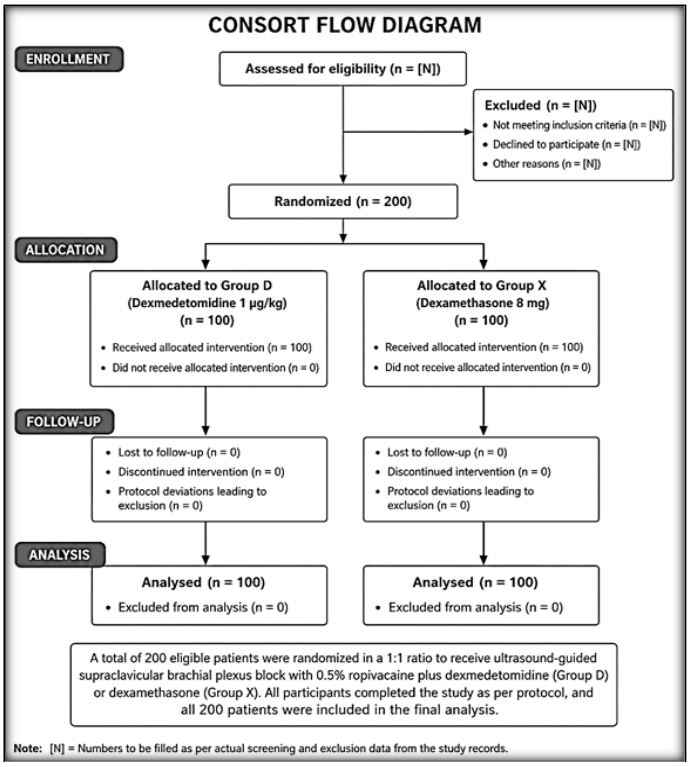


Figure 1. CONSORT flow diagram of participant enrolment, randomization, allocation, follow-up, and analysis.



Study Drug Preparation: Both groups received a final injectate volume of 24 mL. Group D received 0.5% ropivacaine with dexmedetomidine 1 µg/kg, whereas Group X received 0.5% ropivacaine with dexamethasone 8 mg. Sterile normal saline was added as required to maintain an identical final volume and preserve blinding.

Anaesthetic Technique: All patients underwent routine pre-anaesthetic assessment, standard fasting, and counselling regarding the block procedure and postoperative pain assessment. In the operating theatre, electrocardiography, non-invasive blood pressure, heart rate, and peripheral oxygen saturation were monitored, and intravenous access was secured in the contralateral upper limb.

Under aseptic precautions, patients were positioned supine with the operative arm adducted and the head turned contralaterally. A high-frequency linear ultrasound transducer was used to identify the subclavian artery, first rib, pleura, and brachial plexus. The block needle was advanced using an in-plane technique under continuous ultrasound visualisation. After negative aspiration, the 24-mL study solution was administered incrementally in approximately equal aliquots around the upper, middle, and corner-pocket regions of the plexus, with intermittent aspiration and confirmation of satisfactory local anaesthetic spread.

Assessment of Sensory Block: Sensory blockade was assessed every 3 minutes after completion of injection until adequate blockade was achieved or for a maximum of 30 minutes. Sensation was tested in the distributions of the medial cutaneous nerve of the forearm, musculocutaneous, median, ulnar, and radial nerves using cold sensation.

Sensory block was graded as 0 = normal cold sensation, 1 = loss of cold sensation with preserved touch, and 2 = loss of both cold and touch sensation. A total score ≥9/10 was considered

adequate for surgery; a score <9/10 at 30 minutes was considered inadequate.

Sensory block onset was defined as the interval from completion of injection to adequate sensory blockade, and duration as the interval from onset until restoration of normal sensation.

Assessment of Motor Block: Motor blockade was assessed by elbow flexion, thumb opposition, thumb adduction, and thumb abduction. Motor function was graded as 0 = normal power, 1 = paresis/reduced power, and 2 = complete paralysis.

Motor block onset was defined as the interval from completion of injection to adequate motor blockade, while motor block duration was the interval from onset until complete recovery of normal motor function.

Outcome Measures: The primary outcome was duration of postoperative analgesia, defined as the interval from completion of the supraclavicular block to the first requirement for rescue analgesia.

Secondary outcomes included sensory and motor block onset and duration, postoperative Numerical Rating Scale (NRS) pain scores, 24-hour rescue analgesic requirement, perioperative haemodynamic parameters, patient satisfaction, sedation, and other adverse events.

Postoperative Pain Assessment and Rescue Analgesia: Postoperative pain was assessed using an 11-point NRS (0 = no pain; 10 = worst imaginable pain) in the recovery area and at 2, 6, 12, and 24 hours postoperatively.

Rescue analgesia was administered for NRS ≥4 or on patient request using intravenous tramadol 1.5 mg/kg, preceded by ondansetron 4 mg IV. Time to first rescue analgesia was calculated from completion of the block to administration of the first rescue dose.

Cumulative tramadol consumption during the first 24 postoperative hours was recorded in milligrams, and the number of rescue administrations was recorded separately. For categorical outcomes, n (%) represented the number and percentage of patients, not the number of analgesic doses. Additional rescue analgesia was defined as at least one further rescue dose after the initial administration within 24 hours.

Haemodynamic Monitoring and Safety Assessment: Heart rate, non-invasive blood pressure, mean arterial pressure, and peripheral oxygen saturation were monitored throughout the perioperative period.

Patients were observed for bradycardia, hypotension, sedation, postoperative nausea and vomiting, respiratory depression, neurological deficit, vascular puncture, haematoma, local anaesthetic systemic toxicity, and other block-related complications.

Bradycardia was defined as heart rate <50 beats/min and treated with intravenous atropine 0.6 mg when clinically indicated. Hypotension was defined as mean arterial pressure <60 mmHg and managed with intravenous fluids and vasopressors as required. Sedation was assessed using the modified Ramsay Sedation Scale.

Patient Satisfaction: Overall satisfaction with perioperative anaesthesia and postoperative analgesia was assessed on a 0–10 numerical scale, with higher scores indicating greater satisfaction.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation and categorical variables as number and percentage. Normality was assessed using the Shapiro–Wilk test.

Normally distributed continuous variables were compared using the independent-samples Student's t-test and non-normally distributed variables using the Mann–Whitney U test. Categorical variables were analysed using the Chi-square test or Fisher's exact test, as appropriate. Serial postoperative NRS scores and haemodynamic measurements were evaluated using repeated-measures analysis where applicable, with between-group comparisons at predefined assessment intervals.

All tests were two-sided, and $P<0.05$ was considered statistically significant.

RESULTS

A total of 200 patients completed the study and were included in the final analysis, with 100 patients in the dexmedetomidine group (Group D) and 100 patients in the dexamethasone group (Group X). No dropouts or protocol deviations were recorded.

Baseline Characteristics: The two groups were comparable with respect to baseline demographic and perioperative characteristics. There were no statistically significant differences in age, sex distribution, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status, or duration of surgery (all $P>0.05$).

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Group D (n=100)	Group X (n=100)	P value
Age, years	40.6 ± 10.3	41.2 ± 10.7	0.687
Sex, male/female, n	61/39	58/42	0.773
BMI, kg/m²	24.8 ± 2.8	25.1 ± 3.0	0.466
ASA physical status I/II, n	57/43	54/46	0.776
Duration of surgery, min	95.6 ± 18.0	97.1 ± 18.5	0.562

Continuous variables are presented as mean ± SD and categorical variables as number of patients.

Sensory and Motor Block Characteristics: Sensory and motor blockade developed significantly earlier in Group D than in Group X. The mean sensory block onset time was 8.3 ± 1.5 minutes in Group D compared with 9.5 ± 1.6 minutes in Group X ($P<0.001$). Motor block onset was similarly faster with dexmedetomidine (11.7 ± 1.8 vs 13.1 ± 1.9 minutes; $P<0.001$).

The duration of blockade was significantly prolonged with dexmedetomidine. Mean sensory block duration was 825 ± 95 minutes in Group D and 718 ± 92 minutes in Group X,

representing a difference of 107 minutes. Mean motor block duration was 682 ± 86 minutes and 604 ± 82 minutes, respectively, representing a difference of 78 minutes. Both differences were statistically significant (P<0.001).

Table 2: Comparison of Sensory and Motor Block Characteristics

Parameter	Group D (n=100)	Group X (n=100)	P value
Sensory block onset, min	8.3 ± 1.5	9.5 ± 1.6	<0.001
Motor block onset, min	11.7 ± 1.8	13.1 ± 1.9	<0.001
Sensory block duration, min	825 ± 95	718 ± 92	<0.001
Motor block duration, min	682 ± 86	604 ± 82	<0.001

Values are presented as mean ± SD.

Postoperative Analgesic Outcomes: The time to first rescue analgesia was significantly prolonged in Group D compared with Group X (1310 ± 150 vs 1102 ± 145 minutes; P<0.001), corresponding to a mean difference of 208 minutes.

Cumulative intravenous tramadol consumption during the first 24 postoperative hours was significantly lower in Group D than in Group X (57.4 ± 14.8 vs 73.1 ± 16.5 mg; P<0.001).

Additional rescue analgesia during the first 24 postoperative hours was required by 25 patients (25.0%) in Group D compared with 47 patients (47.0%) in Group X (P=0.002).

Table 3: Postoperative Analgesic Outcomes

Parameter	Group D (n=100)	Group X (n=100)	P value
Time to first rescue analgesia, min	1310 ± 150	1102 ± 145	<0.001
Cumulative tramadol consumption during first 24 h, mg	57.4 ± 14.8	73.1 ± 16.5	<0.001
Patients requiring additional rescue analgesia within 24 h, n (%)	25 (25.0)	47 (47.0)	0.002

Values are presented as mean ± SD or n (%), as appropriate. n denotes the number of patients and not the number of rescue analgesic doses.

Postoperative Pain Scores: Postoperative Numerical Rating Scale (NRS) pain scores were significantly lower in Group D at all predefined assessment intervals. The between-group difference was evident in the recovery area and persisted throughout the 24-hour postoperative observation period.

Table 4: Postoperative Numerical Rating Scale Pain Scores

Time point	Group D (n=100)	Group X (n=100)	P value
Recovery room	2.8 ± 0.8	3.4 ± 0.9	<0.001
2 h	2.4 ± 0.7	3.0 ± 0.8	<0.001
6 h	2.1 ± 0.8	2.8 ± 0.8	<0.001
12 h	2.6 ± 0.9	3.3 ± 0.9	<0.001
24 h	2.9 ± 0.8	3.5 ± 0.9	<0.001

Values are presented as mean ± SD. NRS, Numerical Rating Scale.

Perioperative Haemodynamic Parameters: Mean perioperative heart rate was modestly but significantly lower in Group D than in Group X (72.4 ± 7.0 vs 74.7 ± 7.2 beats/min; P=0.023).

Mean arterial pressure was comparable between the groups (84.9 ± 6.6 vs 85.8 ± 6.9 mmHg; P=0.347), as was peripheral oxygen saturation (98.7 ± 0.8% vs 98.6 ± 0.9%; P=0.407).

Table 5: Perioperative Haemodynamic Parameters

Parameter	Group D (n=100)	Group X (n=100)	P value
Mean heart rate, beats/min	72.4 ± 7.0	74.7 ± 7.2	0.023
Mean arterial pressure, mmHg	84.9 ± 6.6	85.8 ± 6.9	0.347
Peripheral oxygen saturation, %	98.7 ± 0.8	98.6 ± 0.9	0.407

Values are presented as mean ± SD.

Patient Satisfaction and Adverse Events: Patient satisfaction was significantly higher in Group D than in Group X (9.2 ± 0.7 vs 8.5 ± 0.8; P<0.001).

Sedation occurred significantly more frequently in Group D, affecting 16 patients (16.0%), compared with 3 patients (3.0%) in Group X (P=0.003).

Bradycardia occurred in 8 patients (8.0%) in Group D and 2 patients (2.0%) in Group X; however, the difference was not statistically significant (P=0.101). There were also no statistically significant differences in hypotension, postoperative nausea and vomiting, or block-related complications between the two groups.

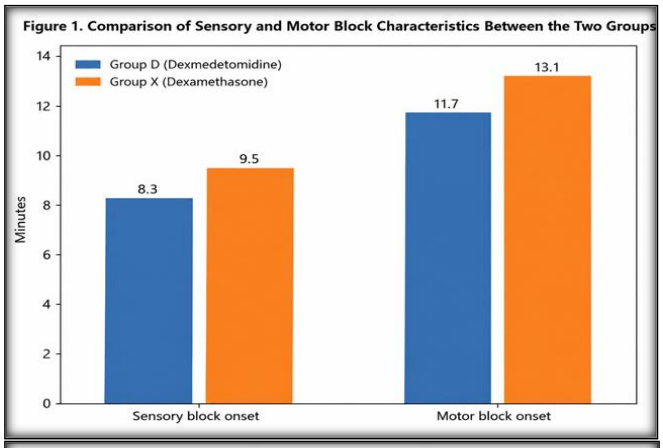
Table 6: Patient Satisfaction and Adverse Events

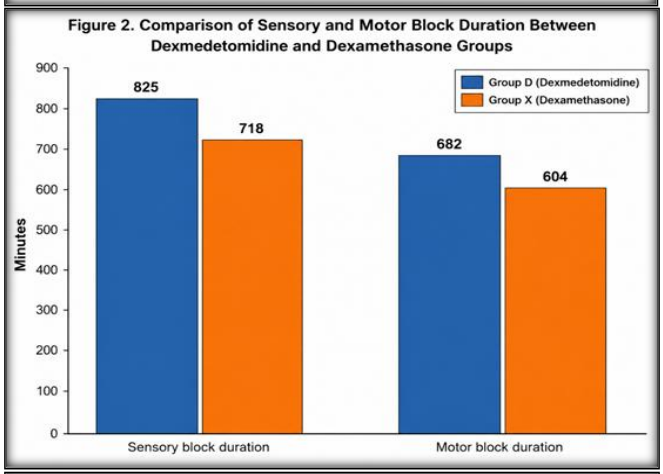
Variable	Group D (n=100)	Group X (n=100)	P value
Patient satisfaction score	9.2 ± 0.7	8.5 ± 0.8	<0.001
Bradycardia, n (%)	8 (8.0)	2 (2.0)	0.101
Hypotension, n (%)	6 (6.0)	4 (4.0)	0.748

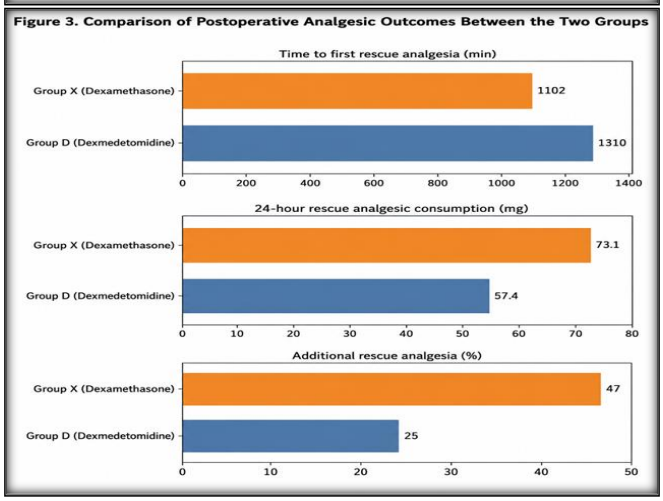
Sedation, n (%)	16 (16.0)	3 (3.0)	0.003
Postoperative nausea and vomiting, n (%)	10 (10.0)	13 (13.0)	0.658
Block-related complications, n (%)	0 (0.0)	2 (2.0)	0.497

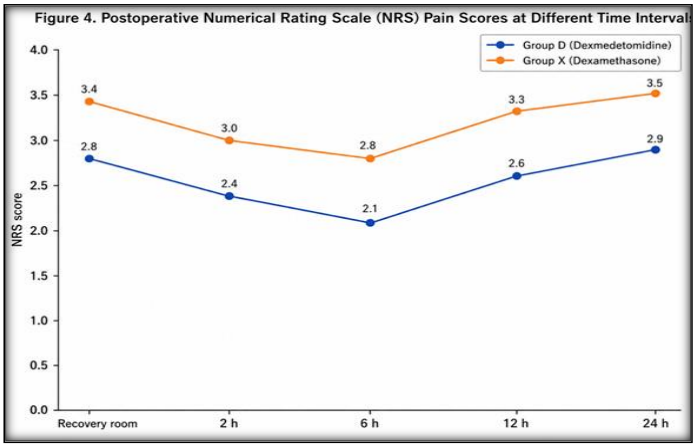
Values are presented as mean ± SD or n (%), as appropriate. n denotes the number of patients.

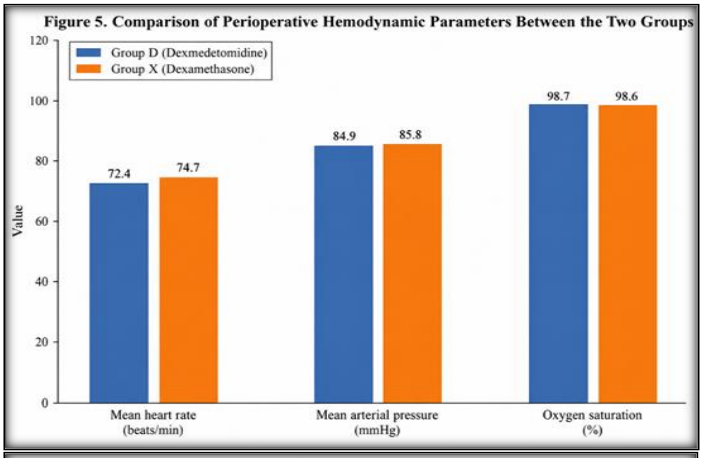
Overall, compared with dexamethasone, dexmedetomidine was associated with faster onset and longer duration of sensory and motor blockade, a longer interval to first rescue analgesia, lower 24-hour rescue analgesic consumption, lower postoperative pain scores, and higher patient satisfaction. Sedation occurred more frequently with dexmedetomidine, while the remaining recorded adverse events were comparable between the two groups.

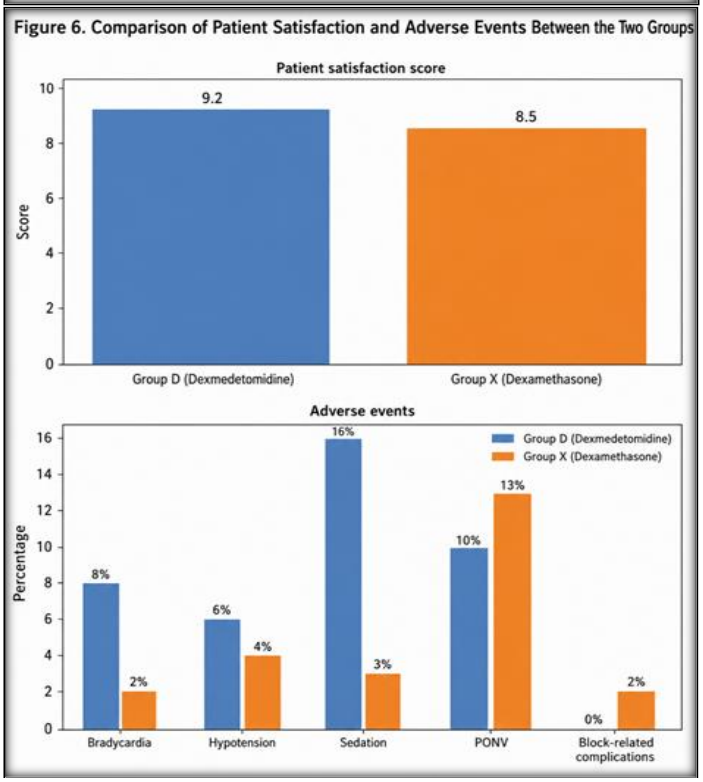












Discussion

The present study compared dexmedetomidine and dexamethasone as adjuvants to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block. Dexmedetomidine was associated with faster sensory and motor block onset, longer sensory and motor blockade, prolonged postoperative analgesia, lower postoperative pain scores and rescue analgesic requirement, and greater patient satisfaction. It was also associated with a modest reduction in heart rate and a higher incidence of sedation, whereas mean arterial pressure, peripheral oxygen saturation, and most other adverse events were comparable. Baseline demographic and perioperative characteristics were similar between groups, reducing the likelihood that major measured baseline differences accounted for the observed treatment effects.

Block Onset: Sensory and motor blockade developed significantly earlier with dexmedetomidine than with dexamethasone (8.3 ± 1.5 vs 9.5 ± 1.6 minutes and 11.7 ± 1.8 vs 13.1 ± 1.9 minutes, respectively; both P<0.001). Similar trends have been reported by Singh et al,[11] Chandran et al,[22] and Ojha et al,[18] although absolute onset times varied considerably among studies. Sudhakar et al,[21] likewise observed numerically faster onset with dexmedetomidine, although the differences were not statistically significant. Collectively, these studies support a tendency towards more rapid establishment of blockade with dexmedetomidine. Variability in absolute onset times may reflect differences in local anaesthetic volume, injection technique, anatomical distribution of injectate, assessment intervals, and definitions of complete blockade.

Duration of Sensory and Motor Blockade: Dexmedetomidine significantly prolonged both sensory blockade (825 ± 95 vs 718 ± 92 minutes) and motor blockade (682 ± 86 vs 604 ± 82 minutes). Comparable prolongation has been reported by Manzoor and Ara,[13] Garg et al.,[15] Chandran et al.,[22] and Sudhakar et al,[21] Garg et al., for example, demonstrated longer sensory and motor blockade with dexmedetomidine, while Chandran et al. reported the same direction of effect using the same adjuvant doses.

Published findings are nevertheless not completely concordant. Ojha et al,[18] reported longer sensory and motor blockade with dexamethasone despite faster onset with dexmedetomidine. Such differences emphasise that the relative effects of these adjuvants may depend on local anaesthetic concentration and volume, adjuvant dose, block technique, operative setting, and definitions of block duration. The present results therefore support prolonged blockade with dexmedetomidine under the protocol studied rather than universal superiority across all clinical settings.

Postoperative Analgesia and Rescue Analgesic Requirement: Duration of postoperative analgesia was the primary outcome. Time to first rescue analgesia was prolonged by approximately 208 minutes with dexmedetomidine (1310 ± 150 vs 1102 ± 145 minutes; P<0.001). Similar findings were reported by Manzoor and Ara,[13] Garg et al,[15] and Sudhakar et al,[21] with the latter reporting analgesia lasting 20.2 ± 2.8 hours with dexmedetomidine compared with 17.3 ± 3.1 hours with dexamethasone.

Conversely, Venkatraman et al,[12] and Ojha et al,[18] reported longer postoperative analgesia with dexamethasone. These contrasting observations are likely related to differences in drug dose and route, local anaesthetic regimen, anatomical block approach, surgical procedure, definition of analgesic duration, pain-assessment schedule, and rescue-analgesic protocol.

In the present study, cumulative 24-hour intravenous tramadol consumption was also lower with dexmedetomidine (57.4 ± 14.8 vs 73.1 ± 16.5 mg; P<0.001), and fewer patients required additional rescue analgesia (25.0% vs 47.0%; P=0.002). Garg et al,[15] and Sudhakar et al,[21] similarly demonstrated reduced postoperative rescue-analgesic requirement with dexmedetomidine. Direct comparison of absolute consumption across studies should, however, be interpreted cautiously because different rescue agents, doses, administration thresholds, and reporting methods have been used.

Postoperative Pain Scores: Postoperative NRS scores were consistently lower with dexmedetomidine throughout the 24-hour assessment period, including recovery and 2-, 6-, 12-, and 24-hour measurements. The lowest scores occurred around 6 hours in both groups, followed by a gradual increase. Chandran et al,[22] and Sudhakar et al,[21] also reported lower postoperative pain scores during periods corresponding to prolonged blockade with dexmedetomidine. The concordance between longer sensory blockade, delayed first rescue analgesia, reduced tramadol requirement, and lower NRS scores supports the internal clinical consistency of the analgesic findings.

Haemodynamic Effects and Adverse Events: Mean heart rate was modestly lower with dexmedetomidine (72.4 ± 7.0 vs 74.7 ± 7.2 beats/min; P=0.023), consistent with its sympatholytic α2-adrenergic action. Mean arterial pressure and peripheral oxygen saturation remained comparable, suggesting overall haemodynamic stability.

Ojha et al,[18] reported higher incidences of bradycardia and hypotension with dexmedetomidine, whereas Sudhakar et al,[21] observed lower heart rate and blood pressure without significant between-group haemodynamic differences. Variability across studies may relate to dexmedetomidine dose, baseline patient characteristics, definitions of haemodynamic adverse events, concomitant medication, perioperative fluid management, and timing of measurements.

Sedation was the most prominent adverse-effect difference in the present study, occurring in 16.0% of patients receiving dexmedetomidine compared with 3.0% receiving dexamethasone (P=0.003). Ojha et al,[18] likewise reported greater sedation with dexmedetomidine, and Singh et al,[11] observed a similar tendency. Bradycardia, hypotension, postoperative nausea and vomiting, and block-related complications did not differ significantly between groups. These observations suggest that sedation is a clinically relevant and relatively reproducible effect of dexmedetomidine, although its incidence varies with dose and study methodology. Appropriate haemodynamic and sedation monitoring therefore remains important.

Patient Satisfaction and Overall Interpretation: Patient satisfaction was significantly higher with dexmedetomidine (9.2

± 0.7 vs 8.5 ± 0.8; P<0.001). This may reflect faster establishment of adequate blockade, longer postoperative analgesia, lower pain scores, and reduced need for rescue medication. However, satisfaction is multifactorial, and Manzoor and Ara,[13] reported comparable satisfaction between groups despite longer analgesia with dexmedetomidine.

Overall, the findings are consistent with several comparative studies demonstrating advantages of dexmedetomidine in one or more aspects of block onset, duration, postoperative analgesia, pain control, and analgesic requirement.[11,13,15,21,22] At the same time, evidence favouring dexamethasone in some studies.[12,18] demonstrates genuine heterogeneity and argues against claiming absolute pharmacological superiority.

Under the conditions evaluated, dexmedetomidine provided a favourable efficacy profile characterised by faster block onset, prolonged sensory and motor blockade, longer postoperative analgesia, lower postoperative pain scores, reduced rescue analgesic requirement, and greater patient satisfaction. These benefits were accompanied by greater sedation and a modest reduction in heart rate. The choice between dexmedetomidine and dexamethasone should therefore be individualised according to patient characteristics, surgical requirements, desired duration of analgesia, and susceptibility to α2-agonist-related sedation and sympatholytic effects.

Strengths

- Prospective, randomised, double-blind comparative design with 200 patients equally allocated between groups.
- Uniform ropivacaine concentration, injectate volume, and ultrasound-guided supraclavicular block technique.
- Evaluation of multiple clinically relevant outcomes, including block characteristics, postoperative analgesia, NRS scores, rescue analgesic requirement, haemodynamics, patient satisfaction, and adverse events.
- Comparable baseline demographic and perioperative characteristics between groups.

Limitations

- Single-centre design may limit generalisability.
- Sample size may be insufficient to detect uncommon adverse events.
- Dexmedetomidine was weight-based, whereas dexamethasone was given as a fixed dose; the regimens were not pharmacologically dose-equivalent.
- Variability in upper-limb surgical procedures may have influenced postoperative pain and analgesic requirement.
- Follow-up was limited to 24 hours, preventing assessment of rebound pain, delayed neurological effects, and longer-term functional recovery.
- Plasma drug concentrations were not measured; therefore, local versus systemic contributions to analgesic prolongation could not be determined.

Future Directions

- Larger multicentrerandomised controlled trials with more diverse populations.
- Evaluation of different adjuvant doses using standardised local anaesthetic concentrations and volumes.
- Longer follow-up to assess rebound pain, functional recovery, delayed neurological effects, and uncommon adverse events.
- Direct comparison of perineural versus intravenous administration.
- Inclusion of quality-of-recovery, mobilisation, opioid-sparing effect, cost-effectiveness, and patient-reported outcomes.

Conclusion

In this prospective randomised double-blind comparative trial, dexmedetomidine used as an adjuvant to 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block was associated with significantly faster sensory and motor block onset and longer sensory and motor block duration than dexamethasone.

Dexmedetomidine also prolonged the time to first rescue analgesia, reduced cumulative 24-hour tramadol requirement, produced lower postoperative NRS pain scores, and was associated with higher patient satisfaction.

Both groups demonstrated generally stable perioperative haemodynamic profiles. Dexmedetomidine produced a modest reduction in heart rate and a significantly higher incidence of sedation, while differences in bradycardia, hypotension, postoperative nausea and vomiting, and block-related complications were not statistically significant.

Under the protocol evaluated, dexmedetomidine therefore provided a favourable efficacy profile when prolonged regional anaesthesia and postoperative analgesia were desired. The choice between dexmedetomidine and dexamethasone should nevertheless be individualised according to patient characteristics, surgical requirements, and the clinical relevance of sedation and sympatholytic effects.

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Conflicts of interest

There are no conflicts of interest.

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