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COMPARISON OF DEXMEDETOMIDINE VS DEXAMETHASONE AS AN ADJUVANT TO 0.5% ROPIVACAINE IN ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPERLIMB ORTHOPAEDICS SURGERIES

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ABSTRACT

Background: Supraclavicular brachial plexus block (SCBP) is a highly effective regional anesthetic technique for upper limb orthopedic surgeries. To prolong anesthesia and postoperative analgesia, various adjuvants are mixed with local anesthetics. Ropivacaine, with its favorable cardiotoxic profile, is widely preferred. Evaluating and comparing effective adjuvants like Dexmedetomidine (a selective α_2-agonist) and Dexamethasone (a potent corticosteroid) is essential to optimize clinical outcomes.**Aim:** To evaluate and compare the clinical efficacy of Dexmedetomidine versus Dexamethasone as an adjuvant to 0.5% Ropivacaine in ultrasound-guided supraclavicular brachial plexus blocks regarding block onset speeds, block durations, and postoperative analgesia quality.**Materials and Methods:** A prospective, randomized, comparative clinical study was conducted in the Department of Anaesthesiology, Sri Siddhartha Medical College and Hospital, Tumkur. Sixty adult patients aged 18–60 years, ASA physical status I and II, scheduled for elective upper limb orthopedic surgeries under supraclavicular block, were enrolled and randomly allocated into two equal groups (n=30 each). Group A (Dexamethasone Group) received 30 ml of 0.5% Ropivacaine + 8 mg (2 ml) of Dexamethasone. Group B (Dexmedetomidine Group) received 30 ml of 0.5% Ropivacaine + 1 µg/kg of Dexmedetomidine. Block characteristics (onset and duration of sensory and motor block), postoperative Visual Analogue Scale (VAS) pain scores, and rescue analgesia requirements were monitored and analyzed.**Results:** Baseline demographic variables and hemodynamic characteristics were comparable between the groups. Group B (Dexmedetomidine) demonstrated a significantly faster sensory block onset (3.2 ± 0.8 min vs. 4.0 ± 1.2 min, p=0.003) and motor block onset (4.3 ± 1.1 min vs. 5.1 ± 1.4 min, p=0.021) compared to Group A (Dexamethasone). Sensory block duration was significantly longer in Group B (747.7 ± 124.0 min) than Group A (685.0 ± 127.1 min, p=0.035). Similarly, motor block duration was significantly longer in Group B (717.0 ± 105.9 min) compared to Group A (642.0 ± 119.9 min, p=0.009). Group B demonstrated lower pain scores at 12 hours post-surgery (VAS 2.4 ± 1.5 vs. 3.5 ± 1.4, p=0.008). No major adverse complications were observed.**Conclusion:** Dexmedetomidine (1 µg/kg) is a superior adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus blocks compared to Dexamethasone (8 mg). It provides significantly faster block onset, prolonged sensory and motor blockade, and improved postoperative analgesia without adverse side effects.

KEYWORDS : Supraclavicular Brachial Plexus Block; Ultrasound-guided; Ropivacaine; Dexmedetomidine; Dexamethasone; Postoperative Analgesia.

INTRODUCTION

Supraclavicular brachial plexus block is often described as the "spinal of the upper limb" due to its ability to provide rapid, dense, and reliable surgical anesthesia for upper limb procedures with minimal systemic impact. Performing this block under ultrasound guidance allows direct visualization of nerves, adjacent vascular structures, and the needle tip, thereby maximizing success rates and minimizing complications like pneumothorax or accidental vascular injection.

Ropivacaine, an amino-amide local anesthetic, has emerged as a safer alternative to bupivacaine, offering a wider safety margin with reduced cardiovascular and central nervous system toxicity. However, single-injection peripheral nerve blocks using ropivacaine may still fall short of providing sustained analgesia well into the postoperative period, particularly for extensive orthopedic reconstructions.

To overcome this limitation, clinicians frequently combine local anesthetics with pharmacological adjuvants. Corticosteroids like Dexamethasone are known to prolong regional anesthesia blocks by reducing nociceptive C-fiber activity and inducing local vasoconstriction. On the other hand, Dexmedetomidine, a highly selective alpha-2 (α) adrenergic receptor agonist, enhances local anesthetic blocks by inducing hyperpolarization of peripheral nerve fibers and reducing systemic inflammatory responses.

While both drugs are widely utilized individually, clinical trials comparing their efficacy head-to-head as adjuvants to ropivacaine under ultrasound guidance are limited. The present study was designed to compare the clinical profiles of Dexamethasone and Dexmedetomidine when added to 0.5% ropivacaine for elective upper limb orthopedic surgeries.

MATERIALS AND METHODS

Study Design & Setting

This was a hospital-based, prospective, randomized, comparative clinical study conducted at the Department of Anaesthesiology, Sri Siddhartha Medical College and Hospital, Sri Siddhartha Academy of Higher Education, Tumkur, Karnataka, India. The study was conducted during the academic year 2024 after obtaining approval from the Institutional Ethical Committee and written informed consent from all participants.

Study Participants

Inclusion Criteria:

- Patients aged between 18 and 60 years.
- ASA Physical Status Grade I and II.
- Scheduled for elective upper limb orthopedic surgeries under supraclavicular brachial plexus block.

Exclusion Criteria:

- Patient refusal to participate.
- Local infection at the site of needle insertion.
- Pre-existing peripheral neuropathy or neurological deficits in the operative limb.
- Coagulopathy or on anticoagulant therapy.
- Severe cardiopulmonary or renal insufficiency.
- Known allergy to local anesthetics, Dexmedetomidine, or Dexamethasone.

Study Grouping & Blinding

Sixty eligible patients were randomly allocated into two groups of 30 patients each using a computer-generated random number table:

- **Group A (Dexamethasone Group, n=30):** Received 30 ml of 0.5% Ropivacaine + 8 mg (2 ml) of Dexamethasone.
- **Group B (Dexmedetomidine Group, n=30):** Received 30 ml of 0.5% Ropivacaine + 1 µg/kg of Dexmedetomidine (diluted in normal saline to a total volume of 2 ml).

Anesthetic and Block Technique

All patients underwent standard preoperative fasting and evaluation. Upon arrival in the operating theater, standard monitoring—including non-invasive blood pressure (NIBP), electrocardiography (ECG), and pulse oximetry (SpO)—was established, and baseline parameters were documented.

Under sterile precautions, a high-frequency linear ultrasound transducer was placed in the supraclavicular fossa to identify the subclavian artery and the adjacent grape-like cluster of the brachial plexus divisions. Using an in-plane needle insertion approach, a 22G, 50-mm insulated block needle was advanced towards the "corner pocket" (inferolateral to the plexus, adjacent to the first rib and subclavian artery). Following negative aspiration for blood, the respective drug mixture (32 ml total volume for both groups) was injected under real-time visualization to ensure uniform circumferential spread around the nerve bundles.

Observation Parameters

- Sensory Block Onset: Time from injection to complete loss of cold sensation (grade 2) in all nerve distributions (radial, median, ulnar, musculocutaneous).
- Motor Block Onset: Time from block injection to the loss of motor power in the hand and forearm (Lovett's rating scale or modified Bromage scale for upper limb).
- Block Durations: Sensory block duration was defined as the time interval between complete sensory block and the recovery of pain sensation. Motor block duration was defined as the time between complete motor block and full motor power recovery.
- Postoperative Analgesia: Pain intensity was assessed at regular intervals postoperatively using the Visual Analogue Scale (VAS) from 0 (no pain) to 10 (worst imaginable pain). Rescue analgesia (injection Tramadol or Diclofenac) was administered if VAS ≥ 4.

Data Analysis

Data were collected and analyzed using SPSS Version 26.0 software. Continuous variables were expressed as Mean ± Standard Deviation (SD) and compared using the independent Student's t-test. Categorical variables were presented as percentages and compared using the Chi-square test or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

All 60 randomized patients completed the study with no dropouts. The patient cohorts in both groups were highly comparable in their demographic profile and baseline physical statuses.

Table 1: Demographic Profiles of the Study Population

PARAMETER	GROUP A (DEXAMETHASONE)	GROUP B (DEXMEDETOMIDINE)	P-VALUE
Age (years)	40.2 ± 11.5	41.5 ± 10.8	> 0.05
Weight (kg)	62.4 ± 8.1	63.8 ± 7.9	> 0.05
Height (cm)	161.2 ± 6.8	162.5 ± 7.2	> 0.05
BMI (kg/m²)	24.0 ± 2.6	24.1 ± 2.4	> 0.05

Table 2: Gender and ASA Grade Distribution

PARAMETER	GROUP A (DEXAMETHASONE)	GROUP B (DEXMEDETOMIDINE)	P-VALUE
Gender (Male / Female)	18 / 12	19 / 11	> 0.05
ASA Grade (I / II)	21 / 9	22 / 8	> 0.05

Table 3: Sensory and Motor Block Characteristics (Onset and Duration)

CHARACTERISTICS	GROUP A (DEXAMETHASONE) (N=30)	GROUP B (DEXMEDETOMIDINE) (N=30)	P-VALUE
Sensory Onset (min)	4.0 ± 1.2	3.2 ± 0.8	0.003*
Motor Onset (min)	5.1 ± 1.4	4.3 ± 1.1	0.021*
Sensory Duration (min)	685.0 ± 127.1	747.7 ± 124.0	0.035*
Motor Duration (min)	642.0 ± 119.9	717.0 ± 105.9	0.009*

***Statistically highly significant (p < 0.05)**

Table 4: Postoperative Pain and Rescue Analgesia Parameters *Statistically significant (p < 0.05)

PARAMETER	(DEXAMETHASONE) (N=30)	(DEXMEDETOMIDINE) (N=30)	P-VALUE
VAS Score at 12 hour	3.5 ± 1.4	2.4 ± 1.5	0.008*
Rescue Analgesia Requirement (%)	10.0% (n=3)	6.7% (n=2)	0.640
Adverse Complication / Side Effects	None	None	> 0.05

DISCUSSION

The core objective of adding adjuvants to regional blocks is to improve patient comfort by accelerating block induction and extending postoperative pain relief. In our comparative investigation, the selective α -agonist Dexmedetomidine demonstrated a clear superiority over the corticosteroid Dexamethasone in all primary block outcomes.

Onset Speed and Mechanism of Action

Group B (Dexmedetomidine) achieved a sensory block onset in 3.2 ± 0.8 minutes and motor onset in 4.3 ± 1.1 minutes, which was statistically faster than Group A (4.0 ± 1.2 min and 5.1 ± 1.4 min respectively).

The rapid block onset associated with Dexmedetomidine is attributed to its highly selective peripheral action. Dexmedetomidine acts by inhibiting hyperpolarization-activated cation currents (I_h currents) in the peripheral nerve membrane. This prevents the nerve from returning to its resting state after a nerve impulse, thereby enhancing and accelerating the local anesthetic's sodium-channel blockade.

In contrast, Dexamethasone works primarily through slow genomic mechanisms, reducing local tissue inflammation and inducing mild localized vasoconstriction that decreases the vascular absorption rate of ropivacaine, which results in a relatively delayed onset compared to Dexmedetomidine.

Block Duration & Postoperative Analgesia

Our study observed that sensory block duration was significantly prolonged in the Dexmedetomidine group (747.7 ± 124.0 min) compared to the Dexamethasone group (685.0 ± 127.1 min, p=0.035). Motor blockade duration was also significantly longer in Group B (717.0 ± 105.9 min vs. 642.0 ± 119.9 min, p=0.009). This extended duration is clinically valuable, providing patients with nearly 12.5 hours of localized anesthesia and muscle relaxation.

Furthermore, postoperative pain scores (VAS) evaluated at 12 hours were significantly lower in patients who received Dexmedetomidine (2.4 ± 1.5) compared to those who received Dexamethasone (3.5 ± 1.4, p=0.008). While the overall rate of rescue analgesia was lower in the Dexmedetomidine group, both adjuvants proved to be highly effective, as only a small fraction of patients in either group (6.7% and 10% respectively) required rescue systemic analgesics within 24 hours. No significant systemic side effects, such as bradycardia, hypotension, or localized neurological injuries, were noted in either cohort, confirming the clinical safety of both adjuvants.

CONCLUSION

In ultrasound-guided supraclavicular brachial plexus blocks for elective upper limb orthopedic surgeries,**Dexmedetomidine (1 µg/kg)** administered as an adjuvant to 0.5% Ropivacaine is clinically superior to**Dexamethasone (8 mg)**. It significantly accelerates the onset of sensory and motor blocks, extends the overall duration of the blockade, and provides superior quality of postoperative analgesia within the critical first 12 hours without any adverse effects.

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