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Original Research Article

Dexmedetomidine and Clonidine as an Adjunct to Ropivacaine in Supraclavicular Brachial Plexus Block: A Randomized Controlled Study

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Abstract

Background & Aim: Many clinical investigations have demonstrated that clonidine extends sensory motor blockade when utilized as an adjunct to ropivacaine, albeit with certain limitations. Our aim was to assess the impact of clonidine and dexmedetomidine on ropivacaine for supraclavicular brachial plexus blockade.

Methods: In a prospective randomized double-blind study, ultrasound-guided supraclavicular brachial plexus blockade was conducted in 100 patients employing clonidine and dexmedetomidine alongside ropivacaine. Group C received 1 µg/kg of clonidine (1 ml) along with 30 ml of ropivacaine (0.5%), while Group D was administered 1 µg/kg of dexmedetomidine (1 ml) along with the same volume of ropivacaine. Sensory and motor block was evaluated every 5 minutes for the first 30 minutes and subsequently at 15-minute intervals.

Results: The average sensory onset time for group D was 2.35 ± 1.8 minutes, while for group C it was 3.94 ± 1.68 minutes, demonstrating statistical significance. Patients in group D had a mean motor onset time of 4.14 ± 1.75 minutes, whereas those in group C demonstrated a mean motor onset time of 7.62 ± 1.39 minutes, with the disparity being statistically significant. The average length of sensory block in group D was 602.34 ± 55.6 minutes, while in group C it was 492.34 ± 65.18 minutes, a statistically significant difference. Patients in group D experienced an average motor block duration of 474.25 ± 54.6 minutes, while those in group C had a mean duration of 375.63 ± 61.9 minutes, a difference that was statistically significant.

Conclusion: Dexmedetomidine when added to ropivacaine increases the duration of motor and sensory block in brachial plexus blockade compared to clonidine.

Keywords: Ropivacaine, Clonidine, Brachial Plexus, Dexmedetomidine.

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Introduction

The brachial plexus block offers intraoperative anaesthesia and postoperative analgesia without systemic side effects.[1] Ropivacaine, possessing lower lipid solubility, has demonstrated reduced central nervous system and cardiotoxicity compared to bupivacaine, leading to its increasing preference for peripheral nerve blocks.[2] The quest for the ideal adjuvant to local anaesthetics for regional nerve blocks continues, aiming to extend analgesia while minimizing adverse effects.[3] This study was designed to assess the impact of incorporating clonidine and dexmedetomidine into ropivacaine on sensory and motor attributes in supraclavicular brachial plexus block.

Methods

Upon receiving authorization from the local institutional ethics committee, we executed this research in a tertiary care facility from April 2024 to September 2025. A total of 100 patients classified as American Society of Anaesthesiologists (ASA) grade I or II, scheduled for hand or forearm surgery, were enlisted in a prospective randomized, double-blind trial. Exclusion criteria included individuals under 18 years or over 60 years of age, those on anticoagulant therapy, patients with a history of hypertension, peripheral neuropathy, and intolerance to local anaesthetics. The specifics of the anaesthetic method and the research protocol were thoroughly elucidated to patients during the preanesthetic evaluation, and informed written consent was secured from every subject. Pertinent inquiries were conducted as necessary. Prior to the intervention, a visual analogue scale (VAS) [4] measuring 0-10 cm was explained to patients where 0 signifies no pain and 10 represents the most severe pain. Patients were randomly assigned using a computer-generated randomization list and

categorized into two groups, C and D. Group C (n=50) - ropivacaine 0.5% (30 ml) combined with 1 µg/kg clonidine (1 ml). Group D (n=40) - 0.5% ropivacaine (30 ml) combined with 1 µg/kg dexmedetomidine (1ml).

The anaesthesiologist, who was not participating in the experiment, prepared the study medications. Upon entering the operating room, baseline heart rate, blood pressure, and oxygen saturation were documented and continuously observed during the surgery. An intravenous catheter was established, and Ringer's lactate infusion commenced. All patients underwent brachial plexus block by the ultrasound-guided supraclavicular technique administered by a skilled anaesthesiologist. After negative aspiration, 31ml of ropivacaine was administered in conjunction with either clonidine or dexmedetomidine. The pin prick technique was utilized to evaluate sensory block.

Evaluation of sensory blockade was conducted every 5 minutes following the conclusion of drug administration in the dermatomal regions associated with the median, radial, ulnar, and musculocutaneous nerves until total sensory blockade was achieved. Sensory onset was deemed present when a dull feeling to a pinprick with a 23G needle was noted along the territory of any of the aforementioned nerves. Total sensory blockade was defined by an absolute absence of sensation to a pin prick. The sensory blockade was classified as follows: Grade 0: Sharp pin perceived, Grade 1: Analgesia with dull sensation perceived, Grade 2: Anaesthesia with no sensation perceived.[5] Evaluation of motor blockade was conducted by the same examiner every 5 minutes until total motor blockade was achieved post-drug administration. The initiation of motor blockage was deemed to occur at Grade 1 motor blockade. Peak motor blockage was defined as the occurrence of Grade 2 motor impairment.

The motor block was assessed using a revised Bromage scale [6] for the upper limbs on a three-point scale. 0 − normal motor function with full extension and flexion of the elbow, wrist, and fingers; 1 − diminished motor strength, permitting movement solely of the fingers; 2 – total motor blockade with an inability to move the elbow, wrist, and fingers.

The blockade was deemed incomplete if any segments innervated by the median, radial, ulnar, and musculocutaneous nerves exhibited analgesia after 30 minutes post-drug administration. These individuals received intravenous fentanyl (1 µg/kg) and midazolam (0.02 mg/kg) as supplementation. If multiple nerves were still functional, it was deemed an unsuccessful block. In this instance, general anaesthesia was administered. Patients were observed for hemodynamic parameters including heart rate, blood pressure, and oxygen saturation every 15 minutes during the procedure and every 60 minutes after surgery. The Ramsay Sedation Score [7] was utilized to evaluate the patient's sedation level. Evaluation of blood loss was conducted, and fluids were provided in accordance with the extent of loss. The evaluation during and after the operation was conducted by an anaesthesiologist who was oblivious to the medication administered. Patients were evaluated for the length of analgesia using a visual analogue scale ranging from 0 to 10. The visual analogue scale was documented every 30 minutes after the operation until a score of 5 was reached. The analgesic for rescue was administered as IV paracetamol at a visual analogue scale rating of 5. All patients were monitored for side effects such as sedation, nausea, vomiting, xerostomia, and complications including pneumothorax, hematoma, and local anaesthetic toxicity.

The duration of sensory blockade was characterized as the time span from the cessation of local anaesthetic delivery to the total resolution of anaesthesia across all nerves. The length of motor blockade was characterized as the period from the cessation of local anaesthetic delivery to the restoration of full motor capability in the hand and forearm. The sample size was determined based on a preliminary investigation including 10 patients per group. To identify a clinically meaningful disparity between the two cohorts (1.8 ± 2) minutes in the initiation of motor block at a 95% significance level and 80% power, a sample size of 45 individuals per group was necessary. To compensate for attrition rate, 50 patients from each group were incorporated into the study. Results are shown as mean ± standard deviation. An unpaired t-test was utilized for demographic data and hemodynamic measures. The commencement and length of sensory and motor blockage, as well as the duration of analgesia, were evaluated using the Chi-square test. Statistical evaluation was conducted using SPSS (version 21). The P-value was deemed significant if it was less than 0.05.

Results

There was no statistically meaningful disparity among the variables such as age, sex, height, weight, ASA grade, and surgical duration. (Table 1)

Table 1: Allocation of subjects based on demographic characteristics

Variables	Group C (Mean ±SD)	Group D (Mean ±SD)	P value
Age (year)	36.65±17.84	38.53±9.36	0.214
Sex ratio (M/F)	40/10	40/10	0.243
Weight (kg)	64.4±10.52	63.2±11.34	0.295
Height (cm)	161.21±12.32	165.35±12.28	0.124
ASA Grade (I/II)	36/14	40/10	0.121
Duration of Surgery (min)	99.63±25.44	98.81±26.62	0.137

No significant variation was observed in the hemodynamic metrics (mean heart rate, mean arterial pressure, oxygen saturation) prior to and following the administration of the block, during the surgical procedure and in the postoperative period.

Table 2: Attributes of sensory and motor blockade in group D and group C

Parameters	Group D (Mean ±SD)	Group C (Mean ±SD)	P value
Onset of sensory block (min)	2.35 ± 1.8	3.94 ± 1.68	0.003
Onset of motor block (min)	4.14 ± 1.75	7.62 ± 1.39	0.011
Duration of sensory block (min)	602.34 ± 55.6	492.34 ± 65.18	0.047
Duration of motor block (min)	474.25 ± 54.6	375.63 ± 61.9	0.019
Duration of analgesia (min)	690±51.54	562.7±62.15	0.114

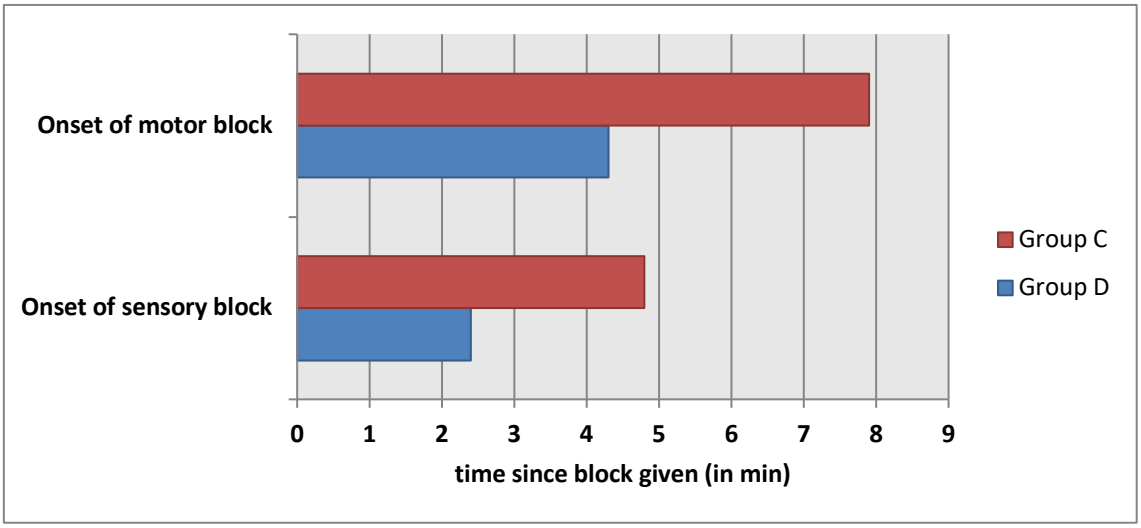

Figure 1: Comparison between Group D and Group C for time of onset for sensory and motor block.

Figure 1 illustrates the comparison of onset times for sensory and motor block between Group D and Group C. The initiation of block occurred sooner in group D patients, with a sensory block time of 2.35 ± 1.8minutes and a motor block time of 4.14 ± 1.75minutes, compared to group C, which had 3.94 ± 1.68minutes for sensory block and 7.62 ± 1.39minutes for motor block, a difference that was statistically significant ($P < 0.05$)(table 2)(figure 1).

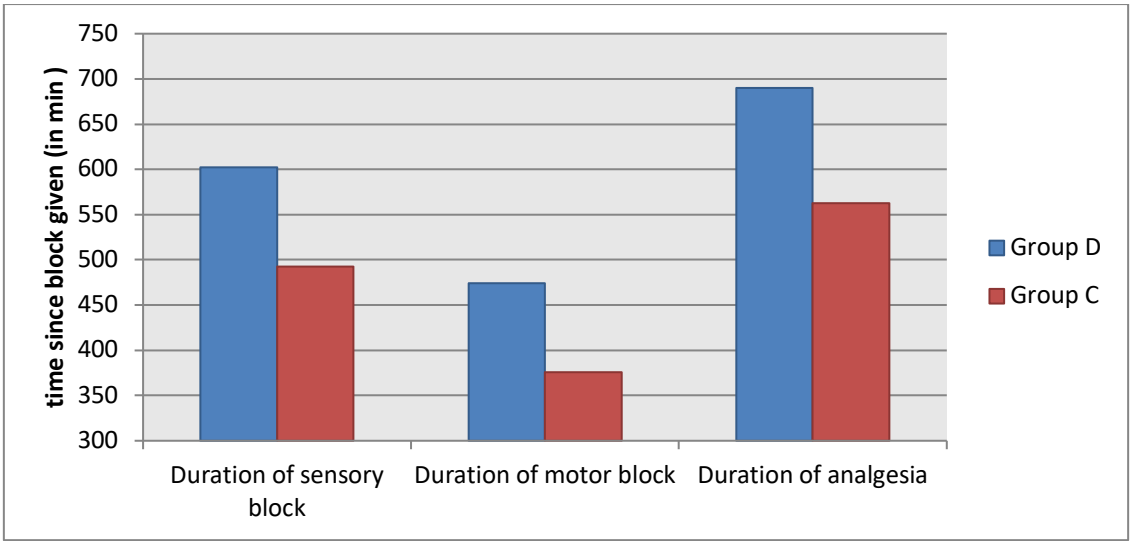

Figure 2: Comparison between Group D and Group C for duration of sensory, motor block and analgesia

Figure 2 illustrates the comparison between Group D and Group C regarding the duration of sensory, motor block, and analgesia.

The average length of sensory block in group D was 602.34 ± 55.6minutes, while in group C it was 492.34 ± 65.18minutes. Patients in group D exhibited a mean motor block duration of 474.25 ± 54.6minutes, while group C demonstrated a mean duration of 375.63 ± 61.9minutes, a difference that was statistically significant. (Table 2) (Figure 2) Postoperative analgesia persisted for 690±51.54 minutes in group D and 562.7±62.15minutes in group C, with this difference also being statistically significant ($P<0.05$).

Discussion

The analgesic effects of clonidine, when given intrathecally or epidurally as an adjunct, have been clearly established. Its influence on the numerous α2 receptors located in the central nervous system, particularly in the locus coeruleus and the dorsal horn of the spinal cord, constitutes the primary mechanism for centrally mediated sedation and analgesia. Our research indicates that the incorporation of dexmedetomidine markedly reduced the time to achieve sensory and motor blockade. Waindeskar V et al.[8] concluded that the addition of dexmedetomidine to levobupivacaine in ultrasound-guided blocks significantly reduces the onset time and extends the duration of sensory and motor blocks, as well as postoperative analgesia. This finding aligns with the observations of Kathuria et al.[9] and Das et al.,[10] who noted that the onset of both sensory and motor blocks occurred earlier in the dexmedetomidine group, although the differences were not statistically significant. Murphy et al. also contributed to this discussion. [11]. MaCartney et al [12] examined randomized trials that assessed the efficacy of various adjuvants, such as clonidine combined with local anaesthetics for brachial plexus blockade.

Based on data from six trials involving 349 patients, it was determined that clonidine, administered in doses up to 150 µg, prolonged postoperative analgesia with negligible side effects. They determined that clonidine was advantageous solely when used with intermediate-acting local anaesthetics. Antonucci S et al [13] assessed the impact of tramadol as an adjunct in brachial plexus block and contrasted it with clonidine and sufentanil.

He employed ropivacaine for the blockade and determined that tramadol as an adjunct yields a substantial decrease in the onset time of sensory motor block, while also extending the duration of anaesthesia and analgesia, achieving a block quality comparable to that of clonidine and sufentanil. El Saied et al.[14] conducted a study involving axillary brachial plexus blockade in 50 patients, utilizing 40 ml of 0.75% ropivacaine. Group (A) received 150 µg of clonidine, while Group (B) was administered 1 ml of normal saline in conjunction with the local anaesthetic. There was no variation in the initiation of sensory motor blockage. They determined that incorporating 150 µg of clonidine with ropivacaine for brachial plexus blockage extends both motor and sensory blockade as well as analgesia, without raising the frequency of adverse effects. Aggarwal S et al. [15] have also determined that the incorporation of dexmedetomidine with local anaesthetic medications extended the duration of motor blockade. The study indicated a quicker initiation of sensory and motor blockade. Sebastian D et al. [16] evaluated the impacts of clonidine and dexmedetomidine, concluding that dexmedetomidine surpasses clonidine in enhancing postoperative analgesia in supraclavicular blocks. Our research corroborated the findings of Patki et al [17], Kanvee et al [18], Harshavardhana et al [19], and Channabasappa et al [20]. These studies indicate that selective α2-adrenoceptor agonists such as clonidine or dexmedetomidine, when used as adjuncts to ropivacaine in various peripheral nerve

blocks, enhance the sensory-motor blockade. Kumari et al [21] in their study concluded that ropivacaine-dexmedetomidine combine provided earlier sensory block and more prolonged postoperative analgesia in supraclavicular brachial plexus block as compared to ropivacaine-clonidine combine which is in agreement with our study.

Conclusion

Dexmedetomidine, when combined with ropivacaine for supraclavicular brachial plexus block, results in a rapid onset of sensory motor blockade and offers extended postoperative analgesia that surpasses the duration achieved with ropivacaine plus clonidine, all while exhibiting minimal adverse effects.

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