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Original Research Article

A Comparison of Intravenous and Perineural Dexmedetomidine as Adjuvants to Ropivacaine in Supraclavicular Brachial Plexus Block in Upper Limb Surgery

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Abstract:

Background: Many adjuvants have been explored in the past in numerous trials to extend the duration of analgesia in supraclavicular brachial plexus block, but the perfect adjuvant has not yet been found. It has been shown that adding dexmedetomidine, a selective Alfa-2 adrenergic agonist, to a local anaesthetic prolongs the block duration and post-operative analgesia in a variety of regional blocks.

Aims and Objectives: The goals and objectives are to investigate the hemodynamic effects of adding dexmedetomidine with ropivacaine in supraclavicular brachial plexus block, as well as the start and duration of sensory and motor blockade and postoperative analgesia.

Materials and Methods: Two groups of sixty patients, of both sexes and classified as class I and II by the American Society of Anesthesiologists and scheduled for upper limb surgery under supraclavicular brachial plexus block, were randomly assigned. The patients ranged in age from 18 to 60 years. Group B got 20 mL of 0.5% ropivacaine in brachial plexus block with dexmedetomidine intravenous infusion at 1 µg/kg over 10 min, whereas Group A received 20 mL of 0.5% ropivacaine in brachial plexus block with adjuvant perineurally at a dose of 1 µg/kg. Non-invasive intraoperative blood pressure, heart rate, SpO2, and sedation were monitored every 5 minutes during the first 10 minutes and then every 15 minutes until the conclusion. The initial rescue analgesic's time, the postoperative pain's severity, and the overall amount of analgesic needed were all noted.

Results: Group A had sensory and motor block onset was more quickly than Group B. Group A had analgesia for a longer period of time than Group B. Group A maintained hemodynamic stability better than Group B. Group B sedation was superior.

Conclusion: In supraclavicular brachial plexus blocks, dexmedetomidine is a more effective adjuvant than ropivacaine in terms of delivering a quicker start of motor and sensory blocks as well as a longer duration of postoperative analgesia with improved hemodynamic stability.

Keywords: Adjuvant; Analgesia; Dexmedetomidine; Perineural; Ropivacaine.

Introduction

It's common to refer to supraclavicular brachial plexus block as "upper extremity spinal anaesthesia." [1] As a result of its efficiency in terms of cost, performance, safety margin, and efficient post-operative analgesia, it is a widely used kind of anaesthesia for a variety of upper limb procedures. [2] It offers a single injection that produces thick, fast-acting anaesthesia in the arm. [3] It guarantees side-effect-free post-operative analgesia and offers the most efficient block for the upper extremities. [4] It is carried out at the proximal division and distal trunk levels. Since the brachial plexus is now compact, a tiny amount of local anaesthetic can reliably and quickly stop its function. Surgery involving the elbow, forearm, and hand can be performed under surgical anaesthesia if the brachial plexus (C5-T1) is blocked. Although the original Kulenkampff method has been modified, a number of other procedures have been reported. However, the primary drawback of these blind approaches is still the slight but considerable risk of pneumothorax. [5-7] In the hands of experts, this risk has been stated to be negligible; nonetheless, other series estimates a 6.1% incidence of pneumothorax. [8,9] Poor localization of nerves owing to anatomical variance or damage to the area can occur when utilizing a landmark approach for regional

blockage, which can lead to unsuccessful anaesthesia or cause morbidity. Surface ultrasonography in the upper limb provides good identification of the brachial plexus's neuronal components and surrounding tissues. [10–12] Accurate nerve identification, real-time visualization of the brachial plexus, blood arteries, needle insertion, and local anaesthetic dissemination are benefits of ultrasound-guided brachial plexus block. It reduces the quantity of efforts with needles.

Many studies with less adverse effects attempted a variety of adjuvants to extend the duration of analgesia; however, the perfect adjuvant is still unknown. Dexmedetomidine is a powerful α2-adrenergic agonist and a highly selective agent—eight times more selective than clonidine. [13] It has sedative, analgesic, antihypertensive, and anesthetic-sparing properties when taken systemically. [14] It has been demonstrated that in a variety of regional blocks, the addition of dexmedetomidine to local anaesthetics extends both the length of the block and the duration of post-operative analgesia. [15–18] It has been documented to increase the effectiveness of epidural, caudal, and intrathecal anaesthesia. [19] Peripheral nerve blocks have been reported to utilize it recently. The effectiveness of dexmedetomidine as an adjuvant in the supraclavicular block is the subject of very few trials.

We made the decision to investigate the effects of dexmedetomidine in conjunction with local anaesthetics on hemodynamics, postoperative analgesia, onset and duration of sensory and motor blockade, and sedation.

Aims and Objectives: In order to assess the effectiveness of both perineural and intravenous dexmedetomidine as a post-operative analgesic, hemodynamic stability, adverse impact, and block onset and duration in supraclavicular brachial plexus block, in comparison to ropivacaine.

Materials and Methods

This prospective interventional study is centered on an institution and was conducted in a medical college and hospital.

Criteria for inclusion: Patients classified as grade 1 or 2 by the American Society of Anesthesiologists (ASA) and aged between 18 and 60 years were scheduled for upper limb surgery.

Criteria for exclusion:

- Second or third-degree heart block;
- lactating and pregnant women;
- hypersensitivity to any study-related medication;
- patients with breathing difficulty;
- patients using anticoagulants;
- pneumothorax or pneumonectomy at a different location;
- local infection;
- Patient refusal.

Preoperative laboratory tests including serum electrolytes, urea, creatinine, blood sugar (fasting and postprandial), complete hemogram, chest X-ray (posterior-anterior view), and 12-lead ECG were performed. Basic random sampling served as the sampling design. The "sealed envelope technique" was used to randomly assign participants to the groups. Following written informed permission and institutional ethics committee approval, sixty patients of both sexes, ASA 1 and 2, between the ages of eighteen and sixty, were split into two groups.

Group A got a brachial plexus block using 20 mL of 0.5% ropivacaine and 1 μg/kg of dexmedetomidine as an adjuvant perineurally.

Group B underwent a brachial plexus block with 20 mL of 0.5% ropivacaine and an intravenous infusion of 1 μg/kg of dexmedetomidine in 50 mL of normal saline over a 10-minute period.

Upon entering the holding area of the operation theatre and obtaining informed permission, an 18G IV cannula was positioned in the contralateral forearm, and an infusion of Ringer's lactate at a rate of 100 mL/h was initiated.

Standard monitoring, such as an ECG, non-invasive blood pressure, and pulse oxymeter, were added when the patient was moved to the operating room. A baseline vital sign was taken of the patient before to the supraclavicular brachial plexus block. Position: The patient's head was rotated to the other side while they were lying supine. To appropriately expose the region, a wrapped cloth was put down the spine, between the shoulders. At the head of the table was the anesthesiologist. The patient was instructed to elevate their head in order to highlight the clavicular head of the sternocleidomastoid. The interscalene groove was palpated by placing the index finger lateral to the muscle. The bottom portion of the interscalene groove was used to palpate the subclavian artery.

Following aseptic preparation, a skin wheal was elevated using 2 mL of lignocaine at this location, which is 2-3 cm above the midline and perpendicular to the clavicle. At this moment, the subclavian artery's pulse could be felt. The nerve locator was adjusted to 0.5 mA current. Next, a 5 cm nerve locator needle was inserted downward, rearward, and medially. The contraction of the hand and forearm muscles was then observed. Subsequently, 20 mL of 0.5% ropivacaine was administered to group A along with 1 μg/kg dexmedetomidine, while group B patients received

20 mL of ropivacaine via nerve locator needle at a current of 0.4 mA. Pinprick tests were used to assess sensory blockage along the radial, ulnar, and median nerve distributions. Bromage scale was used to test for motor blockage. The patient in group B received a dexmedetomidine infusion once sufficient sensory and motor blockage was confirmed. For the first ten minutes of the procedure, parameters such as heart rate (HR), systolic and diastolic blood pressure, SpO2, and the Ramsay Sedation Scale were recorded every five minutes. After that, they were recorded every fifteen minutes. The entire procedure took roughly one hour. The Visual Analogue Scale (VAS) was used to record the time of the first rescue analgesic, and when the VAS score went over three during the postoperative phase, injection Diclofenac 75 mg intramuscularly was administered as a rescue analgesic. General anaesthesia was administered in cases of block failure.

Statistical analysis: The major variable utilized for estimating sample size was the timing of the initial request for analgesia. We required examining 30 experimental participants in each group based on prior research assuming that the group SD was 120 minutes in order to reject the null hypothesis, which states that the group population means are identical with a probability (power) of 0.85. The raw data were analyzed using Pearson's Chi-square test after being loaded into an MS Excel spreadsheet. The ANOVA test was used to analyze continuous variables that were normally distributed. The comparisons were performed using the independent t-test and the Chi-square test. P values less than 0.05 were deemed statistically significant.

Results

Regarding demographic information such as age, sex, weight, kind of surgery, and length of operation, there were no discernible differences between the two groups. [Table 1]

Table 1 demonstrates that there is no statistically significant difference (P>0.05) between the groups for any of the parameters. The groups might therefore be compared. Table 2 employs the Student unpaired t-test to demonstrate statistically significant differences (P<0.05) in mean HR across all time periods between the groups. It is statistically significant that Group A's sensory block started 5.19±0.81 (min) earlier than Group B's 13.21±0.79 (min).

Group A experienced a faster motor block onset of 9.71±1.01 (min) compared to group B's 22.69±1.01 (min), and the difference was statistically significant [Table 2]. Table 2 illustrates that group A's mean length of sensory block was 4.11±0.39 (hours), longer than group B's, which was 2.89±0.41 (hours). Table 2 also demonstrates that group A experienced a mean motor block duration of 2.69±0.31 (hours), which was longer than group B's mean length of 1.61±0.39 (hours) with a significant P-value (0.0112). Group A had a longer mean duration of analgesia (10.79±1.21 hours) than group B (6.91±1.19 hours), with a significant P-value (0.0061), as indicated by Table 2.

Table 3 demonstrates that whereas 2 patients in group A had sedation scores more than 3, 6 patients in group B did.

Table 1: Demographic profile

Parameters	Group A (Mean±SD)	Group B (Mean±SD)	P-value
Age (years)	9.49±7.91	4.81±7.39	0.771
Weight (kg)	61.71±5.19	60.69±4.91	0.218
Gender (M:F)	17:13	18:12	0.942
Duration of surgery (min)	50.01±12.01	49.51±12.59	0.119

Table 2: Comparison of block characteristics between two groups

Parameters	Group A (Mean±SD)	Group B (Mean±SD)	P-value
Onset of sensory block (min)	5.19±0.81	13.21±0.79	0.042
Onset of motor block (min)	9.71±1.01	22.69±1.01	0.017
Duration of sensory block (min)	4.11±0.39	2.89±0.41	0.0081
Duration of sensory block (min)	2.69±0.31	1.61±0.39	0.0112
Duration of analgesia (hours)	10.79±1.21	6.91±1.19	0.0061

Table 3: Incidence of sedation

Parameters	Group A	Group B	P-value
Ramsay's sedation score >3	02 (6%)	06 (20%)	0.0011

Table 4 demonstrates that there are statistically significant differences (P<0.05) in bradycardia and hypotension across the groups. Using the Chi-square test, two groups were compared.

Table 4: Incidence of side-effects

Parameters	Group A	Group B	P-value
Hypotension	03 (10%)	07 (23%)	0.0401
Bradycardia	04 (13%)	11 (36%)	0.0031
Respiratory depression	01 (03%)	02 (06%)	0.2409
Nausea & Vomiting	04 (13%)	05 (16%)	0.9149
LA toxicity	00 (0%)	00 (0%)	-
Neurological deficit	00 (0%)	00 (0%)	-

Discussion

In our investigation, the perineural dexmedetomidine group had start of sensory and motor block earlier than the intravenous dexmedetomidine group. Compared to the intravenous dexmedetomidine group, the perineural dexmedetomidine group experienced a longer overall duration of sensory and motor block. Additionally, analgesia lasts longer when adjuvant dexmedetomidine is administered intravenously via the perineural route. In comparison to the intravenous dexmedetomidine group, the perineural dexmedetomidine group saw less adverse effects overall, including sedation. The effects of mixing 100 µg of dexmedetomidine with 0.5% levobupivacaine for axillary blockade were assessed by Esmaoglu et al.,[17] in 2010. They came to the conclusion that dexmedetomidine reduced the duration of the motor and sensory block, decreased the onset time, and lengthened the period for the initial analgesic usage. In our investigation, the duration of motor and sensory block was extended by the adjuvant addition of dexmedetomidine to ropivacaine. Additionally, utilizing the VAS scale, the length of analgesia was extended with improved patient satisfaction.

Agarwal et al. [20] found that the duration of the supraclavicular brachial plexus block shortens when dexmedetomidine is administered as an adjuvant to bupivacaine. Both surgical analgesia and motor and sensory block last much longer. In our investigation, the addition of dexmedetomidine as an adjuvant to ropivacaine resulted in a shorter time to the start of sensory and motor block and a longer duration of block. In their research, Esmaoglu et al. [17] combined 40 milliliters of 0.5% levobupivacaine with 100 micrograms of dexmedetomidine; however, we took into account the peripheral effects of dexmedetomidine and utilized 20 milliliters of 0.5% ropivacaine.

Our research showed that dexmedetomidine decreased the amount of local anaesthetic used in the peripheral nerve block; ropivacaine was used in place of 40 mL of levobupivacaine. In patients having arthroscopic shoulder surgery under brachial plexus block, analgesia was considerably prolonged with intravenous dexmedetomidine at a dosage of 2.0 µg/kg as compared to 0.5 µg/kg, 1 µg/kg, and placebo, according to a research by K ang et al., [21]. In order to prevent the discrepancies in the results reported in the previous research, we administered 1 µg/kg of dexmedetomidine to both groups A and B. However, because group B received dexmedetomidine intravenously, there was higher hemodynamic instability in that group. In a 2019 study, Somsunder et al.,[22] examined the effectiveness of intravenous and perineural dexmedetomidine as adjuvants to levobupivacaine in supraclavicular brachial plexus block. They found that both types of dexmedetomidine are equally effective in terms of the onset and duration of block. The mean length of sensory block was 4.1 hours in group A and 2.9 hours in group B, indicating that perineural dexmedetomidine was more effective than i.v. dexmedetomidine in our research in terms of delaying the onset and duration of block. In line with our findings, Abdallah et al., [23] showed that both intravenous and perineural dexmedetomidine may successfully extend the duration of the interscalene block and decrease the amount of opioids taken without extending motor blockade.

Group B experienced a higher frequency of hypotension and sedation in comparison to group A. For ten minutes, we infused 1 µg/kg of dexmedetomidine. Therefore, in order to maintain hemodynamic stability without sacrificing block effect and post-operative analgesia, it is advised that future research use lower dosages and longer infusion times. It would have been easier to see the hemodynamic effects of using dexmedetomidine and norepinephrine together with different routes if there had been a clearer plasma concentration of each drug. In order to determine the effectiveness of intravenous dexmedetomidine in supraclavicular brachial plexus block when combined with various local anaesthetics, we advise doing more randomized multicenter studies.

Limitations of the study:

One of the research's limitations was that it was an observational study conducted prospectively; meaning bias cannot be completely eliminated out. (2) The dosage of ropivacaine may have been lowered by the use of ultrasonography. Nevertheless, our institution's anesthesiology department does not have access to ultrasonography equipment for regional nerve

blocks. (3) Limited number of samples. (4) Insufficient amount of follow-up time.

Conclusion

In supraclavicular brachial plexus blocks, dexmedetomidine is a more effective adjuvant than ropivacaine in terms of delivering a quicker start of motor and sensory blocks as well as a longer duration of postoperative analgesia with improved hemodynamic stability.

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