

Dexmedetomidine vs dexamethasone as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block

Nidhi Singh, Shikha Gupta¹, Suneet Kathuria¹

Department of Anaesthesia and Intensive Care, Postgraduate Institute of Medical Education and Research, Chandigarh, ¹Department of Anaesthesia, Dayanand Medical College, Ludhiana, Punjab, India

Abstract

Background and Aims: Both dexmedetomidine and dexamethasone have individually been shown to be beneficial as an adjuvant to ropivacaine. We compared the efficacy of combination of ropivacaine with dexmedetomidine and ropivacaine with dexamethasone in ultrasound-guided supraclavicular brachial plexus (SCBP) block.

Material and Methods: In this prospective randomised double-blind controlled trial, 60 ASA physical status I/II patients undergoing elective upper-limb surgery under ultrasound-guided SCBP block with 30 ml of 0.5% ropivacaine were randomised into three groups. Group 1 (n = 20) received 1 µg/kg of dexmedetomidine, and group 2 (n = 20) received 8 mg of dexamethasone in addition to ropivacaine, while group 3 (n = 20) received only ropivacaine. The primary outcomes studied were onset and duration of sensory and motor block. Secondary outcomes included duration of analgesia, total analgesic consumption in 24 h postoperatively and quality of block. ANOVA and Chi-square test were used to compare results on continuous measurements and categorical measurements, respectively.

Results: Onset of sensory and motor block was faster in group 1 (13.5 ± 4.1 and 17.0 ± 4.1 min) and group 2 (15.6 ± 3.6 and 18.5 ± 3.7 min) as compared to group 3 (20.1 ± 5.3 and 24.9 ± 5.6 min; *P* < 0.001). Block duration was significantly longer in group 1 and group 2 than in group 3. Duration of analgesia was prolonged in group 1 and 2 (1218.0 ± 224.6 and 1128.0 ± 207.5 min, respectively) as compared to group 3 (768.0 ± 273.7 min; *P* < 0.001). Twenty-four hours analgesic consumption postoperatively was reduced in the two study groups.

Conclusion: Both dexmedetomidine and dexamethasone when used as adjuvants to ropivacaine for SCBP block, block onset time, and prolong' block duration.

Keywords: Dexmedetomidine, dexamethasone, ropivacaine, supraclavicular brachial plexus block, ultrasound

Introduction

Brachial plexus block has evolved into an excellent substitute to general anaesthesia for upper limb surgeries. By curtailing the stress response and using minimal anaesthetic drugs it provides intraoperative analgesia along with prolonged postoperative pain-relief.^[1] Varied avenues of brachial plexus blockade

exist namely interscalene, supraclavicular, infraclavicular and axillary approach. With swift onset of dense anaesthesia of upper limb, supraclavicular brachial plexus block (SCBP) block is considered as the 'spinal of the arm'.

Ultrasound facilitates the deposition of drug at the apt place and augments block success. The brachial plexus at

Address for correspondence: Dr. Suneet Kathuria,
87 – C, Udham Singh Nagar, Ludhiana, Punjab, India.
E-mail: suneetkathuria@hotmail.com

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supraclavicular regions is compact and shallow (20-30 mm deep) and the nerve visibility is remarkable.^[2,3]

Consistent efforts have been made to enhance the outcomes of the block by adding myriad adjuncts to local anaesthetics (LAs). Dexamethasone as adjuvant to perineural local anaesthetics augments peripheral nerve block analgesia.^[4,5] Dexmedetomidine, an alpha-adrenergic agonist when mixed with LAs for brachial plexus block facilitates better anaesthesia and analgesia.^[6] The chase for quintessential adjuvant with most benefits and minimal side-effects continues.

Although literature is replete with studies comparing these adjuncts to control, very few studies have directly compared combination of ropivacaine with dexmedetomidine and ropivacaine with dexamethasone in SCBP block.^[7,8] Results of these studies are discordant and call for more direct comparison between the two adjuncts. The current study aimed to compare the efficacy of dexmedetomidine and dexamethasone as adjuvants to 0.5% ropivacaine in ultrasound-guided SCBP block. The primary outcomes studied were onset and duration of sensory and motor block. Secondary outcomes included duration of analgesia, total analgesic consumption in 24 h postoperatively, quality of block and complications.

Material and Methods

After getting ethical committee approval and taking written informed consent, 60 American Society of Anaesthesiologists (ASA) physical status I/II patients, scheduled for elective upper limb surgery below mid-humerus level, under ultrasound-guided SCBP block were recruited in the present prospective, randomised, double-blind, controlled study. Patients having significant coagulopathies, documented neuromuscular disorders, pre-existing significant systemic diseases, infection at block site, pregnancy and known allergy to study drugs, were excluded from the study.

Sixty-eight patients were randomly allocated to one of the three groups.

Group 1: Ultrasound-guided SCBP block given with 30 ml of 0.5% Ropivacaine containing 1 µg/kg Dexmedetomidine.

Group 2: Ultrasound-guided SCBP block given with 30 ml of 0.5% Ropivacaine containing 8 mg Dexamethasone.

Group 3: Ultrasound-guided SCBP block given with 30 ml of 0.5% Ropivacaine alone.

Blinding and randomisation

After enrolment, random allocation was done by the principle investigator who prepared sealed envelopes to maintain

allocation concealment. The sealed envelopes were opened by study physician, who prepared drugs and handed them over to a blinded anaesthetist performing the block, who also monitored all the patients intra-operatively. Another blinded observer monitored the patients in the recovery room. At the end of the study, blinding was opened by the primary investigator.

Each patient was assessed preoperatively and was explained about the usage of visual analogue scale (VAS). On shifting to operation theatre, standard monitoring like pulse-oximeter, electrocardiogram and non-invasive blood pressure measurement was started. Intravenous (i.v.) access was achieved in the non-operative arm and SCBP block was performed under all aseptic precautions using ultrasound (Micromaxx, Sonosite) equipped with high frequency (6-13 MHz) linear probe. With the patient lying supine and head turned 45° contralateral, site was prepared and draped. Ultrasound transducer was placed in supraclavicular fossa in the coronal oblique plane to visualize brachial plexus in the transverse sectional view. Using a 25-gauge needle, 1–2 ml of local anaesthetic was injected. The block needle insertion was done using in plane technique, from lateral-to-medial direction toward the brachial plexus and the study drug was injected incrementally to obtain a uniform spread around the brachial plexus.

Onset of sensory and motor block was assessed every 3 min till complete sensory and motor block or 30 min, whichever was earlier. Sensory block was assessed in the distribution of 4 nerves (musculocutaneous, median, radial and ulnar nerve) by cold testing (alcohol swab) using a 3-point scale as: 0 - no sensory block (cold sensation felt), 1 - analgesia (patient cannot feel cold but can feel touch), and 2 - anaesthesia (patient cannot even feel touch).⁹ Motor block was assessed by elbow flexion (musculocutaneous nerve), thumb opposition (median nerve), thumb abduction (radial nerve) and thumb adduction (ulnar nerve) on a 3-point scale as: 0 - no motor block (normal motor functions), 1 - paresis (decreased motor strength), and 2 - paralysis (complete loss of motor strength).^[9]

The time period from the end of LA administration to achievement of complete sensory or motor block was described as sensory or motor block onset time. Complete sensory block was described as anaesthetic block score - 2 on all the nerve territories. Complete motor block was described as the absence of voluntary movements (score - 2). Any failure in establishing the block was converted to general anaesthesia and that patient was excluded from further study. Intraoperative vitals were recorded every 10 min.

Quality of anaesthesia was graded by an anaesthesiologist who was unaware of the study drugs as: Excellent (4) - No complain

from the patient, Good (3) - Trivial complains with no need of supplementary analgesia or sedation, Moderate (2) - Complain that needed supplemental analgesia or sedation, and Unsuccessful (1) - Patient requiring general anaesthesia. At the conclusion of the surgery, quality of operative conditions were also graded by the operating surgeon, who was unaware of drugs used in block, as: Excellent (4) - Perfect analgesia and muscle relaxation, Good (3) - Good analgesia with acceptable muscle relaxation, Moderate (2) - Satisfactory analgesia but poor muscle relaxation, Unsuccessful (1) - Inadequate analgesia and muscle relaxation. Patient satisfaction was categorised as: Excellent (4) - No complaint from patient, Good (3) - Trivial complaints which are tolerable, Moderate (2) - Complaints that are not tolerable but relieved with intervention, Poor (1) - Complaints that are neither tolerable nor relieved with intervention. Postoperatively, patients were monitored for sensory and motor block regression every 15 min till complete resolution. Time period from the end of LA administration to complete resolution of sensory block (score 0) on all the nerves was taken as duration of sensory block. Time period from the end of administration of LA to return of complete motor function (score 0) of the hand and forearm was defined as duration of motor block. Postoperative pain was assessed every 30 minutes for first 2 hours and then 2 hourly till 24 h, using 10 cm VAS.

Tramadol in a dose of 50 mg slow i.v. infusion with prior i.v. injection of 4 mg of ondansetron was administered either on demand of patient or when VAS score ≥ 4 . After 30 minutes, if patient still felt pain/VAS score ≥ 4 , same dose of tramadol was repeated. If pain was still not relieved, 75 mg of diclofenac sodium was given as slow i.v. infusion. Tramadol was given to a maximum of 100 mg in 4 h or 400 mg in 24 h. Diclofenac sodium as slow i.v. could be repeated after 8 h. The duration of analgesia was taken as the time interval from the end of LA administration to first rescue analgesic injection. Total amount of rescue analgesics used in 24 h after the block administration was noted. Sedation score was determined using Modified Ramsay Sedation Scale.^[10] Side effects and complications of technique and drugs were monitored and appropriately treated.

Statistical analysis

Data was analysed using IBM-SPSS software version 17. Age, height, weight, BMI, onset time of sensory and motor block and duration of surgery were studied by use of independent student *t*-test. Intraoperative and postoperative haemodynamic data was assessed by repeated measure Analysis of variance (ANOVA) followed by independent student *t*-test. The sex ratio, ASA grade and quality of anaesthesia were compared using Chi-square test. Non-parametric data like VAS are presented as median and interquartile range (IQR).

Pain scores and sedation score were assessed by making use of Mann-Whitney U-test for pair wise comparison. All tests were checked out for 95% confidence intervals. As sufficient literature was not available at the time of conduct of this study, a power analysis was done using the software package, G Power. The alpha level taken for this analysis was $P < 0.05$. We used ANOVA using effect size as 1.330 for sensory block duration and power $> 80\%$, sample size of 60 was considered appropriate.

Results

We surveyed 112 patients for eligibility, out of which 68 patients were randomised in three groups to receive ultrasound-guided SCBP block. Sixty patients (20 in each group) were considered for final analysis. All three groups were analogous in terms of demographic data, duration of surgery and ASA physical status [Table 1].

Sensory and motor block onset times were significantly shorter, both in group 1 (dexmedetomidine) and 2 (dexamethasone) as compared to group 3 (control). The difference between group 1 and group 2 was not statistically significant. The duration of sensory and motor block was significantly longer in both group 1 and 2 than in group 3. Groups 1 and 2 were comparable with respect to durations of block [Table 2].

Postoperative pain was not significantly different in the three groups at most of the time points [Table 3].

The duration of analgesia was found to be notably prolonged in group 1 and group 2 compared to group 3. It was comparable between group 1 and 2 [Table 2]. The total analgesic (tramadol) consumption was maximum in group 3 (80.0 ± 25.1 mg) and this was significantly more than group 1 (50.0 ± 0.0 mg) and 2 (53.1 ± 12.5 mg). On comparison between group 1 and 2, no significant difference was found.

The heart rate, systolic and diastolic blood pressure recordings were on lower side perioperatively in patients receiving dexmedetomidine in SCBP block as compared to other two groups, but this was not statistically significant. No patient developed significant bradycardia. One patient of dexmedetomidine group developed hypotension at 50th min and was successfully treated with Inj. ephedrine 3 mg i.v. No other side effect was observed in any of the patient.

Quality of block as graded by the anaesthesiologist and surgeon was excellent in both group 1 and 2. Patient satisfaction was also better in study groups 1 and 2 as compared to group 3. Majority of the patients receiving dexmedetomidine could not

recall the intraoperative events and reported having a sound sleep during the procedure [Table 4].

Discussion

In this study, we found that adding 1 µg/kg dexmedetomidine or 8 mg dexamethasone as an adjuvant to 30 ml ropivacaine (0.5%) in ultrasound-guided SCBP block results in a quick onset of sensory and motor block, extends both sensory and motor block duration, defers the demand for first rescue analgesic and significantly decreases the total 24 h analgesic consumption. Quality of SCBP block is improved as compared to control group without any major side-effect.

Chinappa *et al.* have reported that dexmedetomidine (1 µg/kg) when used as an adjuvant to 30 ml of 0.5% ropivacaine, quickens the onset of sensory and motor block, prolongs SCBP block duration and offers a prolonged duration of postoperative analgesia.^[11] Waindeskar *et al.*, showed that by adding 1 µg/kg dexmedetomidine to 0.325% levobupivacaine during ultrasound-guided SCBP block, onset of block was quickened and duration of sensory/motor block along with the duration of analgesia was significantly extended.^[12] These finding also corroborate with many other studies.^[13-14]

Analogous to our study, Kalpana *et al.* demonstrated that 6 mg dexamethasone when added to plain ropivacaine 0.5%

used for SCBP block shortened the sensory block onset time and motor block onset time along with extending the duration of sensory and motor block.^[15] These results are in concordance to study done by Dar *et al.*^[16] In another study, use of 8 mg dexamethasone along with 0.5% levobupivacaine in SCBP block lead to reduced demand of rescue analgesics with brisk onset of block and extended sensory and motor block duration.^[5]

Hence, both dexmedetomidine and dexamethasone as adjuvants to ropivacaine help in early onset of sensory and motor block. On comparison between these two adjuvants, we found no notable difference in our study except more patient satisfaction in dexmedetomidine group as compared to dexamethasone group. In contrast some studies showed no improvement of sensory and motor block onset time by using dexamethasone as adjuvant.^[17-18] This contrariety may be due to difference in study strategy such as use of variable methods of block assessment, difference in strength and dose of local anaesthetics and use of variable adjuvants.

In our study, the duration of analgesia was significantly prolonged after use of dexmedetomidine or dexamethasone with 0.5% ropivacaine [Table 2]. Ammar *et al.* found significantly decreased requirement of i.v. morphine (4.9 mg vs 13.6 mg) as rescue analgesic with dexmedetomidine as adjuvant in infraclavicular brachial plexus block.^[13] Agarwal *et al.* also reported that in patients receiving SCBP block with 100 µg dexmedetomidine when added to 0.325% bupivacaine, increased the duration of analgesia significantly.^[14]

In a meta-analysis, nine randomized controlled trials (801 patients) were analysed in which 393 patients received dexamethasone (4–10 mg). Authors observed significantly prolonged duration of analgesia when dexamethasone was administered along with long acting local LAs.^[19] In another study, patients receiving dexamethasone in SCBP block required significantly less diclofenac in 24 h postoperative period as compared to control group.^[17]

In our study, although both dexmedetomidine and dexamethasone were found to prolong analgesia when

Table 1: Demographic Data

| Patient variables | Groups | | |
|---------------------------|------------|------------|-----------|
| | 1 | 2 | 3 |
| Age (years) | 37.6±13.0 | 38.8±14.0 | 43.0±15.6 |
| Weight (kg) | 67.5±9.3 | 69.4±9.8 | 70.0±8.0 |
| Gender | | | |
| Male | 14 (70%) | 17 (85%) | 13 (65%) |
| Female | 6 (30%) | 3 (15%) | 7 (35%) |
| ASA Grade | | | |
| I | 13 (65%) | 11 (55%) | 9 (45%) |
| II | 7 (35%) | 9 (45%) | 11 (55%) |
| Duration of Surgery (min) | 118.8±52.1 | 126.5±39.2 | 95.0±40.1 |

Values are expressed as mean±SD or number (%) of patients.

Group 1=Ropivacaine + dexmedetomidine, Group 2=Ropivacaine + dexamethasone, Group 3=Ropivacaine + Saline SD=Standard Deviation, ASA=American Society of Anaesthesiologist

Table 2: Block Characteristics

| Block characteristics (min) | Groups | | | P | | | |
|-----------------------------|--------------|--------------|-------------|--------|-------|--------|--------|
| | 1 | 2 | 3 | 1/2/3 | 1/2 | 2/3 | 1/3 |
| Sensory Block Onset | 13.5±4.1 | 15.6±3.6 | 20.1±5.3 | <0.001 | 0.409 | 0.006 | 0.001 |
| Motor Block Onset | 17.0±4.1 | 18.5±3.7 | 24.9±5.6 | <0.001 | 0.895 | <0.001 | <0.001 |
| Sensory Block Duration | 972.5±90.1 | 940.5±110.8 | 624.8±152.4 | <0.001 | 1.000 | <0.001 | <0.001 |
| Motor Block Duration | 833.0±94.5 | 822.8±98.8 | 528.8±149.1 | <0.001 | 1.000 | <0.001 | <0.001 |
| Duration of Analgesia | 1218.0±224.6 | 1128.0±207.5 | 768.0±273.6 | <0.001 | 0.704 | <0.001 | <0.001 |

Values are expressed as the mean±SD. Group 1=Ropivacaine + dexmedetomidine, Group 2=Ropivacaine + dexamethasone, Group 3=Ropivacaine + Saline. P 1/2/3 : ANOVA used, P value 1/2, 2/3, 1/3 : t-test used. P<0.05 taken as significant

Table 3: Visual Analogue Score-Postoperative pain

| Postoperative time | Groups | | | P |
|--------------------|------------|---------------|---------------|-------|
| | 1 | 2 | 3 | |
| Baseline | 0 (0-0) | 0 (0-0) | 0 (0-0) | 0.362 |
| 0.5 h | 0 (0-0) | 0 (0-0) | 0 (0-0) | 0.343 |
| 1 h | 0 (0-0) | 0 (0-0) | 0 (0-0.75) | 0.189 |
| 1.5 h | 0 (0-0) | 0 (0-0) | 0 (0-1) | 0.287 |
| 2 h | 0 (0-0) | 0 (0-0.75) | 0 (0-1) | 0.551 |
| 4 h | 0 (0-0.75) | 0 (0-0.75) | 0 (0-1.75) | 0.292 |
| 6 h | 0 (0-0.75) | 0 (0-0) | 0.50 (0-1.75) | 0.092 |
| 8 h | 0 (0-1) | 0 (0-1) | 0.50 (0-1) | 0.619 |
| 10 h | 0 (0-1) | 0.50 (0-1.75) | 1 (0-2) | 0.153 |
| 12 h | 0 (0-1) | 0 (0-2) | 2 (1-3.75) | 0.009 |
| 14 h | 0 (0-1.75) | 1 (0-2) | 2 (0.25-3.75) | 0.079 |
| 16 h | 0 (0-2) | 1.50 (0-2) | 1.50 (0-3) | 0.338 |
| 18 h | 0.50 (0-2) | 2 (0-3.75) | 2 (0.25-3.75) | 0.386 |
| 20 h | 0 (0-1.75) | 1 (0-3.75) | 2 (0-2.75) | 0.153 |
| 22 h | 0 (0-1) | 1 (0-2) | 1 (0-2) | 0.386 |
| 24 h | 0 (0-1) | 1 (0-1) | 1 (0-2) | 0.155 |

VAS Score is expressed as median and values in parenthesis is interquartile range

Table 4: Sedation Score

| Group | 1 | 2 | 3 | P | | | |
|----------|---------|---------|---------|-------|-------|-------|-------|
| | | | | 1/2/3 | 1/2 | 2/3 | 1/3 |
| Sedation | 3 (2-4) | 2 (2-2) | 2 (2-2) | 0.001 | 0.001 | 0.317 | 0.001 |

VAS Score is expressed as median and values in parenthesis is interquartile range

compared with control group. On comparison between these two adjuvants, no significant difference was found. This reduced requirement of rescue analgesic in the groups receiving adjuvants in first 24 h postoperative period is because of extended duration of sensory block. These results are tantamount to previous studies using dexmedetomidine or dexamethasone, however, explicit comparisons are arduous because of the heterogeneity of local anaesthetic mixtures and adjuvants used, multiple diverse techniques studied, and disparate means of assessing block duration.^[4,5,12,13,15]

Akin to our study, a comparative study conducted by Kumar *et al.*, using 0.5% ropivacaine with or without 8 mg dexamethasone, reported better (85%) surgeon satisfaction score in dexamethasone group as compared to control group (62.5%).^[20] In our study, perioperative heart rate and blood pressure recordings in patients receiving dexmedetomidine for block were on lower side, but this was statistically insignificant. No patient developed significant bradycardia. One patient of dexmedetomidine group developed hypotension after 50 min of giving block and was successfully treated with Inj. ephedrine 3 mg i.v.

In study by Swami *et al.*, lower pulse rate and blood pressure recordings were observed with use of dexmedetomidine, but none of the patients required treatment.^[21] Esmaoglu

et al. reported high incidence of bradycardia with use of dexmedetomidine with levobupivacaine in axillary block.^[22] They also reported significant hypotension in dexmedetomidine group, which was not seen in our study. Use of lower doses of dexmedetomidine (1 µg/kg), did not lead to development of significant bradycardia or hypotension in our study, as also reported by many other studies.^[21,23]

Verma *et al.* found that dexmedetomidine with ropivacaine provides early onset of sensory and motor block with longer block duration in SCBP block as compared to dexamethasone.^[7] In an indirect adjusted meta-analysis of 49 trials, authors found dexamethasone to be superior to dexmedetomidine as it prolonged the duration of analgesia by 148 minutes more than dexmedetomidine, without the risks of hypotension or sedation.^[24] A handful of other direct comparative studies favour of dexmedetomidine over dexamethasone.^[7,8]

Our study has few limitations like use of fixed dose of dexamethasone (8 mg) as compared to per kg body weight dose of dexmedetomidine (1 µg/kg), small sample size and postoperative follow-up period restricted to 24 h. Another limitation of our study was that different patients underwent diverse surgeries of varying nature and time duration, different tissue handling by differing level of prowess of surgeons, possibly leading to inconsistent perioperative requirement of analgesia.

Conclusion

We conclude that addition of 1 µg/kg dexmedetomidine or 8 mg dexamethasone as an adjuvant to ropivacaine (0.5%)

in SCBP block significantly shortens the sensory and motor block onset time and prolongs sensory and motor block duration. It delays the demand for first rescue analgesic, decreases overall 24 hour total analgesic requirement and improves the quality of block without any added major side effect. Dexmedetomidine use leads to enhanced patient satisfaction as it is associated with more sedation as compared to dexamethasone.

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Conflicts of interest

There are no conflicts of interest.

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