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COMPARISON OF DEXMEDETOMIDINE AND DEXAMETHASONE USED AS AN ADJUVANT TO ROPIVACAINE IN ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

Dr. Shivakumar G.[1], Dr. Umesh N. P.[2], Dr. Arunkumaran D[3*], Dr. Manoj kumar K.V.[4]

[1]Professor & HOD, Department of Anaesthesiology, MIMS, Mandya, Karnataka, India.
[2]Associate Professor, Department of Anaesthesiology, MIMS, Mandya, Karnataka, India.
[3*]Third Year Postgraduate student, Department of Anaesthesiology, MIMS, Mandya, Karnataka, India.
[4]Second Year Postgraduate student, Department of Anaesthesiology, MIMS, Mandya, Karnataka, India.

***Corresponding Author:** Dr. Arunkumaran D.,
*Third Year Postgraduate student, Department of Anaesthesiology, MIMS, Mandya, Karnataka, India.

ABSTRACT

Background: Supraclavicular brachial plexus (SCBP) block is one of the most preferred techniques to provide anaesthesia for upper limb surgeries. Various adjuvants have been used to extend the duration of the block. We compared dexmedetomidine and dexamethasone as an adjuvant to 0.5% Ropivacaine in extending the duration of supraclavicular brachial plexus block and postoperative analgesia.

Aim: This study aims to compare dexmedetomidine and dexamethasone as an adjuvant to 0.5% Ropivacaine in extending the duration of supraclavicular brachial plexus block and postoperative analgesia.

Methods: In this study 60 ASA Physical Status I/II patients undergoing elective upper limb surgeries under ultrasound guided supraclavicular brachial plexus block were randomized into two groups. Group 1(n=30) received 30ml of 0.5% ropivacaine containing 1mcg/kg dexmedetomidine. Group 2(n=30) received 30ml of 0.5% ropivacaine containing 8mg dexamethasone. Parameters studied were onset and duration of sensory and motor block, duration of analgesia and side effects.

Results: We noted significant extended duration of motor block and duration of analgesia in Group 1 when compared to Group 2. No adverse effects were noted in both the groups.

Conclusion: Dexmedetomidine when added as an adjuvant to ropivacaine for SCBP block prolongs duration of block and quality of postoperative analgesia as compared to dexamethasone without any significant side effects.

Keywords: Brachial plexus block, Dexmedetomidine, Dexamethasone, Ropivacaine, VAS score

INTRODUCTION

General anaesthesia is a popular technique for many surgical procedures but it is associated with its own risks and complications but nerve blocks are associated with least physiological changes

compared to General anaesthesia[1] Supraclavicular nerve block gives anaesthesia and analgesia for surgeries of lower arm, forearm and hand. D.Kulenlampff in 1911 demonstrated his first supraclavicular block in Germany.[2] This approach is more advantageous over others because it is more easy, reliable and successful with least side effects.[3]

Ultrasound guided nerve blocks have advantage over any other method as in it shows direct visualization of the target nerve, block needle and applied drugs. Ropivacaine is a pure S-enantiomer and popular local anaesthetic due to its high safety profile over bupivacaine with reduced neurotoxicity and cardiac toxicity. It has superior motor and sensory differentiation. The decreased systemic toxicity is healthier when a possible for top concentration of local agents is employed in peripheral nerve block and epidural anaesthesia.[4]

The adjuvant drugs are added to peripheral nerve blocks to extend the duration of analgesia without causing any systemic adverse effects and prolonging motor blockade. Dexmedetomidine promote hyperpolarization of nerve tissues by modifying transmembrane potential and ion conductance at locus ceruleus within the brainstem, greatly reduce the need for anaesthesia and analgesia. With Ropivacaine, the duration of block increases in a very dose-dependent manner.[5] Dexamethasone reduces inflammation and inhibits potassium channel mediated discharge of pain carrying nociceptive C-fibres[6] Perineural injection of steroids is reported to influence post operative analgesia.[7]

Although literature is replete with studies comparing these adjuvants to control, very few studies have directly compared combination of ropivacaine with dexmedetomidine and ropivacaine with dexamethasone in SCBP block. Results of these studies are discordant and call for more direct comparison between the two adjuvants. 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 and complications.

MATERIALS AND METHODS

This double-blinded, prospective, randomized controlled trial was conducted in the Department of Anesthesiology at the Mandya Institute of Medical Sciences, Mandya, following approval from the Institutional Ethics Committee (Approval No. MIMS/IEC/2024/864). The study was also registered with the Clinical Trials Registry of India (CTRI/2024/08/072515). The trial was conducted over a period of six months, and written informed consent was obtained from all 60 adult participants prior to enrollment.

Sample size is calculated by Statistical Software using the formula, based on one of the previous studies Shaiqa Manzoor et al[8] $(n)=[2(Z1-\alpha/2+Z1-\beta)^2 \times (\sigma)^2]/ d^2$ where Z1-α/2=1.96 (Standard normal variable) Z1-β =0.84 (Power of the test 80%) σ=Standard deviation = 224.63 (Combined standard deviation of duration of sensory block)$\bar{X}$ 1=1084,$\bar{X}$ 2=1374,d= $\bar{X}$ 1 -$\bar{X}$ 2 =290,n= 9.41 approx 9,So we have considered 30 patients in each group and a total of 60 patients were recruited for the study.

Participants included in the study were 18–60 years old**,** of either sex, classified as ASA PS I or II**,** and scheduled for elective upper limb surgery and participants who provided informed consent**.** Exclusion criteria comprised local infection**,** upper limb nerve palsy**,** cardiac conduction abnormalities (first to third-degree heart block), pregnancy**,** coagulation disorders**,** and allergy to local anesthetics**.**

A day prior to surgery, a preoperative visit was conducted during which a detailed medical history was obtained, and a thorough clinical examination was performed. Informed consent was obtained after explaining the procedure to the patient in the language they understood best. Patients who met the inclusion and exclusion criteria and provided informed consent were enrolled in the study. Before the procedure VAS (Visual Analogue Scale) on 0-10cm was clearly explained to the patient for the assessment of post-operative pain. In this scale 0 - indicate no pain, 10 - indicate worst pain.

The data was recorded using a semi-structured questionnaire which contained 2 parts. The first part collected details regarding socio-demographic characteristics like name, age, sex, etc. The second part collected the details regarding their cardiorespiratory parameters (Heart Rate, Systolic and

diastolic blood pressure, mean arterial pressure and SpO2) during pre and post operative period.
They were randomly allocated into two groups Group 1(n=30) received 30ml of 0.5% ropivacaine containing 1mcg/kg dexmedetomidine and Group 2(n=30) received 30ml of 0.5% ropivacaine containing 8mg dexamethasone using simple randomization and the closed envelope method, based on a computer-generated table of random numbers. Both patient and investigator were blinded about the study drugs. The local anaesthetic solution prepared by ananaesthesiologist who was not involved in administration of block and post- operative follow up. The anaesthesiologist performing the block and observing the patient was blinded to the treatment group. The study may be unblinded at any point of time if any complications occurred for benefit of the patient.
On arrival of the patient in the operation room, pre procedure parameters blood pressure, heart rate and oxygen saturation were recorded and noted. In the opposite limb an intravenous access was obtained with 18G cannula and Ringer's lactate was started. The Patients was positioned supine with arm placed by the side. The head was turned facing 45º to the contralateral side to be blocked. The neck was cleaned with povidone iodine solution and draped with sterile towels. The anaesthesiologist stands at the head end of the patient.Sterile gel was used between the probe and skin surface. In the coronal oblique plane the probe was kept in the supraclavicular fossa. The pulsating hypoechoic subclavian artery was identified and confirmed by colour Doppler, lying above the hyperechoic first rib. While maintaining the view of the artery the probe was angled until both the first rib and the pleura were seen simultaneously to visualize these two structures. Once the artery, rib, pleura and plexus were simultaneously in view the aim was to guide the needle inferior to the first rib, medial to the subclavian artery and superior to the nerves. In this area the lower trunk commonly lies. After local skin infiltration, the needle was entered by in - plane from lateralto medial until brachial plexus was reached. The supraclavicular brachialplexus was visualized as a group of hypo echoic nodules. The local anaesthetic solution was injected after careful aspiration and spread was seen encircling the trunks. After injecting the local anaesthetic, the block was tested for both sensory (using pin prick) and motor (using muscle power) and was compared with the contralateral side.
Onset of sensory and motor block was assessed every 3 minutes till complete sensory and motor block occurs in these patients. Sensory block was assessed by pin prick method for the entire upper limb innervation in the distribution of 4 nerves (musculocutaneous, median, radial and ulnar nerve) using a 3-point scale as: 0- Sharp pain felt, 1-Analgesia, dull sensation,2-Complete anaesthesia, absence of sensation. 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 function), 1-paresis (decreased motor functions), 2- paralysis (complete loss of motor strength).
The time period from the end of local anaesthetic administration to achievement of complete sensory and 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). Incomplete block referred to - No analgesia in any of the segments supplied by Median, Radial, Ulnar and Musculocutaneous nerve after 30 minutes of drug injection. Failed block - More than one nerve remained unaffected. In this situation, general anaesthesia was considered and patient was not included for study. Hemodynamic monitoring was done such as heart rate, blood pressure and oxygen saturation continuously throughout the surgery and every 60 minutes post - operative period.
Time period from the end of local anaesthetic administration to complete resolution of sensory block (score 0) on all nerves was taken as duration of sensory block. Time period from the end of local anaesthetic administration to return of complete motor function (score 0) of the hand and forearm was taken as duration of motor block. The duration of postoperative analgesia was defined as the time from completion of drug administration to the first request for post operative analgesia (VAS>3). Postoperative pain will be assessed every 30 minutes for first 2 hrs and 2hrly till 24hrs using 10cm VAS.

Statistical Analysis

All data was entered in Microsoft Excel sheet and analyzed using the trial version of IBM SPSS (Statistical Package for the Social Science) trial software version 21. Continuous data like age, body mass index (BMI), pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure were represented as mean + / - standard deviation. Categorical data like sex, American Society of Anaesthesiologists (ASA) grading, adverse effects were represented as absolute numbers and percentages. Intergroup comparison of demographic data, duration of sensory and motor block, duration of analgesia, heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure values were carried out by student's t test.

RESULTS

A total of 60 patients were randomized into two equal groups, with 30 patients allocated to the dexmedetomidine group and 30 to the dexamethasone group. The progression of participants through each stage of the trial-from enrolment to analysis—has been illustrated using a CONSORT (Consolidated Standards of Reporting Trials) flow diagram, as shown in **Figure 1**. With regards to distribution of age, weight, gender and ASA classification no difference was seen as shown in

Table 1.

Figure 1: Consolidated Standards of Reporting Trials (CONSORT) flow chart			
Group	**Group 1**	**Group 2**	**P**
Gender (Male/Female)	20/10	18/12	0.592
Age (Years)	36.90±10.420	35.7±9.717	0.646
Weight (Kg)	69.83±4.814	69.87±4.524	0.978
ASA PS I/II	23/7	26/4	0.317
Table 1: Patient demographical profile characteristics			

Data are expressed as mean±SD or as number of patients. We observed a comparable onset time of sensory and motor block among the two groups and found that Group 2 has delayed onset of sensory and motor block compared to Group 1

(Table 2)

Parameter	**Group**				**P value**
	Group 1		**Group 2**		
	Mean	**SD**	**Mean**	**SD**	
Onset of sensory block (min)	8.8	1.324	11.37	1.884	**<0.001**
Onset of motor block (min)	14.27	1.388	16.03	2.141	**<0.001**
Table 2: Distribution of onset of motor and sensory block among the study groups					

The mean duration of motor block in Group 1 was 14.275±1.71498 and 11.7667±1.45468 in Group 2 (P < 0.001) **(Table 3).**

The duration of motor block was significantly extended in Group 1 by 2hrs and 5mins when compared to Group 2. Group 1 shows a significantly extended sensory block compared to Group 2 (P<0.001).

Parameters	**Group**				**P value**
	Group 1		**Group 2**		
	Mean	**SD**	**Mean**	**SD**	
Duration of sensory block (hr)	22.717	2.2232	16.867	2.7258	**<0.001**
Duration of motor block (hr)	14.275	1.71498	11.7667	1.45468	**<0.001**
Table 3: Distribution of duration of motor and sensory block among the study groups					

The duration of analgesia was found to be notably prolonged in Group 1 compared to Group 2 (P<0.001).

Parameter	Group				P value
	Group 1		Group 2		
	Mean	SD	Mean	SD	
Duration of analgesia (hrs)	24.25	1.8971	18.867	2.4316	<**0.001**

Table 4: Distribution of duration of analgesia among the study groups

VAS score is comparable between two groups at 18 hrs and 24 hrs (P<0.001) as shown in **Fig 2.**

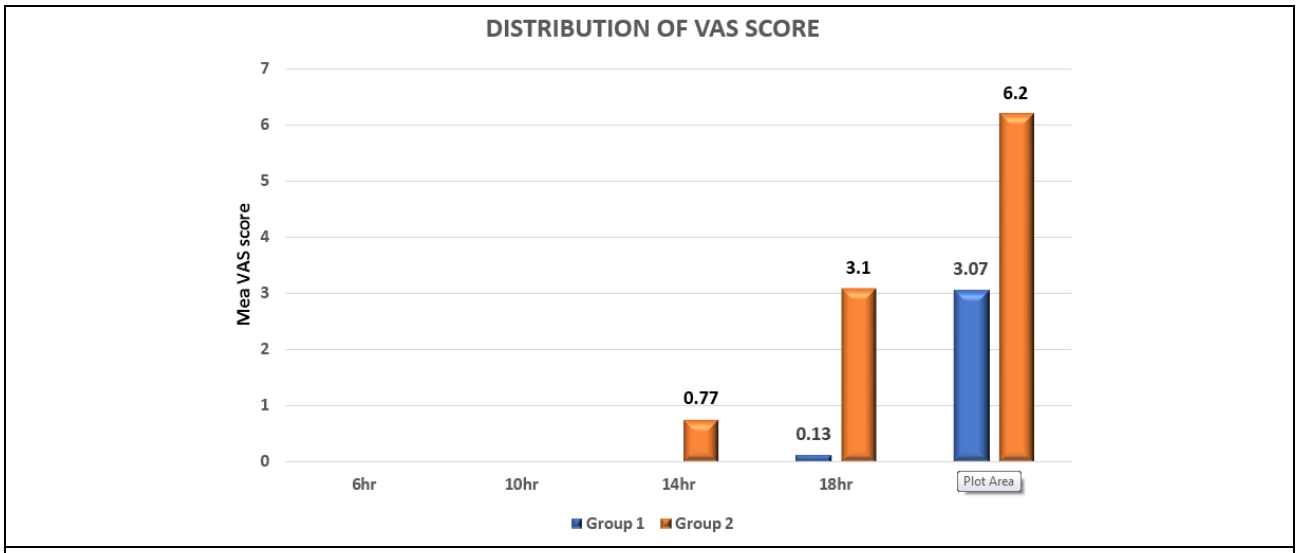

Figure 2: Distribution of VAS score

The heart rate, Systolic and diastolic blood pressure recordings were on lower side perioperatively in patients of Group 1 compared to Group 2. No patients developed significant bradycardia. No other side effects was observed in any of the patients.
Majority of patients in Group 1 reported having a sound sleep during the procedure.

DISCUSSION

In this study, the addition of 1 mcg/kg dexmedetomidine to 30 ml of 0.5% ropivacaine in an ultrasound-guided supraclavicular brachial plexus (SCBP) block was found to significantly hasten the onset of both sensory and motor blockade. It also prolonged the duration of sensory and motor block, as well as the overall duration of postoperative analgesia.
Consistent with our findings, Chinappa et al. showed that 1 mcg/kg dexmedetomidine, when used with 30 ml of 0.5% ropivacaine, expedited the onset and extended the duration of both sensory and motor block in SCBP blocks, along with improved postoperative analgesia.[9] Similar results were reported by Waindeskar et al., who used the same dose of dexmedetomidine with 0.325% levobupivacaine.[10] Multiple other studies have also reported comparable outcomes, further validating these observations.[11,12]
Our results are supported by Kalpana et al., who observed that adding 6 mg dexamethasone to 0.5% plain ropivacaine in SCBP block led to a faster onset of both sensory and motor block, along with prolonged duration.[13] This is in concordance with findings by Dar et al.[14] Furthermore, another study using 8 mg dexamethasone with 0.5% levobupivacaine demonstrated similar benefits, including reduced rescue analgesic need and prolonged block duration.[15]
Our findings indicate that while both dexmedetomidine and dexamethasone are effective adjuvants to ropivacaine in achieving early sensory and motor block onset, dexmedetomidine provides superior

results. It offers not only a faster onset but also significantly longer durations of blockade and analgesia compared to dexamethasone.

In our study, the addition of dexmedetomidine to 0.5% ropivacaine resulted in a significant prolongation of analgesia. Similarly, Ammar et al. reported a notable reduction in the need for intravenous morphine as a rescue analgesic (4.9 mg vs. 13.6 mg) when dexmedetomidine was used as an adjuvant in an infraclavicular brachial plexus block.[11]

In the present study, both dexmedetomidine and dexamethasone were found to significantly prolong the duration of analgesia when used as adjuvants to local anesthetics. However, on direct comparison, dexmedetomidine demonstrated a longer duration of analgesic effect than dexamethasone. This extended sensory block likely accounts for the reduced requirement of rescue analgesics observed within the first 24 hours postoperatively in the adjuvant groups.

These findings are consistent with previous studies that have evaluated the analgesic benefits of dexmedetomidine and dexamethasone as peripheral nerve block adjuvants.[10,11,13,15] Nevertheless, direct comparisons with existing literature remain challenging due to variability in study methodologies. Differences in local anesthetic concentrations and combinations, types and doses of adjuvants, regional anesthesia techniques, and methods of block assessment contribute to this heterogeneity, limiting the ability to draw uniform conclusions across studies.

While our findings suggest that dexmedetomidine provides a longer duration of analgesia compared to dexamethasone, the literature presents mixed evidence on this comparison. An indirect adjusted meta-analysis of 49 trials reported dexamethasone to be superior, demonstrating a greater prolongation of analgesia.[16]

However, several direct comparative studies have yielded contrasting results, favoring dexmedetomidine over dexamethasone in terms of analgesic duration.[17,18] This discrepancy may be attributed to differences in study designs, dosing regimens, routes of administration (perineural vs. intravenous), and patient populations. Therefore, while dexmedetomidine appeared more effective in our study, further well-designed, head-to-head trials are needed to establish the definitive superiority of one adjuvant over the other.

LIMITATIONS

Our study has few limitations like fixed dose of dexamethasone as compared to per kg body weight dose of dexmedetomidine, sample size was 60 patients in total so generalization for population is difficult, a study with larger sample size will allow to generalize the study, post operative follow up period restricted to 24 h.

CONCLUSION

With above mentioned limitations, we conclude that addition of 1 mcg/kg dexmedetomidine 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 also extends the duration of analgesia without any added major side effect.

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Nil

Conflicts of Interest
There are no conflicts of interest

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