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Research Article

Dexmedetomidine as an Adjuvant to Ropivacaine in Ultrasound Guided Brachial Plexus Block Using Supraclavicular Parasagittal Approach for Upper Limb Orthopedic Surgeries

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ABSTRACT

Background: Brachial plexus block is a key technique in anesthesiologist's practice. Ropivacaine is a long acting local anaesthetic, Dexmedetomidine has been included as an adjuvant to enhance block duration.
Aim: To elucidate the effect of addition of Dexmedetomidine to Ropivacaine in ultrasound guided parasagittal supraclavicular brachial plexus approach with respect to duration of analgesia, onset and duration of sensorimotor blockade.
Methods: A randomized single blinded prospective clinical study was conducted among Forty patients of 20-50yrs, ASA Grade I and II, weighing >60kgs scheduled for elective upper limb orthopedic surgeries. Group RN received 25ml of 0.75% ropivacaine with 1ml normal saline, Group RD received 25ml of 0.75% ropivacaine with 1mcg/kg dexmedetomidine diluted to 1ml. Analgesic efficacy, sensorimotor blockade was determined.
Statistical Analysis: Demographic and hemodynamic data was analyzed using student t-test. Unpaired t-test was used to analyze onset, duration of sensorimotor blockade and analgesic duration. Results were statistically significant if p-value <0.05. P-value <0.001 was considered highly significant.
Results: Analgesic duration was prolonged in Group RD rather than Group RN (646.82 +/- 21.56min vs 484.78 +/- 15.52min). Group RD had rapid onset of sensory (7.4 +/- 1.02min vs 9.9 +/- 1.16min) and motor blockade (10.25 +/- 1.13min vs 13.28+/- 1.22min). Duration of sensory (536.62 +/- 9.61min vs 413.79 +/- 15.61min) and motor blockade (430.13 +/- 11.68min vs 298.12 +/- 15.36min) was enhanced in Group RD.
Conclusion: Adding Dexmedetomidine to Ropivacaine provided superior analgesia along with rapid onset and longer duration of sensorimotor blockade.

Brachial plexus block is a key technique in anesthesiologist's practice, and a better alternative for upper limb surgeries [1]. Although many different approaches to the brachial plexus have been described, there is widespread acceptance that injecting at the supraclavicular level is the most reliable method in terms of spread of local anaesthetic agent. Using ultrasound for brachial plexus blocks has improved success rates [2].

Ropivacaine is a long-acting regional anaesthetic that is structurally related to Bupivacaine. It is a pure (S)-enantiomer, unlike Bupivacaine, which is a racemate, developed for the purpose of reducing potential toxicity

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and improving relative sensory and motor block profiles [3].

Dexmedetomidine is a newer α2-adrenoreceptor agonist known for its sedative, analgesic, anxiolytic properties. Dexmedetomidine acts by reducing inflammation around peripheral nerves, and decreases the potential for peripheral nerve injury [1].

Methods

On obtaining institutional ethical committee clearance, patients belonging to ASA status I & II, aged between 20-50 yrs, weighing>60kgs scheduled for elective upper limb orthopedic surgeries under ultrasound guided supraclavicular brachial plexus block using parasagittal approach at Rajarajeswari Medical College and Hospital, were recruited for a prospective randomized single blinded study. Patients with bleeding disorders, uncontrolled diabetes mellitus, renal and liver diseases, pregnant and lactating women, patients with epilepsy, neurological diseases & known hypersensitivity to local anesthetics were excluded from the study. The patients in whom block was not found effective were excluded from the study and given general anaesthesia.

Patients were randomly assigned into two groups based on open envelope method, Group RN and RD. Based on a previous study conducted by Swami SS et.al, [4] we take an approximate value of SD1=98 minutes and SD2=62minutes for duration of analgesia. With Z=1.96 (for a 95% probability) and d =36, we estimate a sample size of approx. 40, (20 in each group). Group RN - patients were given 25ml of 0.75% ropivacaine & 1ml of normal saline. Group RD - patients were given 25ml of 0.75% ropivacaine & 1mcg/kg of dexmedetomidine constituted to 1ml.

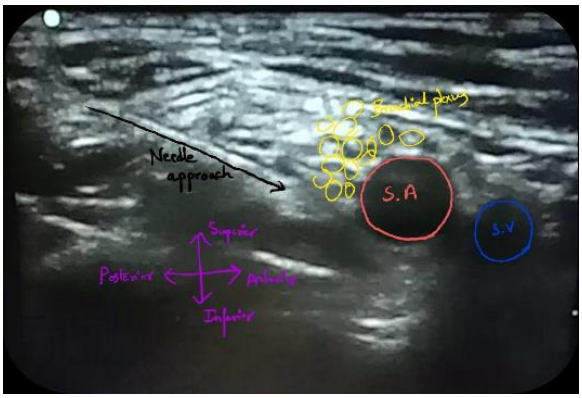
All patients were subjected to detailed pre-anesthetic workup and evaluation. Day prior to surgery patients were attended, examined, explained regarding the procedure and taught to interpret the visual analogue scale (VAS). Informed written consent was taken.

Routine fasting guidelines were maintained. Patients were pre-medicated with oral alprazolam 0.25 mg and ranitidine 150 mg night prior to surgery and inj. Ondansetron 4mg & inj. Ranitidine 50mg, 30 minutes prior to surgery.

Once the patients were shifted to operation theatre, standard anesthesia monitoring- heart rate, NIBP, ECG and SpO2 were started. Intravenous line was secured with 18G cannula in an unaffected limb and I.V. Fluids were given according to the requirement.

Tray with all necessary tools required for brachial was kept ready. The two groups receiving the block were unaware of the composition of the drugs used in block. Patients were positioned supine on the table with pillow under the shoulder with the head turned 45 degrees to the contralateral side to make the landmark more prominent. A pen was placed at the root of the neck and the skin underlying the pen was marked. The pen therefore lies against the skin overlying the trapezius muscle posteriorly and the scalene muscles anteriorly, in a strictly parasagittal plane, with the arc of first rib beneath. An ultrasound machine (sonosite) and a 12 MHz linear type probe was used. After strict aseptic skin preparation and local anesthetic infiltration of skin, probe was placed in parasagittal plane (Figure 1) in the anterior part of supraclavicular fossa, and then a 23G spinal needle was advanced from the anterior border of the trapezius muscle in plane with the ultrasound probe, 10cm extension was attached to the needle and advanced till the tip entered the sheath of plexus, and then volume of prepared local.

Figure 1- Ultrasound image of brachial plexus in parasagittal approach



Anesthetic mixture either with 1ml of normal saline or 1mcg/kg of dexmedetomidine diluted to 1ml was injected after negative aspiration. Sensory and motor blocks were assessed soon after the block was given. Post operatively the patients were followed up for the duration of analgesia and other block characteristics at regular intervals.

The study characteristics were defined and interpreted as below:

Analgesic duration was the interim between complete sensory block and first analgesic request by the patient.

Sensory onset was the interim between the end of local anaesthetic administration and complete sensory block.

Duration of sensory block was the interim between the complete sensory block and complete resolution of anesthesia in the area of distribution of the concerned nerves.

Motor onset was the interim between total local anaesthetic administration and complete motor block in the patient.

Duration of motor block was the interim from complete motor block to complete recovery of motor function of hand and forearm.

Sensory block assessment was done by placing a wisp of cotton over the patient's skin at the desired dermatomal level and appreciating the patient's response to the stimuli.

Motor block was assessed by thumb abduction (radial nerve), thumb opposition (median nerve), thumb adduction (ulnar nerve) on a 3-point scale for motor function.

0= normal motor function,
1= reduced motor strength but able to move fingers,
2= complete motor block

Since we used Dexmedetomidine as an adjuvant, sedation score was assessed according to the Ramsay Sedation Scale (RSS) was used to assess sedation score intra-operatively & post-operatively as follows: 1 = awake, anxious, agitated, or restless; 2 = awake, cooperative, oriented, or tranquil; 3 = awake, responds to commands only; 4 = asleep, brisk response to light, glabellar tap, or loud noise; 5 = asleep, sluggish response to light, glabellar tap, or loud noise; 6 = asleep, no response to light, glabellar tap, or loud noise;

Any adverse events like bradycardia, hypotension, hypoxemia, sedation, respiratory depression, nausea and vomiting were noted. Bradycardia was defined as heart rate <50bpm, and hypotension was defined as decline in blood pressure < 20% from the baseline recordings. Hemodynamics were assessed intra-operatively and post-operatively. Visual Analogue Scale was used to assess pain and if VAS >4, rescue analgesic was considered. Rescue analgesic used was inj. Diclofenac 50mg and its requirement in 24 hours post-operative period was noted in both groups and computed accordingly.

Data was computed and entered in MS excel/analyzed using SPSS software version 16. Demographic and hemodynamic data was analyzed using student t-test. Unpaired t-test was used to analyze onset, duration of sensorimotor blockade and analgesic duration. Results were statistically significant if p-value <0.05. P-value <0.001 was considered highly significant.

Results

Forty patients were enrolled for the study as per the study protocol mentioned above, we did not have any drop-outs in our study. There was no block failure noted among patients in any of the groups. Both the groups RN and RD were comparable with respect to age, sex distribution, weight, height (demographic variables), ASA grading and duration of surgery (Table 1). Duration of analgesia was prolonged in Group RD compared to Group RN (646.82 +/- 21.56min vs 484.78 +/- 15.52min) (Table 2, Figure 2). Group RD had rapid onset of sensory (7.4 +/- 1.02min vs 9.9 +/- 1.16min) and motor blockade (10.25 +/- 1.13min vs 13.28 +/- 1.22min) (Table 3, Figure 3). Duration of sensory (536.62 +/- 9.61min vs 413.79 +/- 15.61min) and motor blockade (430.13 +/- 11.68min vs 298.12 +/- 15.36min) was enhanced in Group RD (Table 4, Figure 4). VAS scores were less in patients of Group RD which led to reduced total analgesic requirement in Group RD (68.62 ± 11.62) when compared to Group RN (102.66 ± 12.70) (p-value <0.001) (Table 5, Figure 5). Sedation scores were higher in Group RD when compared to Group RN. As per the observations noted hemodynamic stability was maintained in patients of both the groups without any significant variations. We did not notice bradycardia, hypotension, hypoxemia, nausea, vomiting and respiratory depression in any of the patients among both the groups.

Table 1- Demographic profile

	Group RN	Group RD	P value
Age(in yrs)	37.6 +/- 6.2	36.8 +/- 7.12	0.45
Weight (in kgs)	62.6 +/- 4.8	61.9 +/- 3.86	0.34
Height (in cms)	161.9 +/- 5.82	162.2 +/- 3.16	0.22
Sex	12:08	11:09	
ASA	10:10	10:10	
Mean duration of Surgery(in minutes)	69.2 +/- 3.16	68.8 +/- 3.04	0.13

Table 2- Duration of analgesia

	Group RN	Group RD	P value
Duration of analgesia (in min)	484.78 +/- 15.5	646.82 +/- 21.56	<0.001

Figure 2- Graphical representation of Duration of analgesia

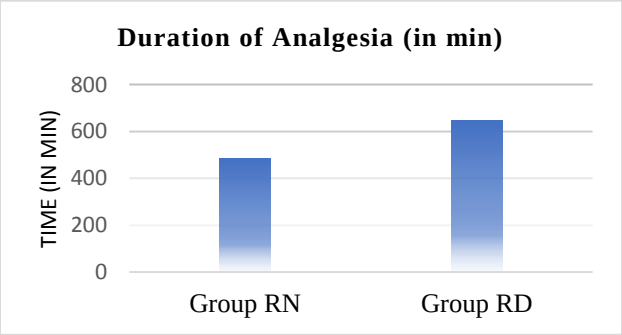


Table 3- Onset of sensory and motor blockade

	Group RD	Group RN	P value
Onset of sensory block (in min)	7.4+/-1.02	9.9+/-1.16	0.0031
Onset of motor block (in min)	10.25+/-1.13	13.28+/-1.22	0.0034

Figure 3- Graphical representation of onset of sensory and motor block

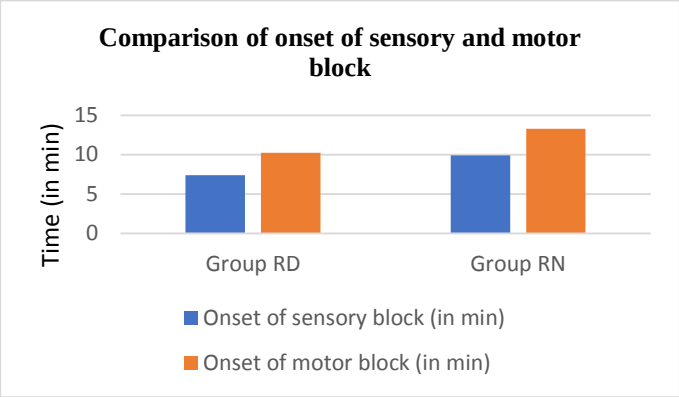


Table 4- Duration of sensory and motor blockade

	Group RN	Group RD	P value
Duration of sensory block (in min)	413.79 +/- 15.61	536.62 +/- 9.61	0.0036
Duration of motor block (in min)	298.12 +/- 15.36	430.13 +/- 11.68	<0.001

Figure 4- Graphical representation of duration of sensory and motor block

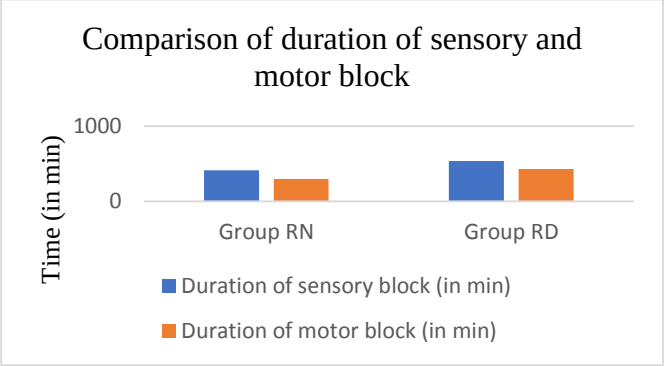
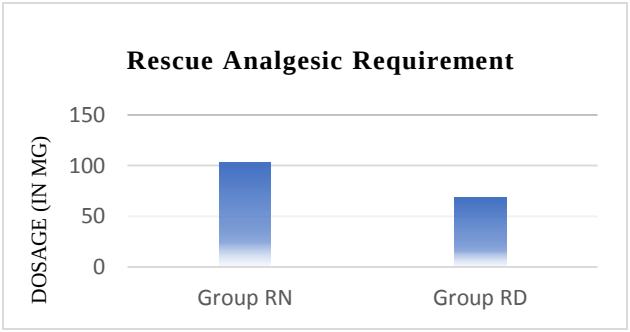


Table 5- Requirement of rescue analgesic

	Group RN	Group RD	P value
Rescue analgesic (inj.diclofenac) in mg	102.66 +/- 12.70	68.62 +/- 11.62	<0.001

Figure 5- Rescue analgesic requirement



Discussion

Brachial plexus block is a key anaesthetic technique which can be used solely or as a supplement to general anaesthesia for surgeries of the upper limb. Ropivacaine, is a local anesthetic used in different concentrations for peripheral nerve blocks. It has lesser cardiac toxicity and higher safety margin. Dexmedetomidine is an α2 agonist used as an adjuvant to Local anaesthetics in peripheral nerve blocks to reduce the time of onset and enhance the duration of the block.

Classic supraclavicular brachial plexus block using ultrasound by placing the probe posterior to the clavicle, with posterolatero-anteromedial orientation provides a very stable location in terms of anatomical delineation, but not always successful in few individuals.

Similar to the study conducted by Adrian Searle et.al, [2] we have used posterior parasagittal approach to the brachial plexus at the supraclavicular level, utilizing the arc of the first rib to provide a deep limit to needle transit, and probe stability by resting against the scalene muscles medially, and clavicle anteriorly. In this approach, brachial plexus, subclavian artery is separated from subclavian vein & plexus is positioned posterior to the artery. Injury to major structures before the needle approaches the brachial plexus is almost prevented. This technique ensures that the needle tip does not trespass the first rib or the pleural dome eliminating the risk of pneumothorax. So, we have used this approach.

Raeder et.al, [5] in their study compared efficacy of 0.75% Ropivacaine and 0.5% Bupivacaine in axillary plexus block and had come to the conclusion that 0.75% Ropivacaine produces axillary plexus block of similar onset and duration but better quality than Bupivacaine 0.5%. Keeping this in consideration, we have used 0.75% Ropivacaine.

In the study conducted by Swami et.al, [4] they found that Dexmedetomidine(1mcg/kg) when added to local anaesthetic enhanced the duration of sensory and motor block & analgesic duration as compared to clonidine(1mcg/kg). Hence, we have used dexmedetomidine.

Rashmi et.al, [6] in their study found that addition of dexmedetomidine to 0.75% ropivacaine in interscalene block significantly reduced the time of onset of the block and enhanced the duration of sensorimotor blockade. We have noticed the similar findings in our study.

In the study conducted by Jung et.al, [7] they found that optimal dose of perineural dexmedetomidine in interscalene block for arthroscopic shoulder surgery as 2mcg/kg, which was associated with increased risk of hypotension. So, we had used dexmedetomidine in the dose of 1mcg/kg.

Based on the study conducted by Sinha et.al, [8] dose of 1mcg/kg of dexmedetomidine with local anaesthetic is a good balance between safety and efficacy. Our study correlates with the study conducted by Nallam et.al, [9] wherein they too found out that addition of 100mcg of dexmedetomidine in brachial plexus block enhances the onset and prolongs the duration of sensorimotor blockade and analgesia, and had higher incidence of bradycardia and sedation, which was relatively less with our study.

Based on the study conducted by Zhang et.al, [10] Dexmedetomidine when added to ropivacaine prolongs the duration of the block, & may also lead to side effects like bradycardia, hypertension, and hypotension. Fritsch et.al, [11] in their study added 150mcg of dexmedetomidine to ropivacaine for interscalene blocks and observed prolongation in the duration of the nerve block and improvement in postoperative pain.

Meta-analysis conducted by Dai et.al, [12] concluded that Dexmedetomidine added to ropivacaine in BPB has a better analgesia effect. Liu et.al, [13] studied the analgesic efficacy on addition of dexmedetomidine to ropivacaine and found that duration of analgesia was 590minutes, which correlates with our study.

In the study conducted by Bangera et.al, [14] it had been found that addition of Dexmedetomidine (1mcg/kg) to ropivacaine provided rapid onset of anaesthesia and enhanced duration of analgesia, similarly noted in our study. Our study correlates with the study conducted by Koraki et.al, [15] wherein they indicated that dexmedetomidine as an adjuvant prolonged the duration of sensory block and analgesia, as well as enhanced the time to onset of sensory block.

Our study has noted superior block characteristics together with enhanced post-operative analgesia on addition of Dexmedetomidine as an adjuvant to 0.75% Ropivacaine when compared to Ropivacaine alone in supraclavicular brachial plexus block. Our study had some limitations, we chose 1mcg/kg dexmedetomidine as earlier studies had a mention of bradycardia and hypotension with higher doses. However, further studies need to be carried out with larger samples to validate our observations using different dosage protocols.

Conclusion

We conclude from our present study that addition of 1mcg/kg of Dexmedetomidine to 0.75% Ropivacaine enhanced the quality of block, onset of both sensory & motor blockade. Duration of sensory and motor blockade was prolonged, making it as one of the potential adjuvants for Ropivacaine in upper limb orthopedic surgeries.

References

[1] Kathuria S, Gupta S, Dhawan I. Dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. Saudi J Anaesth. 2015; 9(2):148-54.

[2] Searle A, Niraj G. Ultrasound‐guided brachial plexus block at the supraclavicular level: A new parasagittal approach. Int J Ultrasound Appl Technol Perioper Care. 2010; 1:19-2

[3] Kuthiala G, Chaudhary G. Ropivacaine: A review of its pharmacology and clinical use. Indian J Anaesth. 2011 ;55(2):104-10.

[4] Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (α2 agonist drugs) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. Indian J Anaesth 2012; 56(3):243-9.

[5] Raeder JC, Drøsdahl S, Klaastad Ø, Kvalsvik O, Isaksen B, Strømskag KE, et al. Axillary brachial plexus block with ropivacaine 7.5 mg/ml: A comparative study with bupivacaine 5 mg/ml. Acta Anaesthesiol Scand. 1999; 43(8):794-8.

[6] Rashmi HD, Komala HK. Effect of dexmedetomidine as an adjuvant to 0.75% ropivacaine in interscalene brachial plexus block using nerve stimulator: a prospective, randomized double-blind study. Anesth Essays Res. 2017; 11(1):134-139.

[7] Jung HS, Seo KH, Kang JH, Jeong JY, Kim YS, Han NR. Optimal dose of perineural dexmedetomidine for interscalene brachial plexus block to control postoperative pain in patients undergoing arthroscopic shoulder surgery: A prospective, double-blind, randomized controlled study. Medicine. 2018; 97(16):e0440.

[8] Sinha C, Kumar A, Kumari P, Singh AK, Sharma S, Kumar A, et al. Comparison of two doses of dexmedetomidine for supraclavicular brachial plexus block: A randomized controlled trial. Anesth Essays Res. 2018; 12(2):470-4.

[9] Nallam SR, Chiruvella S, Karanam S. Supraclavicular brachial plexus block: Comparison of varying doses of dexmedetomidine combined with levobupivacaine: A double-blind randomised trial. Indian J Anaesth. 2017; 61(3):256-261.

[10] Zhang Y, Wang CS, Shi JH, Sun B, Liu SJ, Li Pet al. Perineural administration of dexmedetomidine in combination with ropivacaine prolongs axillary brachial plexus block. Int J Clin Exp Med. 2014; 7(3):680-5.

[11] Fritsch G, Danninger T, Allerberger K, Tsodikov A, Felder TK, Kapeller M, et al. Dexmedetomidine added to ropivacaine extends the duration of interscalene brachial plexus blocks for elective shoulder surgery when compared with ropivacaine alone: a single-center, prospective, triple-blind, randomized controlled trial. Reg Anesth Pain Med. 2014; 39(1):37-47.

[12] Dai W, Tang M, He K. The effect and safety of dexmedetomidine added to ropivacaine in brachial plexus block: A meta-analysis of randomized controlled trials. Medicine. 2018; 97(41):e12573.

[13] Liu Z, Jiang M, Xu T, Hua H. Analgesic effect of Ropivacaine combined with Dexmedetomidine on brachial plexus block. BMC anesthesiology. 2018;18(1):107.

[14] Bangera A, Manasa M, Krishna P. Comparison of effects of ropivacaine with and without dexmedetomidine in axillary brachial plexus block: A prospective randomized double-blinded clinical trial. Saudi J Anaesth. 2016; 10(1):38-44.

[15] Koraki E, Stachtari C, Kapsokalyvas I, Stergiouda Z, Katsanevaki A, Trikoupi A. Dexmedetomidine as an adjuvant to 0.5% ropivacaine in ultrasound- guided axillary brachial plexus block. Journal of clinical pharmacy and therapeutics. 2018; 43(3):348-52.