

Perineural Dexmedetomidine as an Adjuvant to Ropivacaine in Supracalavicular brachial plexus nerve block

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Abstract

Introduction: Regional anesthesia techniques provide important advantages including excellent pain control, reduced side effects, and shortened stay in the post-anesthesia care unit. However, these early advantages can be short lived and limited by the relatively brief duration of the action of currently available local anesthetics, potentially resulting in block resolution before the period of worst post-operative pain.

Aim: The aim of the study is to compare the analgesic properties of perineural dexmedetomidine and intravenous dexmedetomidine to test the hypothesis whether the effect of dexmedetomidine is due to centrally mediated or its local action on nerve plexus.

Methods: This randomized, triple arm, triple-blind, controlled study was conducted in patients undergoing upper limb surgeries done under supraclavicular brachial plexus nerve block. Group C: 30 mL 0.5% ropivacaine and 30 mL normal saline in IV, Group D: 30 ml ropivacaine 0.5% containing 1 mics/kg dexmedetomidine and 50 ml normal saline, and Group D IV: 30 ml ropivacaine 0.5% and 50 ml normal saline containing 1 mics/kg dexmedetomidine.

Results: The onset of sensory block and motor block between groups is statistically significant. Perineural dexmedetomidine provides faster onset of sensory and motor block. Perineural dexmedetomidine prolongs the duration of both sensory and motor block. The quality of anesthesia was excellent in most patients in Group D and good in Group D IV and moderate in Group D IV.

Conclusion: Perineural dexmedetomidine with ropivacaine provides prolonged post-operative analgesia, hastens the onset of sensory and motor block, and prolongs the duration.

Key words: Brachial plexus block, Dexmedetomidine, Regional anesthesia, Ropivacaine

INTRODUCTION

Brachial plexus nerve block has evolved as an important technique in anesthesia day-to-day practice, as a safe alternative to general anesthesia for upper limb surgery and relief of perioperative and post-operative pain.^[1] Its increased popularity is due to advancements in regional

anesthesia technique in terms of newer adjuvant drugs and the use of ultrasound for safe and successful block. It helps to avoid side effects of general anesthesia, less financial burden, and reduced hospital stay. Many additives to local anesthetics such as opioids, neostigmine, clonidine, and tramadol have been used to improve post-operative pain management, to increase the duration of block, and to avoid the catheter placement for continuous drug infusion.^[2] A newer alpha-2-adrenoceptor agonist, dexmedetomidine is currently used for its sedation, analgesic, and anxiolytic properties. Administration of dexmedetomidine intravenously, pre- and intra-operative, has shown that the duration of sensory block was prolonged with local anesthetic during peripheral nerve block.^[3] In human beings, dexmedetomidine prolongs the duration of block and post-operative analgesia when

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Month of Submission : 09-2018
Month of Peer Review : 10-2018
Month of Acceptance : 11-2018
Month of Publishing : 11-2018

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added to local anesthetic solution in various regional blocks.^[4-6] In most human studies, dexmedetomidine is used as an adjuvant to bupivacaine or levobupivacaine.^[7] Ropivacaine is being preferred by an increasing number of anesthesiologists for peripheral nerve block, due to fewer side effects and unique pharmacological properties. There are very minimal studies on dexmedetomidine as an adjuvant to ropivacaine.^[4] This study was chosen with an aim to assess the effect of adding dexmedetomidine to ropivacaine 0.5% in supraclavicular brachial plexus nerve block in terms of onset and duration of sensory and motor blockade, quality of blockade, duration of post-operative pain relief, and to test the hypothesis, whether the effect of dexmedetomidine is due to centrally mediated or its local action on nerve plexus.^[1]

Aim

The aim of the study is to compare the analgesic properties of perineural dexmedetomidine and intravenous dexmedetomidine by assessing onset and duration of sensory and motor blockade, quality of blockade, duration of post-operative pain relief, and to test the hypothesis,

whether the effect of dexmedetomidine is due to centrally mediated or its local action on nerve plexus.

MATERIALS AND METHODS

This randomized, triple arm, triple-blind, controlled study was conducted in patients undergoing upper limb surgeries done under supraclavicular brachial plexus nerve block at Government Kilpauk Medical College and Government Royapettah Hospital, Chennai, between November 2016 and April 2017 will be assessed for inclusion and exclusion criteria and will be included in the study after obtaining written informed consent.

Inclusion Criteria

The following criteria were included in the study:

1. Patients undergoing elective upper limb surgeries under supraclavicular brachial plexus nerve block
2. Age between 18 and 50 years
3. Males and females
4. American Society of Anesthesiologists (ASA) Class 1 and 2
5. Patients who have given valid informed consent.

Exclusion Criteria

The following criteria were excluded from the study:

1. Patients not satisfying inclusion criteria.
2. Patients with an allergy or sensitivity to local anesthetics (LAs) and dexmedetomidine.
3. Patients with preexisting peripheral neuropathy of upper limb.
4. Patients with bleeding disorders.
5. Infection at injection site.
6. Patients with untreated pneumothorax.
7. Patients who are unconscious or severely ill.
8. Pregnant patients.
9. Patients with a history of severe cardiac, respiratory, hepatic, or renal disease.

Patients in the above-mentioned inclusion criteria selected will be counseled about the risks and benefits involved in the study. After getting consent, patients who are willing to be included in the study will be enrolled and analyzed. A total of 60 patients will be included in the study. Patients will be divided into three groups of 20 patients of each as follows:

Group C: Ultrasound-guided supraclavicular brachial plexus block given with 30 ml of ropivacaine 0.5% and 50 ml normal saline administered as IV infusion over 15 min.

Group D: Ultrasound-guided supraclavicular brachial plexus block given with 30 ml ropivacaine 0.5%

Table 1: Duration of surgery

Group	Duration of surgery (minutes)		P value
	Mean	SE	
Ropivacaine	125.50	3.99	0.710
Ropivacaine+perineural dexmedetomidine	130.10	4.08	
Ropivacaine+IV dexmedetomidine	128.75	4.02	

SE: Standard error

Table 2: Onset of sensory blockade

Group	Onset time of sensory blockade (minutes)		P value
	Mean	SE	
Ropivacaine	24.75	0.46	0.0001
Ropivacaine+perineural dexmedetomidine	10.45	0.34	
Ropivacaine+IV dexmedetomidine	17.35	0.60	

SE: Standard error

Table 3: Onset of motor blockade

Group	Onset time of motor blockade (minutes)		P value
	Mean	SE	
Ropivacaine	38.00	0.82	0.0001
Ropivacaine+perineural dexmedetomidine	19.75	0.54	
Ropivacaine+IV dexmedetomidine	32.50	0.61	

SE: Standard error

Table 4: Duration of sensory blockade

Group	Duration of sensory blockade (minutes)		P value
	Mean	SE	
Ropivacaine	512.55	5.99	0.0001
Ropivacaine+perineural dexmedetomidine	882.75	11.29	
Ropivacaine+IV dexmedetomidine	701.00	6.41	

SE: Standard error

Table 5: Duration of motor blockade

Group	Duration of motor blockade (minutes)		P value
	Mean	SE	
Ropivacaine	433.35	6.59	0.0001
Ropivacaine+perineural dexmedetomidine	818.25	10.66	
Ropivacaine+IV dexmedetomidine	663.00	8.83	

SE: Standard error

Table 6: Quality of anesthesia

Group	Quality of anesthesia			P value
	2	3	4	
Ropivacaine	12	6	2	0.0001
Ropivacaine+perineural dexmedetomidine	0	9	11	
Ropivacaine+IV dexmedetomidine	0	13	7	

SE: Standard error

containing 1 mics/kg dexmedetomidine and 50 ml normal saline administered as IV infusion over 15 min. Group D IV: Ultrasound-guided supraclavicular brachial plexus block given with 30 ml ropivacaine 0.5% and 50 ml normal saline containing 1 mics/kg dexmedetomidine administered as IV infusion over 15 min.

Sensory and motor block evaluation was done every 5 min after giving block until complete sensory and motor blocker 30 min, whichever is earlier. Sensory block was assessed by pinprick test with 23G hypodermic needle in the distribution of all four nerves (ulnar, median, radial, and musculocutaneous nerves) using a 3-point scale as 0=Normal sensation, 1=Loss of sensation of prick, and 2=Loss of sensation of touch. Motor block was evaluated by thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb opposition (median nerve), and flexion at elbow (musculocutaneous nerve) on a 3-point scale as follows: 0=Normal motor function, 1=Reduced motor strength, and 2=Complete motor block. Onset time for sensory or motor block was defined as the time interval between the end of total local anesthetic

administration and complete sensory or motor block. Complete sensory block was defined by anesthetic block on all nerve territories. Complete motor block was defined as the absence of voluntary movement on hand and forearm.

RESULTS

There is no statistical difference in the demographics between the groups. The mean age was 31.25 in Group C, 30.45 in Group D, and 31.90 in Group D IV. The gender distribution in Group C was 16 males and 4 females, 13 males and 7 females in Group D, and 12 males and 8 females in Group D IV. The mean weight in Group C was 60.70 kg, 61.15 kg in Group D, and 64.00 kg in Group D IV. 18 patients belong to ASA 1 and two patients belong to ASA 2 in Group C. 16 patients come under ASA 1 and four patients under ASA 2 in Group D. 17 patients belong to ASA 1 and three patients belong to ASA 2 in Group D IV. There was no statistically difference among the patients in the three groups with respect to age, weight, height, gender, body mass index, duration of surgery, and ASA physical status, as *P* value was not significant ($P > 0.05$) Table 1. The onset of sensory block was 24.75 min in Group C, 10.45 min in Group D, and 17.35 min in Group D IV, and was statistically significant with $P = 0.0001$ Table 2. It shows that perineural dexmedetomidine provides faster onset of sensory block. The onset of motor block was 38.00 min in Group C, 19.75 min in Group D, and 32.50 min in Group D IV. It was statistically significant with $P = 0.0001$ Table 3. It means that perineural dexmedetomidine provides faster onset of motor block. The duration of sensory block was 512.55 min in Group C, 882.75 min in Group D, and 701.00 min in Group D IV. It was found to be statistically significant with $P = 0.0001$ Table 4. The duration of motor block was 433.35 min in Group C, 818.25 in Group D, and 663.00 in Group D IV, and was statistically significant with $P = 0.0001$ Table 5. It indicates that the perineural dexmedetomidine prolongs the duration of both sensory and motor block. The quality of anesthesia was excellent in most patients in Group D and good in Group D IV and moderate in Group D IV Table 6.

DISCUSSION

Apart from sedative, analgesic, hemodynamic-stabilizing properties, and sympatholytic pharmacologic effects, the alpha (α)-2-adrenergic receptor agonists have been used to increase the duration of thermal antinociception and analgesia in some animal studies. Our study demonstrated that addition of an alpha agonist like dexmedetomidine

to ropivacaine resulted in prolonged duration of analgesia postoperatively. It also showed that there were early onset and prolonged duration of sensory and motor blocks. By increasing the duration of analgesia with a single block, we could achieve a longer duration of post-operative analgesia without significant clinical side effects.^[3] In our study, we have found that addition of dexmedetomidine (50 µg) to 30 ml ropivacaine 0.5% in ultrasound-guided brachial plexus block resulted in a quick onset of sensory and motor block prolonged duration of both sensory and motor block, prolonged duration of analgesia, and a good quality of analgesia. Bupivacaine, levobupivacaine, and ropivacaine are all long-acting LAs. Due to its unique pharmacologic properties and fewer side effects, ropivacaine has been accepted by an increasing number of anesthesiologists for peripheral nerve blocks.^[8]

Zhang *et al.*, in 2014, also reported prolonged sensory and motor blockade duration in patients who received dexmedetomidine (50 µg) in 40 ml of 0.33% ropivacaine when compared to control group for axillary brachial plexus blockade.^[4]

Esmoğlu *et al.* showed that dexmedetomidine added to levobupivacaine for axillary brachial plexus blocks shortens the onset time and prolongs the durations of the blockade and post-operative analgesia, which also leads to bradycardia. However, no difference in the onset time with or without the use of dexmedetomidine was found in our study, possibly due to the different LAs.^[9]

Dexmedetomidine can cause dose-dependent side effects such as bradycardia and hypotension. We used 20 µg perineural and systemic dexmedetomidine and did not find hemodynamic side effects, which support the safety profile of our study medication regime.^[10]

CONCLUSION

It is concluded that in supraclavicular brachial plexus nerve block addition of dexmedetomidine as an adjuvant to 0.5% ropivacaine shortens the onset of sensory and motor block, and prolongs the duration of sensory and motor block. It delays the first requirement for analgesia supplementation and provides better quality of anesthesia, greater patient satisfaction. Hence, therefore, the action of dexmedetomidine is most probably peripheral rather than centrally mediated.

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How to cite this article: Kumar KD, Kamal JSK, Sellappan P. Comparative Study of Perineural Dexmedetomidine as an Adjuvant to Ropivacaine and Intravenous Dexmedetomidine in Patients Undergoing Upper Limb Surgeries under Ultrasound Guided Supraclavicular Brachial Plexus Nerve Block. *Int J Sci Stud* 2018;6(8):1-4.

Source of Support: Nil, **Conflicts of Interest:** None declared.