***International Journal of Biomedical Research***
ISSN: 0976-9633 (Online); 2455-0566 (Print)
Journal DOI: 10.7439/ijbr
CODEN: IJBRFA

**Original Research Article**

# Effect of dexmedetomidine as an adjuvant to 0.75% ropivacaine in axillary brachial plexus block for forearm and hand surgeries

**S. Arun***

*Assistant Professor, Department of Anesthesiology, Dr. S.M.C.S.I Medical College, Karakonam, Trivandrum, India*

***Correspondence Info:**
Dr. S. Arun M.D. Anesthesiology,
Assistant Professor,
Dr. Somervell Memorial CSI Medical College (SMCSI),
Parassala Vellarada Road, Thiruvananthapuram, Kerala 695504 India
E-mail: arunsam85@yahoo.com

## Abstract

**Objective**: In this study, we aimed to investigate the effects of adding dexmedetomidine to 0.75% Ropivacaine for an axillary brachial plexus block with respect to onset and duration of sensory and motor block and duration of analgesia.
**Methods**: 60 patients of American Society of Anesthesiologists physical status I/II scheduled to undergo forearm and hand surgery, in which an axillary block was used, were randomly divided into 2(30 each) groups:
Group R patients - 25 ml Ropivacaine 0.75% plus 1 ml of normal saline.
Group D patients -25 ml Ropivacaine 0.75% and 1 mL dexmedetomidine (50 µg).
Demographic data, mean arterial pressure, heart rate , peripheral oxygen saturation, sensory and motor block onset times and block durations, time to first analgesic use, total analgesic need, postoperative visual analogue scale data, and side effects were recorded for each patient.
**Results**: Sensory block onset time was shorter in group D ($P$ <0.05). Sensory block duration and time to first analgesic use were significantly longer in group D ($P$ < 0.05). No statistically significant changes in intraoperative MAP and HR, spo2 among two groups. Bradycardia, hypotension, hypoxemia, nausea, vomiting, and any other side effects were not seen in any patients**.**
**Conclusions**: It was concluded in our study that adding dexmedetomidine to axillary brachial plexus block shortens sensory block onset time, increases the sensory block duration and time to first analgesic use, and decreases total analgesic use with no side effects.
**Keywords:** Dexmedetomidine, Ropivacaine, Brachial Plexus Block

## 1. Introduction

An effective Pain management in postoperative period may improve patient satisfaction, contribute to lower postoperative morbidity, a faster recovery & rehabilitation, and decrease the cost of treatment as a whole.

Most of the 20th century saw the development of chemical compounds with improved safety profile. Conduction block with Ropivacaine [1] in low doses displays greater sensory and motor separation and a lower incidence of serious adverse effects make it the preferred drug in its class for peripheral nerve blockade. Adjuvants with ropivacaine are being used to improve the quality of block, to achieve a better intraoperative hemodynamics and to increase the duration of postoperative analgesia with minimal side effects. Various adjuvants have been used to improve the efficacy of nerve blocks including antagonist of NMDA receptor (ketamine, magnesium), GABA agonist (midazolam), adrenergic agonist [2] (clonidine, adrenaline [3]), COX2 inhibitors (keterolac), tramadol [4] etc. Alpha 2 adrenergic agonists [5] used as adjuvants for peripheral nerve blockade produces better analgesic effects with minimum complication. Dexmedetomidine is a highly selective alpha2 adrenergic agonist with eight time greater affinity for alpha-2 than clonidine which is also an alpha adrenergic agonist [6]. Animal studies have shown that dexmedetomidine enhances onset of sensory and motor blockade along with increased duration of analgesia [7-9]

With the knowledge of pharmacological properties and drug interactions we designed a double blinded prospective randomized controlled study to study the effect of 0.75% ropivacaine alone and 0.75% ropivacaine with dexmedetomidine [5-7] in axillary brachial plexus block using nerve locator. Our aim is to compare the onset and duration of sensory and motor block and side effects.

### 1.1 Aim and objectives of the study

The aim of the study is to compare the efficacy of 0.75% ropivacaine and combination of 0.75% ropivacaine

and dexmedetomidine (50 µg) in axillary brachial plexus block for forearm and hand surgeries.

The objectives of the current study is to compare the efficacy of 0.75% ropivacaine along with combination of 0.75% ropivacaine and dexmedetomidine (50 µg) in axillary brachial plexus block with respect to

Onset of sensory block
Onset of motor block
Duration of sensory block
Duration of motor block
Rescue analgesia

## 2. Materials and Method

After obtaining ethical committee approval, this prospective randomized study was carried out.

**2.1. Study design:** A Prospective randomized double-blinded study.

**2.2. Sample size:** 60 patients were selected and allocated in two groups randomly.

**2.3. Study period-** one year

**2.4. Inclusion Criteria:**

ASA PS I & II
Age 18 to 60 for forearm and hand surgeries
Weight more than 60 kgs
Both sexes

**2.5. Exclusion Criteria:**

Patient Refusal
Patient with history of bleeding disorders
Patients on anticoagulation therapy
Patients with documented neuromuscular disorders
Patient with known allergy to local anesthetic drugs
Psychiatric illness

**2.6 Preop preparation**

Patients who satisfy the inclusion criteria were selected. Informed consent obtained from all the patients. Preoperative evaluation including detailed history, clinical evaluation, investigations and airway assessment were done. Visual Analogue Scale (VAS) was explained in detail to the patients in the preoperative period.

**2.7 Premedication**

All patients premedicated with inj glycopyrolate 0.2 mg IV 10 min before surgery. Patients also received midazolam 0.1 mg/kg before the procedure.

**2.8. Monitoring**

Continuous ECG, intermittent noninvasive blood pressure monitoring, Spo2 monitoring done.

**2.9. Methodology**

After preop evaluation, written informed consent, and premedication patient shifted inside the theatre. Intravenous access was done using 18 G I.V catheters and IV infusion was started. Preoperative heart rate, Spo2, blood pressure was obtained.

Patients were randomly assigned to one of the two groups using a "slips of paper in box" technique:

Group R-Receives 25 ml volume of 0.75% ropivacaine and 1 ml normal saline.

Group D - Receives 25 ml volume of 0.75% ropivacaine and 1 ml (50 µg) of dexmedetomidine.

Patients in both groups are placed in supine position with upper limb to be blocked kept with the arm abducted to 90˚ and the elbow flexed. Axillary block performed using nerve stimulator guidance in both groups

The following parameters were observed following the block.

**2.10. Hemodynamic parameters**

Pulse rate, non-invasive blood pressure, oxygen saturation are monitored. Mean arterial blood pressure and pulse rate, will be recorded before application of the block as well as immediately after block & 5 min intervals until 30 min & with 30 min intervals thereafter, until the end of the operation.O2 saturation will be monitored throughout the intraoperative and postoperative period .Any drop in blood pressure more than 20% from the baseline signifies hypotension and managed with inj. ephedrine 6 mg. Any decrease in pulse rate of less than 60 beats /min managed with inj. atropine

**2.10.1. Sensory block**

Sensory block tested with a 22-gauge hypodermic needle by using the pinprick test and compared with the same stimulation in the contra lateral hand. Sensory block tested every 1 min.

Time to Onset of Sensory Block (minute) is defined as the time between the end of last injection and the total abolition of the pinprick response, and complete paralysis in all sensation over hand and forearm

**2.10.2. Motor block**

Motor block accessed according to modified bromage scale [10] for upper extremity

0-able to raise the extended arm to 90˚for full 2 seconds;
1-able to flex the elbow and move the fingers but unable to rise the extended arm;
2-unable to flex the elbow but able to move the fingers.
3- unable to move arm, elbow or fingers.

Assessed at 1 minute interval until complete motor blockade occurred.

Time taken from the injection of drug to development of complete motor block (bromage score 3)

**2.10.3. Duration of sensorial block (minute)**

Time interval between withdrawal of the needle and reappearance of paresthesia in the 4 nerve distribution areas.

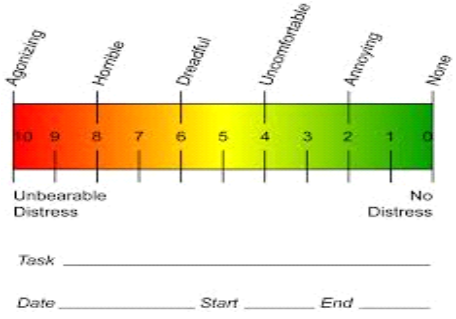
**2.10.4. Duration of motor block (minute):** defined as the time interval between the onset of motor block till the complete regression of motor block.

**2.10.5. First analgesic requirement time (minute):** Rescue analgesia is defined as the time interval between block placement and patient's first analgesic request.

Postoperatively, pain scores were recorded by using visual analogue score between 0 to 10(0-no pain, 10= most severe pain)

Rescue analgesia given at VAS score of 4 or above

**Fig 1: visual analogue score.**




During the intraoperative period and postoperative period patients monitored for side effects like hypotension, bradycardia, hypoxia, nausea, vomiting.

**2.10.6. Statistical analysis**

Data were analyzed using SPSS16.0V, software. Two sided independent "students t tests" to analyze continuous data and chi square test for categorical data were used. P<0.05 was considered as statistically significant.

## 3. Observation and results

The age, sex distribution, body weights, ASA status in the two groups were found to be comparable [Table 1].

**Table 1: Comparison of demographic data between the two study groups**

| | Group R | Group D | P value |
|---|---|---|---|
| Age | 36.2±12.881 | 37±12.268 | 0.390 |
| Weight | 67.5 ± 2.596 | 68.57±1.9950 | 0.08 |
| ASA I/II | 19/11 | 17/13 | 0.596 |
| Sex(M/F) | 25/5 | 25/5 | 0.09 |
| The results are expressed as Mean ±SD | | | |

The sensory and motor block onset was significantly quicker in group D than in group R. The mean sensory block onset time was 9.97±0.92 min in group D as compared to12.7±1.343 min in group R. The mean motor block onset time was 13.2±0.92 min in group D when compared to 15.6±1.589 min in group R.

**Table 2: Block characteristics**

| | Group R | Group D | P value |
|---|---|---|---|
| Sensory block onset | 12.7±1.343 (min) | 9.97±0.928 (min) | 0.001 |
| Motor block onset | 15.6±1.589 (min) | 13.2±0.925 (min) | 0.034 |
| Sensory block duration | 419.6±9.665 (min) | 597.33±10.807 (min) | 0.0028 |
| Motor block duration | 357.67±9.71 (min) | 360.00±8.3 (min) | 0.32 |
| Rescue analgesia | 607.33 ±13.62 (min) | 774.67 ± 10.743 (min) | 0.001 |
| The results are expressed as Mean ±SD (p-value<0.05, was considered statistically significant) | | | |

The duration of sensory as well as motor block was significantly prolonged in group D compared to group R. The duration of sensory block was maximum in group D 597.33±10.807 (min). 50±121.98 min) and 419.6±9.665 (minutes) in Group R.

The duration of motor block was 360.00±8.3 (minutes) in group D), and 357.67±9.71 (minutes) in group R. Duration of motor block was found to be not statistically significant.

The duration of analgesia was significantly prolonged in group D (774.67 ± 10.743 (min)) when compared with group R (607.33 ± 13.62in).

**Table 3: Hemodynamic variables**

| Parameters | Group R | Group D | P value |
|---|---|---|---|
| Intraoperative spo2 | 99± 0.0046 | 99±0.0026 | 0.9602 |
| Postoperative spo2 | 100±0.001 | 99±0.00111 | |
| Pulse rate | 81.87±1.737 | 81.43±1.775 | 0.343 |
| Mean arterial blood pressure | 105.3±2.748 | 105.07±2.703 | 0.962 |

There was no statistical significance between two groups in respect to Saturation, and hemodynamic variables both during intraoperative and postoperative period (P>0.05) Bradycardia, hypotension, hypoxemia, nausea, vomiting, and any other side effects were not seen in any patients.

## 4. Discussion

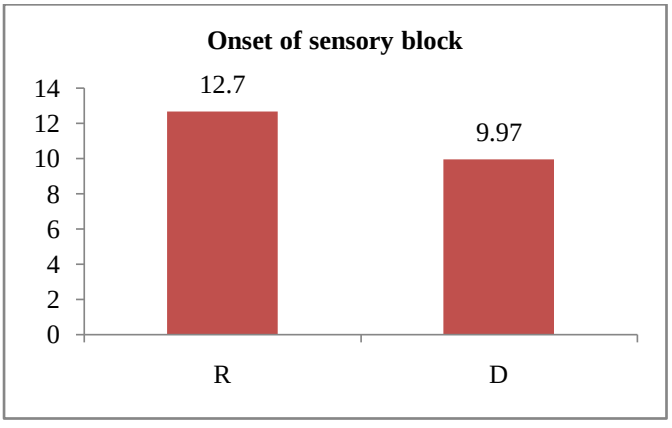
Adjuvants are used along with local anesthesia to improve the quality of block .An ideal adjuvant should provide a longer duration of analgesia and better hemodynamic stability. Alpha 2 agonists show promising results with local anesthetics in increasing the block duration and quality.

Brummett *et al* [8] states dexmedetomidine added to ropivacaine increased the duration of sciatic nerve blockade in rats, most likely due to the blockade of hyperpolarization-activated cation current (i.e., a direct effect on the peripheral nerve activity

Abdallah *et al* [11] showed that perineural dexmedetomidine as a local anesthetic adjuvants can prolong the duration of analgesia when compared to local anesthesia alone.

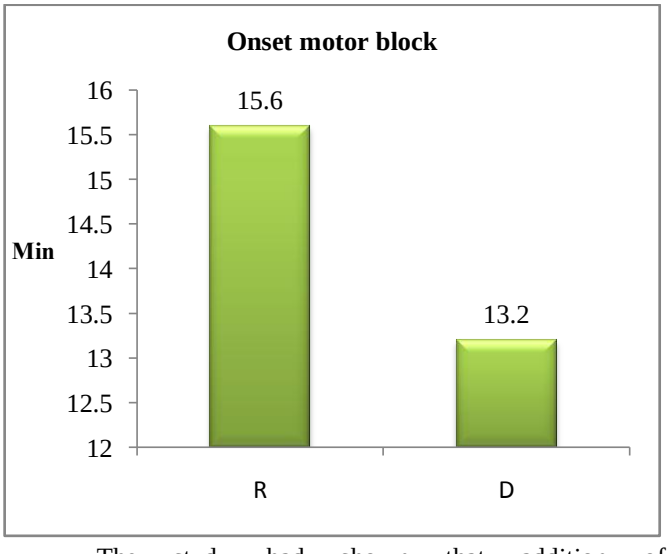
In our study 50 µg(1 ml) of dexmedetomidine was added to 25 ml of 0.75% ropivacaine or 25ml of 0.75% ropivacaine 1 ml of normal saline added. The efficacy of dexmedetomidine as an adjuvant in axillary brachial plexus block was studied in 30 patients in each group who underwent elective forearm and hand surgeries.

**Fig 2: Onset on sensory block**




The study had shown that addition of dexmedetomidine with ropivacaine in group D reduced the onset time for sensory block (fig 2) when compared to ropivacaine with normal saline in group R. In the group R the onset of sensory block was only 12.7±1.343 compared to group D which was shorter 9.97±0.928. This result was concurrent with the Feroz Ahmad Dar *et al* [12] where they concluded Sensory and motor block onset times were shorter in group RD (11.3±2.61) minutes than in group R (13.12±2.30) minutes. This also correlated with study of Lin *et al* [13] where they concluded that the addition of dexmedetomidine to ropivacaine shortened the sensory block onset time compared with the ropivacaine group (95% confidence interval [CI] 4.18±5.26; p < 0.05).

**Fig 3: Onset of motor block**

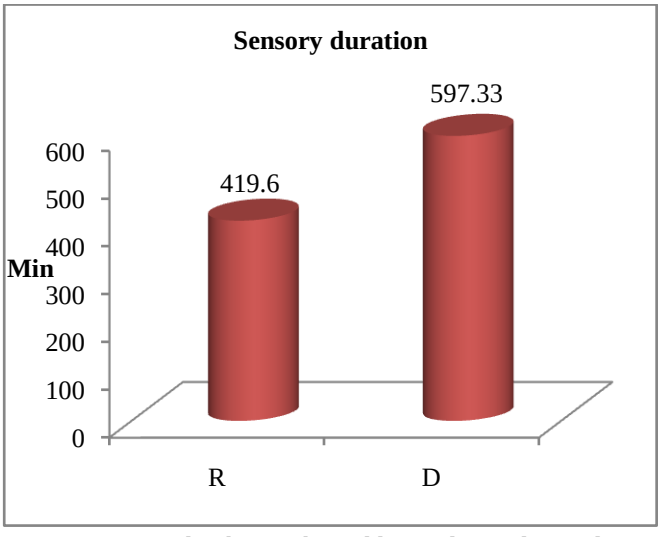



The study had shown that addition of dexmedetomidine in group D reduced the onset time for motor block when compared to 0.75% ropivacaine with normal saline in group R (fig 2) .In the group R the onset of motor block was only 15.6±1.589 compared to group D which was shorter 13.2±0.925. (Fig 3) This result was correlated with following studies:

Marhofer *et al* [14] observed that motor onset time was significantly faster in Group Rp (dexmedetomidine20 µg+ 0.75% ropivacaine ) when compared with the other study groups [mean (SD)] [21 (15) vs 43 (25) min in Group RsD and 47 (36) min in Group R.

Kaygusuz *et al* [15] observed that motor block onset time, in the levobupivacaine alone group is 15.75 (4.06) minutes and dexmedetomidine and levobupivacaine group is 14.25 (3.92) minutes. P (<0.05). They found a shorter onset time with dexmedetomidine concurrent with our study.

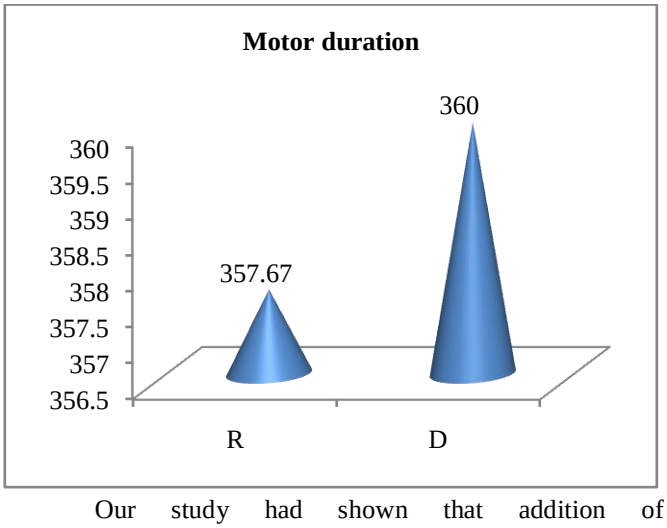
**Fig 4: Sensory block duration**




Our study shown that addition dexmedetomidine in group D prolongs the duration of sensory block when compared to 25 ml of ropivacaine 0.75% with normal saline in group R (fig 4). In group R the duration of sensory block was 419.6±9.665 minutes compared to group D which was 597.33±10.807 minutes. P (<0.05).

This result was concurrent with Rancourt *et al* [16] Compared the addition of dexmedetomidine with ropivacaine (RD) and ropivacaine alone (R) for tibial nerve block, they found that sensory block lasted longer in group RD than in group R (21.5 VS 16.2 hrs).

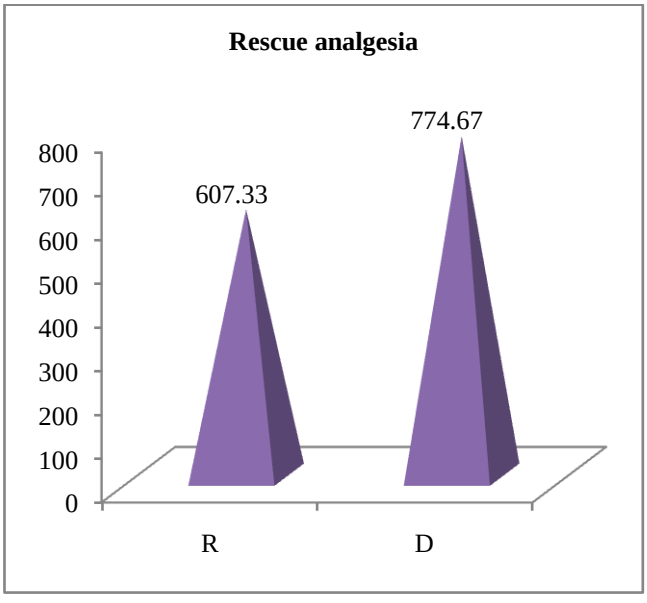
**Fig 5: Motor block duration**




Our study had shown that addition of dexmedetomidine in group D prolongs the duration of motor block when compared to 25 ml of ropivacaine 0.75% with normal saline in group R but not in significant way (Fig 5). In group R the duration of motor block was 357.67±9.71

minutes compared to group D 360±8.3 minutes even though various studies describes an significant increase in motor block duration our study shows an insignificant increase in motor duration in dexmedetomidine group (RD) when compared to ropivacaine alone group(R).

**Fig 6: Analgesic duration**




Our study shown that addition of dexmedetomidine in group D prolongs the duration of analgesia and prolong the patients first analgesic request, 774.67 ±10.743 minutes, when compared to 25 ml of ropivacaine 0.75% with normal saline in group R 607.33±13.629. (Fig 6)

The mechanism of action of $\alpha_2$-adrenoceptor agonists in peripheral nerve blocks is not understood fully. The most probable mechanisms include vasoconstriction, central analgesia, and anti-inflammatory effects [17-19]

Yoshitomi *et al.*, [20] demonstrated that dexmedetomidine as well as clonidine enhanced the local anesthetic action of lignocaine via peripheral α-2A adrenoceptors.

Masuki *et al*, [21] suggested that dexmedetomidine induces vasoconstriction via α2 adrenoceptors in the human forearm possibly also causing vasoconstriction around the site of injection, delaying the absorption of local anesthetic and hence prolonging its effect.

The heart rate, mean arterial pressure, remained stable both during intraoperative and postoperative period. The blood pressure never decreased below 20% of baseline values. No significant hypotension and bradycardia were observed in the study.

## 5. Summary and Conclusion

This study was done to evaluate the onset of sensory and motor blockade, duration of sensory and motor blockade, duration of analgesia and time for rescue analgesia and side effects of 50 µg of dexmedetomidine with 25 ml of 0.75% ropivacaine (Group D ) vs 25 ml of 0.75% ropivacaine (Group R) given by axillary brachial plexus block. Thus the additions of dexmedetomidine to ropivacaine improve the block quality, duration and provide better intraoperative conditions and better postoperative analgesia.

To conclude 50µg of dexmedetomidine seems to be a better adjuvant to 0.75% ropivacaine in axillary brachial plexus block in increasing the duration of analgesia, shortening the onset time of sensory and motor blockade and prolonging the duration of sensory blockade without side effects.

## Limitations

Non availability of ultrasound at our center hindered usage of decreased dosages of local anesthetics. In our study to give us a better insight of its efficacy, safety profile, and cost effectiveness; its use needs to be explored in a larger study population and in different nerve blocks. The limitation of present study was small sample size and ropivacaine or dexmedetomidine was not used as per body weight in kg.

## Acknowledgement

First of all, I would like to thank God, the Almighty, for having made everything possible by giving me strength and courage to do this work.

I am extremely thankful to Prof. Dr. Sugantharaj Anuradha, M.D., D.A., Professor and Head of the Department, Department of Anesthesiology, for her concern and support in conducting this study.

I owe my deepest gratitude towards my better half Aparna, for her eternal support and understanding of my goals and aspirations. Her infallible love, support and encouragement was in the end what made this article possible. My mom Mrs. G. Panchaly and my sister Ahila receive my deepest gratitude for their dedication and the many years of support, during my undergraduate studies that provided the foundation for this work.

A special thanks to my brother in law Mr. Arul Raj and my niece Annie for their love and affection.

My heartfelt regards goes to my father in law, mother in law, sister in law, grandpa, grandma for their love and moral support.

Last but not the least, I thank my colleagues and friends for their help and support.

## References

[1] McClure J.H. Ropivacaine, *Br journal of anesthesia* 1996.

[2] Singelyn FJ, Dangoisse M, Bartholomee S, Gouverneur JM. Adding clonidine to mepivacaine prolongs the duration of anaesthesia and anaesthesia after brachial plexus block. *Reg Anesth*. 1992; 17:148–50.

[3] Gaumann DM, Forster A, Griessen M, *et al*. Comparison between clonidine and epinephrine admixture to lidocaine in brachial plexus block. *Anesth Analg.* 1992; 75: 69 –74.

[4] Murphy DB, McCartney CJ, Chan VW. Novel analgesic adjuncts for brachial plexus block: a systematic review. *Anesth Analg*. 2000; 90:1122–8.

[5] Marhofer D, Kettner S, Marhofer P, Pils S, Weber M, Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study. *Br J Anaesth* 2012; 109:923e7.

[6] Virtanen R, Savola JM, Saano V, Nyman L. Characterisation of selectivity, specificity and potency of medetomidine as an alpha 2-adrenoceptor agonist. *Eur J Pharmacol*. 1988; 150:9–14.

[7] Brummett CM, Amodeo FS, Janda AM, Padda AK, Lydic R. Perineural dexmedetomidine provides an increased duration of analgesia to a thermal stimulus when compared with a systemic control in a rat sciatic nerve block. *Reg Anesth Pain Med* 2010; 35: 427–31.

[8] Brummett CM, Hong EK, Janda AM, Amodeo FS, Lydic R. Perineural dexmedetomidine added to ropivacaine for sciatic nerve block in rats prolongs the duration of analgesia by blocking the hyperpolarization-activated cation current. *Anesthesiology* 2011; 115: 836–43.

[9] Brummett CM, Norat MA, Palmisano JM, Lydic R. Perineural administration of dexmedetomidine in combination with bupivacaine enhances sensory and motor blockade in sciatic nerve block without inducing neurotoxicity in rat. *Anesthesiology* 2008; 109:502–11.

[10] Sarkar DJ, Khurana G, Chaudhary A, Sharma JP. A comparative study on the effects of adding fentanyl and buprenorphine to local anaesthetica in brachial plexus block. *J Clin Diagn Res*. 2010; 4:3337–43.

[11] Abdallah F.W. and Brull R. Facilitatory effects of perineural dexmedetomidine on neuraxial and peripheral nerve block: A systematic review and meta-analysis; *British Journal of Anaesthesia* 2013.

[12] Feroz Ahmad Dar, Mohd Rafiq Najar and Neelofar Jan. Dexmedetomidine Added to Ropivacaine Prolongs Axillary Brachial Plexus Block. *International Journal of Biomedical and Advance Research*; 2013; 04 (10): 719-722.

[13] Lin Yu-Nan, Qiang Li, Rui-Min Yang, Zhong-Xuan Mao, Jing-Chen Liu. Addition of dexmedetomidine to ropivacaine improves cervical plexus block; *Acta Anaesthesiologica Taiwanica* 2013; 51: 63-66.

[14] Marhofer D., Kettner S. C., Marhofer P., S. Pils, M. Weber and M. Zeitlinger. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study; *British Journal of Anaesthesia* 2012: 1-5.

[15] Kenan Kaygusuz, ; Iclal Ozdemir Kol; Cevdet Duger, Sinan Gursoy; Hayati Ozturk; Ulku Kayacan; Rukiye Aydin; and Caner Mimaroglu. Effects of Adding Dexmedetomidine to Levobupivacaine in Axillary Brachial Plexus Block; *Current Therapeutic Research*, 2012; 72 (3).

[16] Plunkett AR, Shields C, Stojadinovic A, Buckenmaier CC. Awake thyroidectomy. Rancourt MPM, Albert NT, Côté M, Létourneau DR, Bernard PM. Posterior tibial nerve sensory blockade duration prolonged by adding dexmedetomidine to ropivacaine. *Anesth Analg* 2012; 115: 958e62.

[17] Obayah G.M., Refaie A., Aboushanab O. Addition of dexmedetomidine to bupivacaine for greater palatine nerve block prolongs postoperative analgesia after cleft palate repair. *Eur J Anaesthesiol.* 2010; 27: 280–284.

[18] Esmaoglu A., Yegenoglu F., Akin A., Turk C.Y. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anesth Analg*. 2010; 111:1548–1551.

[19] Singelyn F.J., Gouverneur J.M., Robert A. A minimum dose of clonidine added to mepivacaine prolongs the duration of anesthesia and analgesia after axillary brachial plexus block. *Anesth Analg.* 1996; 83: 1046–1050.

[20] Yoshitomi T, Kohjitani A, Maeda S, Higuchi H, Shimada M, Miyawaki T. Dexmedetomidine enhances the local anesthetic action of lidocaine via an alpha-2A adrenoceptor. *Anesth Analg*. 2008; 107:96–101.

[21] Masuki S, Dinenno FA, Joyner MJ, Eisenarch JH. Selective alpha2-adrenergic properties of dexmedetomidine over clonidine in the human forearm. *J Appl Physiol.* 2005; 99:587–92.