

EFFECT OF ADDITION OF DEXMEDITOMIDINE TO 0.5% ROPIVACAINE OR 0.5% ROPIVACAINE IN AXILLARY ROUTE BRACHIAL PLEXUS BLOCK IN HAND AND FOREARM SURGERY

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ABSTRACT

Background- The present evidence supports the addition of 50mcg /kg Dexmedetomidine in moderate doses to potentiate the efficacy of peripheral nerve blocks without increasing risks of adverse events. Thus present study was designed to compare the role of addition of Dexmedetomidine to Ropivacaine 0.5% or Ropivacaine 0.5% alone in axillary route brachial plexus block in hand & forearm surgery. **Method-** 60 study subjects scheduled to undergo hand & forearm surgery in ASA grade I & II were randomised into two groups Group R (n=30) and Group II (n=30). In Group I subjects were administered Ropivacaine 0.5 % 15 ml, normal saline 5ml (Total 20 ml) (n=30) and in Group II subjects were administered Ropivacaine 0.5% 15 ml , normal saline 4ml + 50mcg /kg Dexmedetomidine 1 ml (Total 20 ml) (n=30) . Intergroup comparison made for hemodynamic parameters , onset of sensory block & motor block,duration of sensory & motor block, total duration of analgesia and any untoward events. **Results-** At baseline ,the demographics & hemodynamic parameters were comparable(p>0.05). The onset of sensory block in Group RD (17 ± 4.97 min) was attained faster than Group R (21.4 ± 2.78 min) was statistically significant($p<0.001$). The onset of motor block in Group RD (19 ± 2.879 min) was achieved faster than in Group R (24.21 ± 2.31 min) which was statistically significant ($p<0.001$). The duration of sensory block , motor block & duration of analgesia in Group RD statistically significantly prolonged ($p<0.05$). Intergroup comparison showed a significant decline in the HR in Group RD ($p < 0.05$). **Conclusion -** Addition of 50mcg /kg Dexmedetomidine to long acting amide local anaesthetic Ropivacaine 0.5% hastens the onset of sensory & motor block, lengthens the duration of sensory block, motor block & analgesia. Thus can be efficiently used by anaesthetists in Ropivacaine in axillary route brachial plexus block in hand & forearm surgery with minimal adverse events which are transient & do not require treatment.

Keywords – Dexmedetomidine, Ropivacaine , Axillary brachial plexus , nerve block



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INTRODUCTION

The Brachial plexus blocks have been used since 1880s when Halstead first used this technique . It relieves perioperative , postoperative pain and chronic pain , is safer & eliminates the adverse effects of general anaesthesia. With the advent of newer techniques , various local anesthetic and adjuvant drugs , it has gained importance & popularly used by anaesthesiologists worldwide. It is widely used in orthopedic hand & upper arm surgeries to relieve perioperative pain.(1)

Various approaches to brachial plexus are axillary, supraclavicular, interscalene & infraclavicular. Due to easy access , safety , reliability & avoidance of adverse events like pneumothorax and vascular injuries axillary approach is most favoured . The terminal branches of the brachial plexus including the median, ulnar, radial and musculocutaneous nerves are blocked by the axillary block . The musculocutaneous nerve often departs from the lateral cord in the proximal axilla and is commonly spared by the axillary approach. The rest three

nerves lie next to the axillary artery and are surrounded by the coracobrachialis, biceps and triceps muscles.(2)

Studies have proven long acting LA like Ropivacaine to provide effective , site specific, regional anaesthesia. In comparison to Bupivacaine it shows longer duration of action, lesser cardiovascular & central nervous system toxicity. But inspite of these properties it has slower onset & shorter duration of sensory blocks which warrants the usage of opioids. This shortcoming is overcome by adding adjuncts to Ropivacaine to enhance onset & increase the duration of analgesia. These adjunctives are ketamine , epinephrine, neostigmine ,opioids, clonidine and Dexmedetomidine .(3)

Current researches have put focus on α_2 -adrenoreceptor agonist , Dexmedetomidine explaining its analgesic , sympatholytic and sedative properties. Dexmedetomidine has α_2 : α_1 selectivity ratio 8 times higher than clonidine . Thus has recently been highly investigated for its analgesic effects and has the potential to become an alternative to clonidine.⁴ When used systemically, it shows potent analgesic, sedative and anesthetic sparing effects .

Studies by Bangera et al and Das et al -have shown that Dexmedetomidine shortens the onset of sensory & motor block & prolong the duration of analgesia when used as an adjunct to Ropivacaine in hand & upper arm surgeries.(5,6) Fewer published literature is available evaluating the effects of Dexmedetomidine use along with 0.5% Ropivacaine.(7)

Thus this study was designed to assess the adjuvant efficacy of 50mcg Dexmedetomidine with 0.5% Ropivacaine in brachial plexus block through axillary route in upper arm & hand surgeries .

MATERIAL & METHODS

This prospective randomised clinical study included 60 patients in the age range of 20-65 yrs belonging to American Society of Anesthesiologists (ASA) physical status I, II who came to the Department of Anesthesiology & critical care of our institution and scheduled to undergo surgery of upper arm & hand. Patients with blood coagulation disorders, pregnant females , psychiatric diseases ,hepatic & renal disorders , history of allergy to test drugs and infection at the site of the block were excluded. An institutional ethical approval was completed. The nature of study explained to the study subjects & written informed consent obtained.

The study subjects were randomised in two groups

Group I- received 0.5 % Ropivacaine 15 ml, normal saline 5ml (Total 20 ml) (n=30)

Group II – received 0.5% Ropivacaine 15 ml , normal saline + 50mcg /kg Dexmedetomidine 1 ml (Total 20 ml) (n=30)

A thorough preanaesthetic checkup done & subjects advised to not consume solids /liquids 6 hr prior to surgery. Study subjects shifted to operating room. Multipara monitor was attached and hemodynamic parameters at baseline were recorded i.e. heart rate(HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), electrocardiogram and oxygen saturation (SpO₂) . Following complete aseptic precautions , placing operating limb in proper position, brachial plexus block was performed by an experienced anaesthetist using insulated 24 G 50 mm length , short beveled stimulating needle in accordance with multiple injection techniques utilising nerve locator.In the upper one third of arm axillary artery was palpated & just above & below using a 2% lignocaine solution a skin wheal was raised. With current intensity at 2mA , electrolocation of the four nerves was completed.

The intensity was reduced slowly to 0.5mA to attain desired responses.To keep a check on accidental intravascular needle positioning during electrolocation, continuous negative aspiration was done. After location of nerves in axillary region ,subsequent administration of small amount of LA was precisely done using multiple injection technique after negative aspiration for blood.

Parameters monitored :

1.Haemodynamic parameters (HR, SBP,DBP, MAP, SpO₂) were recorded at baseline , past block administration for every 3 min for first 15 min , after that an interval of 15 min till surgery was completed.

2.Onset of sensory block – was assessed on a three point scale where 0 meant sharp pain, 1 meant dull pain & 2 meant no pain at all using a pin prick method.

3.Onset of motor block – assessed on a three point Bromage scale : for radial nerve , ulnar nerve , median nerve, musculocutaneous by abduction of thumb, by adduction of thumb, by thumb opposition and by flexion of elbow. Respectively.

4. Duration of sensory block

5. Duration of motor block
 6. Total duration of analgesia
 7. Adverse events
 Onset of sensory block assessed at the following dermatomes:
 Radial Nerve - dorsal 1st and 2nd intermetacarpal area
 Median nerve- palmar side of tip of the 3rd finger
 Ulnar nerve- palmar side of tip of the 5th finger
 Musculocutaneous nerve- lateral aspect of forearm
 Onset of Motor Block assessed using 3 point Bromage scale :
 0-sharp pain
 1-dull pain
 2- no pain

Sensory and motor block, post-operative analgesia, hemodynamic parameters and side effects were monitored for a day.

Hypoxia was defined as SpO₂ less than 93% , Hypotension as SBP less than 90mm Hg, Bradycardia as HR less than 40 beats/ min and if occurred were treated accordingly.

Statistical analysis: Data was put in microsoft excel 2007 tabulated & analysed using SPSS statistical software version 22 . Data was expressed as mean ± standard deviation , proportions presented as percentages.Comparisons were analysed using independent Student *t*-tests. At 95% confidence interval *P* <0.05 was considered statistically significant.These were presented as line diagram.

RESULTS

The patient demographic variables were comparable in both the groups (Table I) . No statistically significant difference was observed with respect to age, weight & duration of surgery (*p* > 0.05). At baseline, the hemodynamic variables (HR , SBP, DBP, MABP , SpO₂) were comparable in both Groups with no statistically significant difference (*p* > 0.05). (Table I)

Intergroup comparison showed a significant decline in the HR in Group RD (*p* < 0.05). But , bradycardia(HR<60/min) was not clinically significant warranting no treatment. No statistically significant change in SBP,DBP,MABP & SpO₂ were noted at all time intervals (*p* > 0.05). No adverse events were observed.

Table I Demographic characteristics

	Group R	Group RD	
Age	42.23 ±16.76 yrs	39.56 ± 15.48 yrs	<i>p</i> > 0.05
Weight	65.98 Kg	67.56 kg	<i>p</i> > 0.05
HR	81.56 ± 19.54	80.2 ± 16.87	<i>p</i> > 0.05
SBP	132.46 ± 8.25	134.43 ± 21.34	<i>p</i> > 0.05
DBP	78.7 ± 7.63	80.89 ± 2.41	<i>p</i> > 0.05
MABP	99 mmHg	102 mm Hg	<i>p</i> > 0.05
Duration of surgery	84.47 ± 14.26	86.97± 43.15	<i>p</i> > 0.05
SpO₂	98.45 ± 0.78	97.23 ± 1.62	<i>p</i> > 0.05

Table II Study Observations

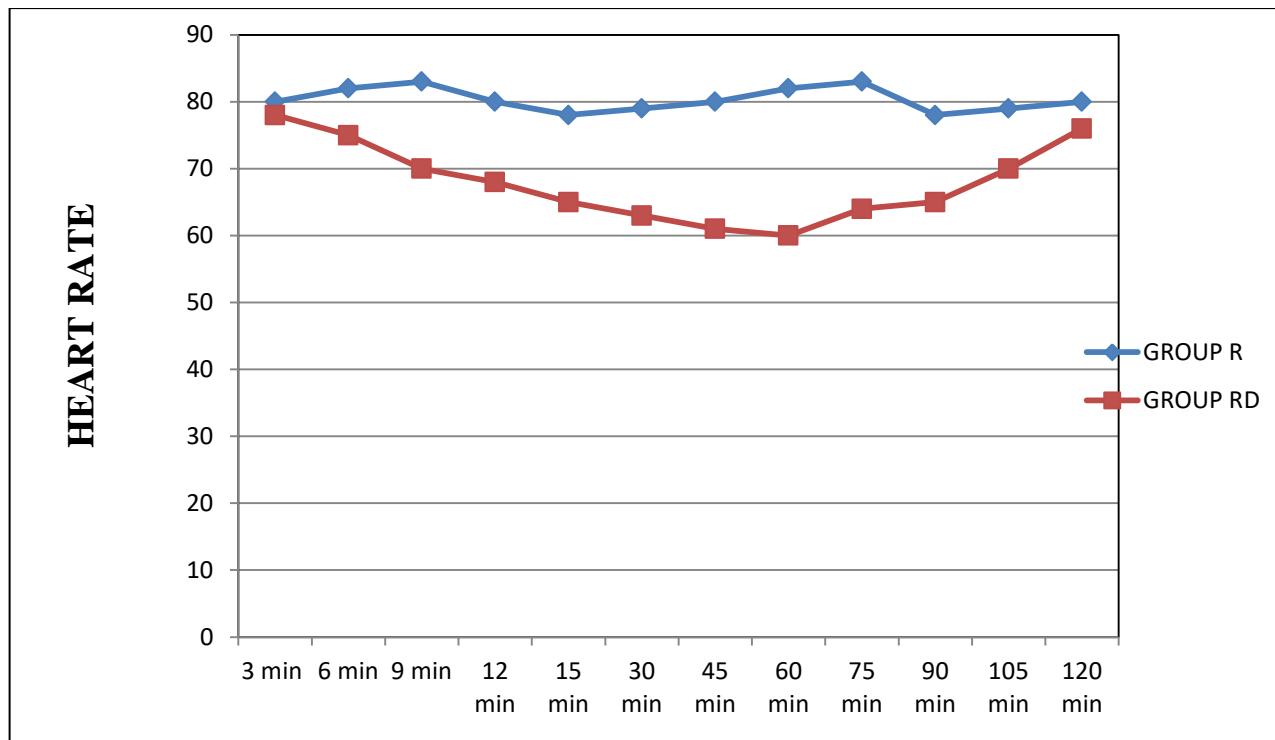
Study parameter	Group R	Group RD	P value
	Mean ±SD(min)	Mean ±SD(min)	
Onset of sensory block	21.4± 2.78	17±4.97	<0.001
Onset of motor block	24.21±.231	19±2.879	<0.001
Duration of sensory block	491.41±72.654	672.76±89.564	<0.001
Duration of motor block	530.65± 68.342	720.66±78.43	<0.001
Duration of analgesia	582.77±78.543	768.45±99.05	<0.001

The onset of sensory block in Group RD (17±4.97 min) was attained faster than Group R (21.4± 2.78

min) was statistically significant(<0.001). The onset of motor block in Group RD (19 ± 2.879 min) was achieved faster than in Group R (24.21 ± 2.31 min) which was statistically significant ($p<0.001$). The duration of sensory block in Group RD (672.76 ± 89.564 min) was statistically significantly prolonged than Group R(491.41 ± 72.65 min) . The

duration of motor block in Group RD (720.66 ± 78.43 min) was statistically significantly prolonged than Group R(530.65 ± 68.342 min) .The duration of analgesia was prolonged in Group RD (768.45 ± 99.05 min) as compared to Group R (582.77 ± 78.543 min) which was found to be statistically significant ($p<0.001$).

Fig 1 Changes in Heart Rate in Group R and Group RD



DISCUSSION

One of the most widely used regional anaesthesia techniques for upper arm & hand surgeries is brachial plexus block through axillary route. It has various advantages over other blocks. The common adverse events of pneumothorax and vascular injuries in interscalene and supraclavicular brachial plexus block are not observed. (8)

The selection of LA is established by the duration of sensory analgesia desired. For longer duration surgeries 0.5% Ropivacaine increases the length of anesthesia for 9 hrs and 0.33% Levobupivacaine for 11 hrs. Adjuvants have a synergistic effect to LA and prolongs & intensify block and analgesia.(9)

The present prospective study was carried out in patients scheduled for upper arm & hand surgeries and used axillary brachial plexus block . It is safer as compared to other route of brachial plexus , as it

minimises the risk of blockage of phrenic nerve & pneumothorax with slight risk of intravascular or intraneuronal injection. (1)

Both the Group R and Group RD were comparable with respect to age, weight, and duration of surgery. The mean age in Group R was 42.23 ± 16.76 yrs and in Group RD 39.56 ± 15.48 yrs ($p > 0.05$). The mean weight in Group R was 65.98 Kg and in Group RD was 67.56 kg ($p > 0.05$). The minimum duration of surgery in Group R & RD was 84.47 ± 14.26 & 86.97 ± 43.15 respectively ($p > 0.05$).

In the present study , onset of sensory block in Group RD (17 ± 4.97 min) was attained faster than Group R(21.4 ± 2.78 min) was statistically significant ($p<0.001$). Also , the duration of sensory block in Group RD (672.76 ± 89.564 min) was

statistically significantly prolonged than Group R(491.41 ± 72.65 min) ($p < 0.001$). Similar study was conducted by Bangera et al 2016 on 80 patients in ASA grade I & II axillary brachial plexus block . The Ropivacaine group received 0.375% ropivacaine(39 ml)with 1 ml of normal salineand ropivacaine with dexmedetomidine group received 0.375% ropivacaine(39 ml) and 1g/kg dexmedetomidine.The onset of sensory block was found to be hastened in Group RD (16.13 ± 4.0001 min) than Group R (20.5 ± 3.889 min)which was statistically significant($p < 0.05$). Also , the longer duration of sensory block in Group RD(677.25 ± 99.64 min) was observed as compared to Group R(494.38 ± 70.64 min which was statistically significant.(5) Similar findings noted by Ammar and Mahmoud,(10) Kaygusuz et al.(11)

In the present study , onset of motor block in Group RD (19 ± 2.879 min) was achieved faster than in Group R (24.21 ± 2.31 min) which was statistically significant ($p < 0.001$). Also, the duration of motor block in Group RD (720.66 ± 78.43 min) was statistically significantly prolonged than Group R(530.65 ± 68.342 min).Similarly, studies conducted by Ammar and Mahmoud et al (10) Kaygusuz et al (11) found significant hastening of onset and duration of motor block in Group RD than Group R.

In the present study , the duration of analgesia was prolonged in Group RD (768.45 ± 99.05 min) as compared to Group R (582.77 ± 78.543 min) which was found to be statistically significant ($p < 0.001$).Similar results observed by Koraki et al 2018 Ropivacaine 75 mg used alone or in combination with (n=18) 100 mcg DEX (n=19) significantly prolonged duration of analgesia . (12)

In the present study at baseline, the hemodynamic variables (HR , SBP, DBP, MABP , SpO₂) were comparable in both Groups with no statistically significant difference ($p > 0.05$). (Table I). Intergroup comparison showed a significant decline in the HR in Group RD ($p < 0.05$). But , bradycardia(HR<40/min) was not clinically significant warranting no treatment. No statistically significant change in SBP,DBP,MABP & SpO₂ were noted at all time intervals ($p > 0.05$). Accordingly , in Das et al study bradycardia was observed in four patients in Group RD which was managed by atropine. No bradycardia noted in Group R.6 In another study of axillary brachial plexus block by Bangera et al hemodynamic parameters (HR, SBP, DBP & MABP) in Group RD

showed a decline from baseline from 15 min to 480 min after block administration, but bradycardia or hypotension did not require any treatment. These hemodynamic changes were statistically significant ($P < 0.001$). (5)

In the present study no adverse events were noted. However, in a prospective study conducted by Das et al with supraclavicular brachial plexus block evaluating the effects of dexmedetomidine as an adjuvant , side effects like pneumothorax and Horner syndrome were observed in both group R & RD but the difference was not statistically significant ($p < 0.05$).6 In an another study Esmaoglu et al.(13) noted significant bradycardia in Group levobupivacaine with dexmedetomidine than Group levobupivacaine alone.Also significant hypotension was observed which was not found in present study .

CONCLUSION

The role of 50mcg Dexmedetomidine as an adjuvant to 0.5% ropivacaine hastens the onset of sensory & motor block ,prolonging the duration of sensory & motor block with increased duration of analgesia. Axillary brachial plexus block is safer , reliable regional anaesthesia with stable hemodynamic variables in surgeries of forearm and hand surgeries .

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