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Research Paper

Dexmedetomidine Added to Levobupivacaine Prolongs the Duration of Anaesthesia and Analgesia After Axillary Brachial Plexus Block

Anaesthesiology

KEYWORDS : Axillary brachial plexus block, Dexmedetomidine, Levobupivacaine

Dr Shilpa Y. Gurav — Professor & Head, Department of Anaesthesiology, MIMER Medical College Talegaon Dabhade, Dist Pune 410507

Dr Anita M. Kulkarni — Assistant Professor, Department of Anaesthesiology, MIMER Medical College Talegaon Dabhade, Dist Pune 410507

ABSTRACT

This prospective, randomized double blind study, compare the effect of Levobupivacaine (L) alone to that of adding Levobupivacaine to Dexmedetomidine (LD) in axillary brachial plexus blockade. Sixty patients scheduled to undergo elective forearm and hand surgery were divided in to 2 group of 30 each (group L and group LD). In group L (n = 30) 35ml (175mg) of 0.5% Levobupivacaine + 1ml saline and in group LD (n = 30) 35ml (175mg) of 0.5% Levobupivacaine + 1ml Dexmedetomidine were given. Two groups were compared for motor and sensory onset time, block durations and duration of anaelgesia. There was significant difference in duration between groups. In group LD duration of analgesia was longer then group L (p <0.05). Sensory and motor block onset times were shorter and motor blockade duration were longer in group LD then group L (P< 0.05). Dexmedetomidine added to Levobupivacaine for axillary brachial plexus block shortens the onset time of sensory and motor block. It also prolongs the duration of block and duration of postoperative analgesia.

Introduction: Since the early 1970s, α_2 - adrenergic receptor agonists have been used successfully to treat patients with hypertension and patients withdrawing from long term abuse of drugs or alcohol. Alpha 2 agonist produce diverse responses, including analgesia, anxiolysis, sedation, and sympatholysis (Kamibayashi T, Maze M.) Dexmedetomidine, a potent α_2 adrenoreceptar agonist, is approximately eight times more selective towards the α_2 adrenoreceptar then clonidine (Raimo V, Juha M, Veijo S). In humans, Dexmedetomidine has also shown to prolong the duration of block and post-operative analgesia when added to local anaesthetic in various regional blocks studied by various studies (Kanazi GE et al; Memis D et al; Esmaoglu A et al; Obayah GM et al). The local anaesthetic investigated in this study, Levobupivacaine is the S(--) enantiomer of racemic bupivacaine ; having less cardiotoxicity than bupivacaine (Erlacher W et al). The current study was designed to study the effect of adding Dexmedetomidine as an adjuvant Levobupivacaine in axillary brachial plexus block. Our aim was to study onset time, duration of sensory and motor block and duration of analgesia.

Material methods: After ethical committee approval and written informed consent, a double- blind randomized prospective clinical study was carried out on 60 ASA grade I and II patients of either sex aged 18-16 years, undergoing forearm and arm Orthopaedic surgeries under axillary brachial plexus block. There were 30 patients in each study group. Patients excluded from this study were in whom axillary brachial plexus block or study medication were contraindicated or who had a history of psyctriatric neurological, cardiac, respiratory hepatic or renal failure, as well as pregnant and lactating women. Also barred from the study were patients receiving adrenoreceptor agonist or antagonist therapy. No premedication was given. Patients were randomly assigned using "Sealed envelope technique" to one of the following group L: 35 ml of 0.5 % Levobupivacaine + 1ml Saline, Group D: 35 ml of 0.5% Levobupivacaine + 1 ml of Dexmedetomidine.

The solution was prepared by anaesthesiologist not involved in this study. On arrival in the operation room 20 G IV canula was inserted in the non operated arm and ringer lactate was started after that baseline heart rate, blood pressure, oxygen saturation (SPO2) were recorded. All the patients received a standard axillary block, technique (supine position, arm abducted 90° with forearm flexed and externally rotated) after preparation of part axillary pulse was identified. The injection site was infiltrated with 1 ml of lignocaine 2% subcutaneously. Neural localization was advised by using a nerve locator connected to 22G,50 mm long stimulating needle. The location end point was a distal motor response with an output lower than 0.5 MA. Following negative aspiration, 35 ml of a solution of either group L or group D as mentioned above was injected.

Sensory block was assessed by pin prick method using a 3 point scale 0= Sharp pin felt, 1-Analgesia (loss of sensation of pinprick), 2- anaesthesia (no sensation felt). Motor block was determined according to a modified Bromage scale for upper extremities on a 3 point scale (0- normal motor functions, 1= reduced motor strength with ability to move the fingers, 2= complete motor block with inability to move the fingers). Sensory and motor blocks were evaluated every 3 minutes until 30 minutes after injection in the dermatomal areas corresponding to median nerve, radial nerve ulnar nerve and musculocutaneous nerve after finishing surgery sensory and motor block were evaluated every 30 minutes, until they had resolved. Onset time was defined as the time interval between the end of total local anaesthetic administration and complete sensory block. Complete sensory block was defined by anesthetic block (score 2) on all nerve territories. The duration of sensory block was defined as the time interval between the end of local anaesthetic administration and the complete resolution of anaesthesia on all nerves. The duration of motor block was defined as the time between the end of local anesthetic administration and recovery of complete motor functions of the hand and forearm. The rescue analgesia was given in the form of Inj Diclofenac Sodium (1.5 mg/kg) intramuscularly at the numeric rating scale of 5 and the time of administration was noted. Heart rate, systolic arterial blood pressure and diastolic arterial blood pressure were recorded at 0, 5, 10, 15, 30, 45, 60, 90, 120 minutes. All patients were observed for any side effects like nausea, vomiting, hematoma, local anaesthetic toxicity and post block neuropathy in the intra and post block neuropathy. In the intra and post operative period adverse effect like hypotension, bradycardia, and hypoxemia were also noted.

Statistical power was calculated to be 99.9% for motor block period as alpha=0.05, Beta=0.001, and was calculated to be 99.9% for sensory block period as alpha=0.05, Beta=0.001. Mean SD, median, minimum and maximum values were calculated. To compare the groups in respect to bradycardia, we used the exact method of X^2 test.P<0.05 value was considered to be statistically significant.

Results:

Demographic and patients surgical characteristics were depicted

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in table 1. These two groups were identical and no significant difference was observed. Sensory and Motor Block onset time, duration of block and analgesia duration in LD group were significantly longer ($p < 0.01$) as compared to group L (table 2).

Table 1. Characteristics of study population showing demographic and surgical character.

Variable	Group L (n=30) [x± SD]	Group LD (n=30) [x± SD]
Age (Years)	32.96 ± 10.59	35.96 ± 12.59
Gender (F/M)	9/21	7/23
Height (cm)	164.16 ± 4.41	168.16 ± 7.21
Weight (Kg)	68.43 ±10.35	70.10 ± 8.01
Duration of Surgery (Minuets)	61.70 ± 30.01	76.12 ± 38.72
Duration of tourniquet	60.88 ± 25.21	71.73 ± 30.31
Type of Surgery (Bone/ soft tissue)	12/18	15/15

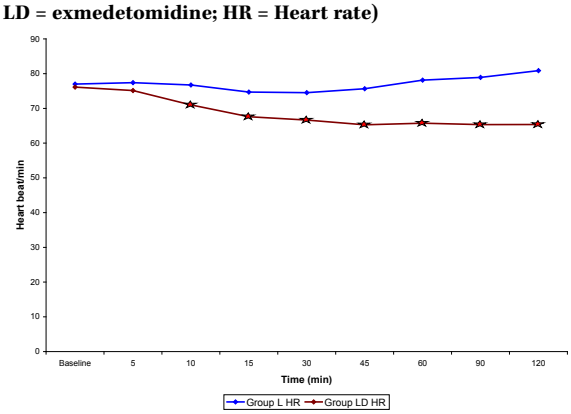
(L= Levobupivacaine; LD = Levobupivacaine- Dexmedetomidine; F= Female; M= male.)

Table2: Sensory and Motor Block onset time, duration of block and analgesia duration in study groups

Variable	Group L (n=30)(x ±SD)	Group LD (n=30)(x ±SD)	t test	p value
Onset time of sensory block (min)	12.16 ± 2.38	8.66 ± 1.34	6.9	< 0.01
Onset time of motor block (min)	14.16 ± 2.38	9.46 ± 1.02	9.7	< 0.01
Duration of sensory block (min)	597.00 ± 56.57	765.00 ± 48.21	12.2	< 0.01
Duration of motor block (min)	485.60 ± 46.57	640 ± 49.19	12.3	< 0.01
Duration of analgesia (min)	841 ± 70.34	945 ± 68.73	5.7	< 0.01

(L= Levobupivacaine; LD = Levobupivacaine- Dexmedetomidine)

Fig 1. Heart rate values in the group (L = Levobupivacaine; LD = exmedetomidine; HR = Heart rate)



The baseline heart rates in both the groups were comparable (P > 0.05) upto 5 minutes. As shown in fig 1, Heart rate in LD group at 10, 15, 30, 45, 60, 90, 120 minutes were significantly lower (P < 0.01) as compared with Group L. In group L there was no evidence of bradycardia. However, in group LD bradycardia was observed in 5 patients and all of these patients were treated with atropine.

Fig 2. Blood pressure for the group (L = Levobupivacaine; LD = Dexmedetomidine; SBP =Systolic blood pressure, DBP= Diastolic blood pressure)

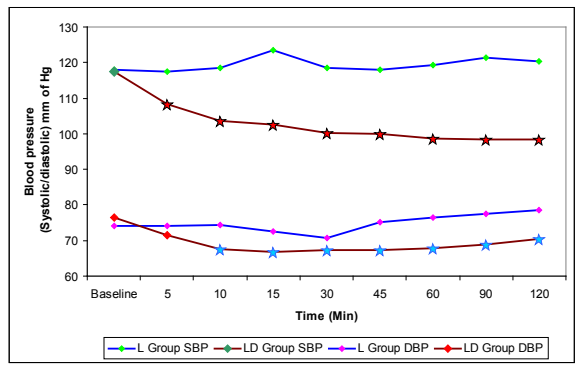


Figure 2 compares the homodynamic changes between the groups at various time points. The systolic arterial pressure in group LD at 5, 10, 15, 30, 45, 60, 90,120 minutes were significantly lower (P <0.01) then those in group L. In group LD diastolic arterial pressure level at 10, 15, 30, 45, 60, 90,120 minutes were significantly lower (P<0.01) then those in group L.

Discussion: In well conducted randomized clinical trails, α_2 agonist have been shown to be effective for their analgesic, sedative-hypnotic and sympathetic properties (Tatsushi Y et al). Also, α_2 adrenoreceptar agonist enhanced the local anaesthetic actions of lignocaine and he (Tatsushi Y et al) suggested that Dexmedetomidine acts via α_2A adrenorecptor. In addition α_2-AR Dexmedetomidine have demonstrated a dose dependent increase in the duration of thermal antinociception and analgesia in some animal studies (Brummett CM, Padda AK, Amodeo FS; Brummett CM, Amodeo FS, Janda AM).

Therefore many of these advantageous effects of adding Dexmedetomidine to local anesthetic during regional anaesthesia and peripheral nerve blockade procedures may also prove effective for the surgical patient. The mechanism by which α_2-AR agonists produce analgesia and sedation is not fully understood, but is likely to be multifactorial. Dexmedetomidine possesses analgesic properties and many other advantageous influences but lacks respiratory depression (Carollo DS etal). Both hypnotic and supraspinal analgesic effects of Dexmedetomidine are mediated by noradreregic neurons (via hyperpolarization). This action is through, inhibition of nor epinephrine release and its associated activity in the descending medullo-spinal nor adrenergic pathway and it also suppresses neuronal firing in the locus coeruleus (Ishii H, Kohno T, Yamakura T).The result of our study shows that all patients in both groups were comparable with respect to demographic profile, duration of surgery. With these doses we had stable haemodynamics in patients except significant lower pulse rate in Group LD as compared to Group L. The pulse rate was below 60 beats/min in Group LD in 5 patients which were treated with Inj Atropine IV successfully.

In this study we demonstrated that in patients undergoing axillary plexus block, Dexmedetomidine added to Levobupivacaine shortens sensory and motor block onset time and extends block durations. None of patients in group LD required sedation intraoperatively and they were comfortable throughout the surgery with arousable sedative effects. This can be explained on the basis that amount of systemic absorption of drug could be present (Pöpping DM, Elia N, Marret E). As α_2 agonist produces sedation by central action, they supressesses neuronal firing in the locus coerulus. Suppression of these inhibitory control causes release of mediators and neurotransmitters that in turn decreases the secretion of histamine and produces hypnosis (very similar to normal sleep) all without evidence of depression of ventila-

tion (Kanazi GE et al). In one of the study, Dexmedetomidine is added to Levobupivacaine showed that when 40 ml of local anaesthetic was given for axillary brachial plexus block, it shortens the onset time in both sensory and motor block, also prolongs the duration of block as well as duration of post-operation analgesia (Esmaoglu A, Yegenoglu F, Akin A). In our study we found the same results, except in LD group we found early onset of sensory and motor action compared to this study also found that SBP and DBP in LD group decreased significantly over a time. Clinically there was no significant haemodynamic instability and none of patients required any active intervention.

Dexmedetomidine is a potent α_2 -AR agonist and has widespread actions on the mammalian brain (sedation). In the neuraxial space (sympatholytic properties) and in the periphery during regional anaesthesia with peripheral nerve blockade (anesthetic-sparing and post operative analgesia). A large body of work and supporting found of knowledge supports its favorable profile in improving the outcome and long term function without evidence of destructive neurologic impact. Sources of such benefits are seen in the neuroprotective properties that are evident in experimental animal models as well as in the clinical setting (Thomas M, Halaszynski TM).

This study suggest that Dexmedetomidine can be safely used with local anaesthetic in peripheral nerve blocks, however further trails to determine the side effect like bradycardia and the safe optimal dose of Dexmedetomidine. In conclusion we would like to state that Dexmedetomidine may lead to bradycardia and shortens the onset time of sensory and motor block. If onset time prolongs the duration of sensory and motor block, it also extends the analgesia duration when used as an adjuvant to Levobupivacaine in axillary brachial plexus block.

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