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A Clinical Comparision between 0.375% Ropivacaine and 0.375% Ropivacaine added with 0.5µg/kg dexmedetomidine in patients undergoing upper limb surgeries under supraclavicular brachial plexus block

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Abstract
Introduction: Regional anaesthesia is the preferred choice nowadays for upper limb surgeries because of their many advantages. Local anaesthetic added with alpha-2 agonists like dexmedetomidine, provide added advantages to the block. This study is aimed to assess onset and duration of sensory and motor block and post-operative analgesia in the first 24 hours surgery with the use of additives.
Materials and Methods: 100 patients aged 18-60 years of ASA Grade I & II posted for upper limb surgeries under supraclavicular brachial plexus block were randomly allocated into two groups with 50 patients in each. Group R and R+D received 35cc of 0.375% injection Ropivacaine and 35cc of 0.375% Ropivacaine with 0.5 µg/kg of injection Dexmedetomidine respectively through nerve stimulator guided supraclavicular block. Onset and duration of sensory and motor block, time to first and total analgesic need were noted postoperatively for 12 hours.
Results: Demographic variables were insignificantly comparable with $p>0.05$. Sensory and motor block onset time was significantly lower in the Group R+D than Group R ($p=0.001$). Duration of sensory and motor block was significantly longer in the Group R+D than Group R ($p=0.001$). The time to the first analgesic requirement was longer in Group R+D than Group R ($p=0.001$). The total analgesic requirement was significantly lower in Group R+D than Group R ($p=0.001$).Heart rate and systolic and diastolic blood pressure was significantly lower after drug administration in group R+D than group R.
Conclusion: in supraclavicular block when Dexmedetomidine is added to Ropivacaine, sensory and motor blockade is achieved earlier with prolongation of postoperative analgesia and thus reduces requirement of pharmacological analgesics. Thus, Dexmedetomidine can be used as an effective adjuvant in supraclavicular blocks.

Keywords: Ropivacaine, dexmedetomidine, supraclavicular block

Introduction
Upper limb fracture surgeries are among one of the commonly performed orthopaedic procedures requiring anaesthesia mandatorily. Patients require complete intraoperative sensory and motor loss along with good post-operative analgesia. Anaesthesia for these surgeries could be general anaesthesia, total intravenous anaesthesia, regional anaesthesia or local infiltration of drugs. Among regional anaesthesia, supraclavicular blocks with different techniques like ultrasound guided, nerve stimulator guided or landmark guided are most commonly performed. Local anaesthetic agent used in regional anaesthesia must provide effective analgesia with minimum side effects. Ropivacaine is the pure S(-)- enantiomer of bupivacaine with efficacy similar to it but side effects are much less especially cardiac and cerebral [1]. Various drugs like opioids [2], clonidine [3], dexamethasone [4], midazolam [5] and magnesium [6] have been used as adjuvant to local anesthetics. Dexmedetomidine is as newer drug. It is a selective alpha-2 agonist drug having sympatholytic, analgesic, sedative effects. In previous studies, it has been shown that when added with local anesthetic, dexmedetomidine increases onset of action of local anaesthetic drug along with increased duration of analgesic effect [7, 8].
In this study, we have intended to compare the onset of blockage and overall analgesic duration when ropivacaine is used alone and when it was added with dexmedetomidine in supraclavicular block for upper limb surgeries.

Materials and Method

It was a prospective randomized comparative study involving 100 adult patients aged 18-60, belonging to ASA physical status I & II of either gender posted for upper limb surgeries under supraclavicular brachial plexus block. Those who refused for study, history of anaphylaxis to local anaesthetics, patients with a history of significant coexisting systemic diseases, patient with coagulopathy and neuropathy were excluded from study. After getting approval from the institutional ethical committee, patients were divided into two groups of 50 each. After a thorough pre-anaesthetic evaluation and minimal necessary investigation done, a written informed consent was taken from all the patients. Patients were shifted to operation theatre and baseline vitals were noted. After achieving an intravenous access using 18G intravenous cannula in unaffected hand, an intravenous fluid ringer lactate was started.

All patients received a brachial plexus block through the supraclavicular approach through peripheral nerve stimulator. A 22G 50mm long stimulating needle of peripheral nerve stimulator inserted caudal, medial, and in posterior direction. The goal was to achieve an isolated muscle twitches in all fingers either in extension or flexion to verify needle proximity to the lower trunks of the plexus. After negative aspiration, the local anaesthetic drug solution in the labelled syringe was injected after repeated aspiration every 4-6 ml to avoid intravascular injection. Group R received 35cc of 0.375% injection Ropivacaine and group RD received 35cc of 0.375% Ropivacaine with 0.5µg /kg of injection Dexmedetomidine. Sensory block was evaluated by pinprick method.

Sensory block was graded as

- Grade 0: Sharp pain felt
- Grade 1: Analgesia, dull sensation felt
- Grade 2: Anaesthesia, no sensation felt
- Motor block assessment was done according to the modified Bromage scale for upper extremities on a three-point scale as;
- Grade 0: Normal motor function with full flexion and extension of elbow, wrist, and fingers.
- Grade 1: Decreased motor strength with the ability to move a finger
- Grade 2: Complete motor block with inability to move fingers.

Onset of sensory block was taken following attainment of the complete sensory block (Grade 2 block) which is anaesthesia on all nerve territories. The onset of motor block was taken following attainment of the complete motor block that is the absence of voluntary movement on fingers (Grade 2 block). Duration of sensory block analysed as the time period between the onset of sensory block and complete recovery of anaesthesia of the blocked nerves. The duration of motor block was assessed as the time period between the onset of motor block and resolution of motor block. Patients monitored for HR, SBP, DBP, RR, SPO2 after drug administration and then till 12hr postoperatively. Pain assessed using Visual analogue scale (VAS) scale after drug administration and then 12hr postoperatively. Duration of analgesia was taken as the period between the end of local anaesthetic solution administration and the first analgesic need.

- Patients shifted to the postoperative recovery room. All patients received oxygen supplementation by face mask @ 3-4L/min with FiO2-0.5% for 4 hours.
- Side effects like nausea, vomiting, hypotension, bradycardia, sedation were recorded.

Statistical Analysis: Intergroup mean comparison was done using Unpaired‘t’ test; the comparison of proportion between the two groups was done using Fisher’s Exact Test. A p value of < 0.05 was taken as statistically significant. OPEN EPI software for calculating the sample sized based on comparison of means of two samples was used and according to that we had included 50 patients in each group.

Results

There were 50 (50.0%) patients each in Group R and Group R+D. Demographic variables like age, weight, gender (male preponderance in both the groups), ASA physical status and duration of surgery were comparable in both the groups with $p>0.05$ i.e. statistically insignificant (table 1). The mean heart rate was significantly lower in Group RD in comparison to Group R ($p<0.05$). The mean SBP and DBP was significantly lower in Group RD in comparison to Group R ($p<0.05$). In Group R, none of the patients experienced any side effects. (table 3) In Group RD, 6 patients had hypotension. The mean sensory block onset time and duration in Group R was 18.21 ± 2.49 minutes and 402.66 ± 46.23 minutes respectively and in Group RD was 5.09 ± 2.07 minutes and 631.22± 52.03 minutes respectively. The mean onset of sensory block was faster in Group RD and also it was longer in Group RD in comparison to Group R (p=0.001) (fig.1). The mean motor block onset time and duration in Group R was 19.31 ± 0.22 minutes and 356.24 ±45.41 minutes respectively and in Group RD was 7.96 ± 2.34 minutes and 521.04 ± 38.06 minutes respectively (fig.2). The mean onset of motor block was faster in Group RD and also it was longer in Group RD in comparison to Group R. (p=0.001).(table 2) The mean time to first analgesic requirement and mean total analgesic requirement in Group R was 418.52 ± 76.08 minutes 3.02 ± 2.79 respectively and in Group RD was
649.13 ± 55.65 minutes and 0.79 ± 1.41 respectively. The difference was found to be statistically significant (p=0.001). The mean time to first analgesic requirement was longer and mean total analgesic requirement was significantly lower in Group RD in comparison to Group R. (table 2)

Table 1: Demographic profile

Demographic variables	Group R	Group RD
Age(mean)	38.24 ± 16.44	36.67 ± 21.22
Weight(mean)	61.76±3.87	62.01±5.34
Gender(ratio)	34:16	36:14
Asa Physical Status [I/II (%)]	88/12	91/09
Duration of Surgery(min)	106.45±24.88	109.31±39.64

Table 2: Characteristics of blockade in patients

Parameters	Group R	Group RD	P-Value
Sensory block onset time(min)	18.21 ± 2.49	5.09 ± 2.07	*p*<0.001
Sensory block duration(min)	402.66 ± 46.23	631.22± 52.03	*p*<0.001
Motor block onset time(min)	19.31 ± 0.22	7.96 ± 2.34	*p*<0.001
Motor block duration (min)	356.24 ±45.41	521.04 ± 38.06	*p*<0.001
Time of first rescue analgesia(min)	418.52 ± 76.08	649.13 ± 55.65	*p*<0.001
Total consumption of analgesic(mg)	3.02 ± 2.79	0.79 ± 1.41	*p*<0.001

Table 3: Comparison of side effects

Side Effects	Group R	Group RD
Nausea	0	0
Vomiting	0	0
Sedation	0	0
Hypotension	0	5

Discussion

Supraclavicular blocks are now known as 'spinal anaesthesia of the upper limb' as they are so frequently used nowadays for upper limb surgeries as they block all the sensory, motor and sympathetic supply of upper limb. Regional anaesthesia have many added advantages over general anaesthesia like no airway trauma and laryngoscopy related hemodynamic alterations, reduces drugs related side effects like residual sedation, PONV etc, provide excellent post-operative analgesia etc.

Bupivacaine is commonly used local anaesthetic drug for regional anaesthesia but it has many side effects especially cardiac toxicity if injected intra vascularly by mistake. Ropivacaine is an S(-)- enantiomer of bupivacaine with safety profile especially cardiac better than bupivacaine with potency and efficacy equivalent to it.

Adjuvants when added to local anaesthetic agents have shown to increase their efficacy by shortening the onset timeof action and prolonging the overall effect. Dexmedetomidine is an alpha-2 agonist agent when added with ropivacaine fastens the onset of action and prolongs the analgesic effect of the anaestheic agent. We chose Dexmedetomidine as an adjuvant with Ropivacaine because it is a very specific and selective α2 adrenoreceptor agonist, with α2/α1 selectivity and superiority of Dexmedetomidine has been already demonstrated in comparison to clonidine and Ketrorolac in various studies [9, 10, 11, 12, 13]. Dexmedetomidine causes presynaptic activation of α2 adrenoreceptor in the central nervous system and inhibits the release of norepinephrine and peripheral pain signals which possibly defines its analgesic property [19]. Central α2 adrenoreceptor agonist action causes a decrease in substance P release at the dorsal root neuron and causes an analgesic effect [14, 15] Further to increase its safety profile we preferred to use 0.5µg/kg.

In our study, we found that demographic variables in both the groups were comparable with p>0.05 i.e. statistically insignificant.

In our study, we found that Dexmedetomidine when added to Ropivacaine causes early onset of sensory and motor block. The mean sensory and motor block onset time was significantly lower in the Group RD in comparison to Group R. In our study we found that the addition of Dexmedetomidine as an adjuvant to Ropivacaine causes prolonged sensory and motor block duration. We observed that mean duration of sensory block was significantly longer in the Group RD (661.08 ± 61.0 minutes) in comparison to Group R (457.64 ± 62.23 minutes) (p=0.001) and mean duration of motor block was significantly longer in the Group RD (573.04 ± 59.80 minutes) in comparison to Group R (399.18 ± 53.53 minutes) (p=0.001).

In our study the mean time to the first analgesic requirement was longer in Group RD in comparison to Group R. The mean total analgesic requirement was significantly lower in Group RD in comparison to Group R.

Intraoperative heart rate changes in our study, we noticed that in both the group's heart rate decreased after drug administration. However, bradycardia did not occur in our study so there was no need for pharmacological intervention. Our findings are in concordant with the findings of Atul Dixit *et al*. [21] who also found a decrease in heart rate after giving 1µg/kg Dexmedetomidine with Ropivacaine but the mean heart rate remained to be normal.

Intraoperative blood pressure changes we found that SBP and DBP were significantly lower in Group RD in comparison to Group R (*p*<0.05)

In terms of side effects, none of the patients in both groups had nausea, vomiting and sedation. As in our institute, USG guided block modality is not available so we preferred to use a nerve stimulator guided supraclavicular brachial plexus blocks.

S. Sharma *et al*. [16] in their study found that addition of Dexmedetomidine 0.75 mcg/ kg to 0.5% Ropivacaine results in early onset of sensory and motor blockade, prolongation of duration of sensory and motor blockade and duration of analgesia postoperatively without any significant side effects.

B. Das *et al*. [17]. found results similar to our study and they concluded that Dexmedetomidine along with ropivacaine decreases the onset of motor and sensory block and increases the duration of sensory and motor block in supraclavicular brachial plexus block.

Dharmarao PS *et al*. [18]. In their study observed that dexmedetomidine prolongs the duration of sensory and motor block and postoperative analgesia as compared to fentanyl when used as an adjuvant to ropivacaine in supraclavicular brachial plexus block and is not associated with any major adverse events.

Nasir Hussain *et al*. [19]. Conducted a meta-analysis trial study and concluded that Dexmedetomidine has the ability to hasten the onset and prolong the duration of blockade when used as an adjuvant to local anesthesia for brachial plexus blockade. Considering an analgesic effect to be either decreased pain, a longer duration of analgesic block, or decreased opioid consumption, the addition of dexmedetomidine to local anesthetics for brachial plexus blockade was found to significantly improve analgesia in all 18 included studies. Their results were in concurrence of our study.

Dai Wei *et al*. [20]. Found results similar to our study like Dexmedetomidine added to ropivacaine in BPB has a better analgesia effect (shorter onset time and longer duration) compared to ropivacaine alone. At the same time, there was

no difference in the incidence of bradycardia and hypotension.

Conclusion

We finally conclude that Dexmedetomidine as an adjuvatnt to Ropivacaine reduces the onset and prolongs the duration of sensory & motor blockade & provides a good post-operative analgesia thus reducing the need of rescue analgesia in post-operative period and on the other hand it is associated with reduced heart rate and brief hypotension for which continuous heart rate and blood pressure monitoring are required.

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