Original Research Article

Dexmedetomidine as an adjuvant to 0.75% ropivacaine and 0.5 % levobupivacaine in peripheral nerve stimulator guided supraclavicular brachial plexus block

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Abstract

Background: The aim of study was to assess the effect of Dexmedetomidine as an adjuvant to Ropivacaine 0.75% and Levobupivacaine 0.5% in Peripheral Nerve Stimulator guided supraclavicular brachial plexus block. **Methods:** The study was a single-center, prospective, randomised experiment in which patients were randomly assigned to one of two groups conducted at SVBP Hospital affiliated with LLRM Medical College, Meerut. The study was done in 80 patients undergoing various elective forearm procedures under peripheral nerve stimulator guided brachial plexus block via supraclavicular route. **Result:** The mean time of onset of sensory block in Group B (Levobupivacaine + Dexmedetomidine) was found to be slight quicker than Group A (Ropivacaine + Dexmedetomidine) and the difference between both groups was found to be significant ($p= 0.042$) and the duration of analgesia was significantly ($p<0.01$) prolonged in Group B than Group A. **Conclusions:** 0.5 % Levobupivacaine and dexmedetomidine combination have quick onset of sensory and motor blockade and a significant prolongation in duration of sensory blockade than 0.75% Ropivacaine and Dexmedetomidine.

Keywords: Levobupivacaine, Ropivacaine, Dexmedetomidine, Peripheral nerve stimulator

Introduction

Brachial plexus block has evolved as a safe alternative to general anesthesia for upper limb surgery and for relief of perioperative pain. Its increased popularity is because of advancements in regional anesthesia techniques in terms of local anesthetic drugs, newer adjuvant drugs and use of peripheral nerve stimulators and ultrasound for safe and successful conduct of block. It helps in reduced hospital stay, less financial burden and avoidance of undesirable side-effects of general anesthesia.

Since the introduction of first brachial plexus block using cocaine by Halstead (1884) the technique of brachial plexus block has Levobupivacaine is the S(−)enantiomer of bupivacaine with favorable clinical profile and lesser cardiotoxicity when compared with racemic bupivacaine[3,4] is being favored local anesthetic for regional block nowadays.

Dexmedetomidine[5] is an alpha 2 agonist widely used as an adjuvant to regional techniques. It is highly selective (8 time more selective than clonidine), specific and potent α2-adrenergic agonist having analgesic, sedative, antihypertensive, and anesthetic sparing effects when used in systemic route. The purpose of adding an adjuvant to local anesthetics for peripheral nerve block is to have early onset of sensory and motor block and to prolong the duration of post-operative analgesia with lesser adverse effect.This study was designed to evaluate and compare the effect of adding dexmedetomidine to ropivacaine 0.75% and to levobupivacaine 0.5% in Peripheral Nerve Stimulator guided supraclavicular brachial plexus block in terms of onset and duration of sensory and motor block, quality of block, duration of postoperative analgesia, and to find out any complications.

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evolved[1]. Many additives to local anesthetics such as opioids, clonidine, neostigmine and tramadol etc. have been used to increase the duration of the block, to improve postoperative pain management.

A supraclavicular block offers dense anesthesia for surgical procedures at sites at (or) distal to elbow, forearm & hand. It can be used as the sole anesthetic technique or in combination with general anesthesia for perioperative analgesia.

Ropivacaine[2] is one of the most widely used amide local anesthetic as it has a longer duration of action varying from 5 to 8 hours and also has less cardiotoxic effects when compared to other amide local anesthetics.

Methods

After approval of the institutional ethics committee all participants were asked for written and informed consent. Eighty patients of American Society of Anaesthesiologist (ASA) physical status Grade I and II of either sex and age between the 18 to 60 years admitted to SVBP Hospital associated to LLRM Medical College, Meerut undergoing upper limb elective surgeries were included in the study.

The exclusion criteria was infection at injection site, Coagulopathy, Pregnancy, Major Central Nervous System, Cardiovascular System, Respiratory System and Haematologic system abnormalities. Randomization was done using sealed envelopes technique. Patients were randomly divided into two groups for the study as follows:

GROUP A - Ropivacaine 0.75% (20 cc) + Dexmedetomidine (50µg, 0.5 cc) + (0.5 cc) Normal Saline- Total volume 21 cc

GROUP B - Levobupivacaine 0.5% (20cc)+Dexmedetomidine (50µg, 0.5 cc) + (0.5 cc) Normal Saline- Total volume 21cc

In the study sensory block was assessed by pin-prick method by a three-point scale:

- 0-normal sensation
- 1-loss of sensation of pin-prick(analgesia)
- 2-loss of sensation of touch(anaesthesia)
- Motor block assessment was done according to Modified Bromage scale for upper extremities on a three-point scale:

- Grade 0: normal motor function with full flexion and extension of elbow, wrist and fingers.
- Grade 1: decreased motor strength with ability to move fingers only.
- Grade 2: complete motor block with inability to move fingers.

Sensory and motor blocks were evaluated every 5 minutes until 30 minutes after injection and then every 30 minutes until they have resolved.

Visual Analogue Score (VAS) was used for pain assessment. It consist of a line with two descriptors representing extremes of the pain intensity (eg: no pain and worst imaginable pain) at each end. Rescue analgesia was given on patient's demand. Injection diclofenac sodium aqueous solution, 75 mg IV infusion was given as rescue analgesic. A careful and thorough systemic examination was done to rule out any cardiovascular, respiratory and neurological disorder. Airway examination was done at Pre Anaesthetic Check-up (PAC) clinic. The following base line vitals like Heart Rate, Mean Arterial Pressure, Systolic Blood Pressure, Diastolic Blood Pressure and O2 Saturation (SpO2) are recorded before the procedure and monitored for every 5 minutes for the initial 30 minutes and for every 30 minutes for 120 minutes. An intravenous line, preferably through an 18 Gauge intravenous cannula, was secured in the unaffected limb and Ringers lactate solution was started.

Anaesthetic Technique

The patient was placed in the supine position with his/her head turned in opposite direction to the arm to be blocked and placed in an anatomical neutral position as far as possible.

The interscalene groove was followed until the subclavian artery is palpated. After skin preparation and with strict aseptic precautions a 22- gauge, 5 cm, insulated stimulation needle was advanced with a nerve stimulator (PLEXYGON-VYGON France). The needle was directed dorsally tangential to the subclavian artery.

The nerve stimulator (PLEXYGON-VYGON France) was initially set to a current intensity of around 0.8 mA- 1.5mA and a pulse width of 100 µs. The placement of the needle was judged to be successful when a muscle twitch is observed with threshold intensity <0.5 mA. As the needle penetrates the fascia, a click was appreciated and the tip is close to the brachial plexus. Nerve stimulation at this point identifies the division, which is stimulated. If subclavian artery is not palpated, clavicle middle was taken as the insertion point.

The respective amount of drug was injected after proper placement of the needle. Onset of sensory and motor blockade was assessed and vital parameters were monitored till 120 minutes.

Patients undergoing the study was also observed for incidence of complications like: Drowsiness, Pruritus, Nausea/vomiting, Horner's syndrome, Phrenic nerve palsy, Pneumothorax, Respiratory depression and any signs and symptoms for local anaesthetic toxicity were recorded and if any complications occur. They were also followed up for the assessment of the duration of sensory and motor blockade and for any requirement of rescue analgesia.

As seen over many supraclavicular blocks distal responses produces more effective block rather a proximal one. Proximal responses are contraction of the biceps, triceps, flexor carpi radilais or flexor carpi ulnaris. Those are to be ignored. Initial proximal (deltoid) responses are observed followed by more distal (extension/flexion of wrist) responses. The distal responses are the flexion or extension of the wrist or fingers, which are to be accepted.

Statistical Analysis

To reduce bias and error the sample size was calculated as total 72 patients or 36 patients in each group. The calculation was based at α error of 0.05 and study power of 90%.To make good for attrition rate, 40 patients in each group were included for the study. Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences) for Windows (version 16.0).Categorical variables were described as frequency (percentage), mean ± standard deviation was used for continuous parameters. For all analyses, a two-tailed p-value of <0.05 was considered statistically significant.

Observations and results

The mean age of the study group A was 41.8±10.1 years (mean±s.d.) and group B was 42.9±11.87 years respectively. The gender wise distribution of study participants showed that majority of them were males 67.5% and 32.5% were females. The physical status of study participants (ASA) showed that majority of them were ASA Type I (90%), only 10% individuals were ASA Type II. The mean weight in Group A was 56.8 ± 8.5 kg and mean weight in Group B was 57.1 ± 5.3kg.

In the hemodynamic observation the pulse rate variation was not significant. However in systolic blood pressure it was significantly higher in group B at 30, 60 and 120 mins (*p* value <0.01). In diastolic and mean blood pressure it was lower in group B at 5, 10 and 15 mins (*p* value <0.01). SpO2 variation in the study was not significant.

The mean time of onset of sensory block in Group B (Levobupivacaine + Dexmedetomidine) was found to be slight quicker than Group A (Ropivacaine + Dexmedetomidine) and the difference between both groups was found to be significant (p= 0.042) and the mean time of onset of motor block in Group A was 14.3 ± 1.34 minutes and in Group B was 11.25 ± 0.98 minutes, so quick onset of motor block with group B combination and the difference was found to be significant (p <0.01). (Table 1)

Table 1: Mean time of onset of sensory and motor block among study subjects:

Onset of Block (in Minutes)	GROUP	N	Mean	SD	p-Value
Sensory Block	Group A	40	7.72	0.876	0.042*
	Group B	40	7.30	0.966	
Motor Block	Group A	40	14.30	1.343	<0.01*
	Group B	40	11.25	0.980	

The duration of sensory block was prolonged in Group B in comparison to Group A and the mean difference between both groups in duration of sensory block was found to be highly significant (p <0.01) and duration of motor block between both groups was found to be not significant (p= 0.8025).(Table 2)

Table 2: Mean duration of sensory and motor block among study subjects

Duration of Block (in Minutes)	GROUP	N	Mean	SD	p-Value
Sensory Block	Group A	40	861.95	29.90	<0.01*
	Group B	40	916.37	32.28	
Motor Block	Group A	40	811.25	40.04	0.805
	Group B	40	809.12	36.94	

The mean duration of analgesia (time of requirement of rescue analgesia) among the study groups was significantly (p<0.01) prolonged in Group B than Group A.(Table 3)

Table 3: Mean duration of analgesia among study subjects

	Group	N	Mean	SD	p-value
Duration of Analgesia (in minutes)	**Group A**	40	899.37	40.04	<0.01*
	Group B	40	954.50	29.56	

The mean difference between both groups in duration of surgery was not significant.

Complications among study groups

Table 4 shows the description of complications encountered among study participants. Group A and Group B don not have any significance difference in terms of complications occurred during the study (p =0.644)

Table 4: Complications among study groups

			Complication		Total
			No	Yes	
Group	Group A	N	37	3	40
		%	49.33 %	60%	50.0%
	Group B	N	38	2	40
		%	50.66 %	40%	50.0%
Total		N	75	5	80
p-value = 0.644					

Discussion

In this study we found out that there is significance difference in onset of sensory and motor blockade in both of our study groups. The combination of Levobupivacaine and Dexmedetomidine showed earlier onset of sensory blockade and earlier onset of motor blockade than Ropivacaine and Dexmedetomidine combination. We also found out in our study that there is prolonged sensory blockade by the Levobupivacaine and Dexmedetomidine combination (Group B) in comparison to Ropivacaine and Dexmedetomidine combination (Group A). The duration of motor blockade was nearly same in both the groups. We found out significant prolongation in duration of analgesia in groups received levobupivacaine and dexmedetomidine than the other group who receive ropivacaine and dexmedetomidine.

In a study conducted by C. Piangatelli *et al*[6], they have given 0.5% Levobupivacaine and 0.75% Ropivacaine to different study populations for psoas compartment block and sciatic nerve block. And the study showed that the onset time of the motor block was shorter($p<0.05$) in Group Levobupivacaine than in Group Ropivacaine. This result suggests rapidity and, above all, less variability in Group Levobupivacaine than Ropivacaine Group. Motor block offset time was much the same for the 2 groups, Group Ropivacaine having a slightly longer time, while sensory blockade offset time proved greater in Group Levobupivacaine. Analysis of means and standard deviations showed that Levobupivacaine presented sensory block resolution times higher than Ropivacaine with less inter-patientvariability. Local anaesthetics bind directly to the intracellular voltage- dependent sodium channels. They block primarily open and inactive sodium channels, at specific sites within channel. Lipid solubility appears to the primary determinant of intrinsic anesthetic potency (ropivacaine is less lipid soluble than levobupivacaine).Another study conducted by Sarita S Swami *et al*[7] reviewed dexmedetomidine addition to the local anesthetic Ropivacaine injected in performing supraclavicular brachial plexus block thus provides prolonged post-operative analgesia and markedly reduces the rescue analgesia in both the early and late post-operative period. Dexmedetomidine prolonged the surgical anesthesia and extended duration of analgesia as well as shortened the onset of motor blockade significantly.Ratan Kumar *et al*[8] in their study on 60 subjects who underwent supraclavicular brachial plexus blockade concluded that, dexmedetomidine added to levobupivacaine in supraclavicular brachial plexus block prolongs the duration of block and the duration of postoperative analgesia. In their study the mean duration of sensory blockade, motor blockade and duration of analgesia with levobupivacaine with dexmeditomidine combination were 840±50.23 minutes, 898±32.33 minutes and 997±154.23 minutes respectively.The above studies also show that selective α2-adrenoceptor agonist like dexmedetomidine when added as adjuvant to ropivacaine and levobupivacaine in different peripheral nerve blocks potentiates the sensory and motor blockade. The mechanism is not clear. Probably peripherally, α2-agonists produce analgesia by reducing release of nor epinephrine and causing α2-receptor-independent inhibitory effects on nerve fibre action potentials.The incidence of hematoma, pneumothorax, accidental intravascular injection, post block vomiting/convulsions/neuralgia were nil in either group. Intraoperative nausea was seen in three patients in group A and two patients in group B, which was mild and did not required any intervention.Hemodynamic parameters like HR/BP/SPO2 were within normal limits in both groups. No patient required any intervention.

Conclusion

From the present study it can be concluded that 0.5 % Levobupivacaine and dexmedetomidine combination have quick onset of sensory and motor blockade than 0.75% ropivacaine and dexmedetomidine. There is significant prolongation in duration of sensory blockade with 0.5 % Levobupivacaine and dexmedetomidine than 0.75% ropivacaine and dexmedetomidine. There is significant prolongation in duration of analgesia with 0.5% levobupivacaine with dexmedetomidine than 0.75% ropivacaine with dexmedetomidine. There is no significant prolongation of motor blockade with either of the two drug combinations. Both of the drug combinations are found to behemodynamically stable with no significant complications

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