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Original article

Dexmedetomidine as an adjuvant to Ropivacaine in upper limb surgeries under ultrasound-guided supraclavicular brachialplexus block

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Abstract:

Background- The use of peripheral nerve block for anaesthesia & post-operative analgesiahas increased in recent years. The upper extremity surgeries can be performed safely usingbrachial plexus block. In our study we have compared ropivacaine 0.75% and in other group same concentration of ropivacaine with adjuvant dexmedetomidine 1µg/kg. Thestudy has been designed to find out the effect of dexmedetomidine as an adjuvant to ropivacaine in USG guided supraclavicular brachial plexus block with comparison with soloropivacaine 0.75%, in upper limb surgery. The aim of the study to find out the duration of analgesia, onset of sensory & motor blocks duration of sensory & motor blocks any side effect / complications.

Materials and methods-In this descriptive longitudinal study 100 patients aged between 18 to 60 years of either gender, belonging to ASA1 & ASA2, patients undergoing upperlimb surgeries under USG guided supraclavicular brachial plexus block were studied undertwo groups: Group A- patients who will receive 20ml of 0.75% ropivacaine. Group B- patients who will receive 20ml of 0.75% ropivacaine with 1µg/kg body weight Inj.dexmedetomidine. In both groups we noted duration of analgesia, onset of sensory block, onset of motor block, duration of sensory block, duration of motor block, any side effect / complications. All the patients were monitored for the pulse rate, SBP, DBP, MAP, oxygen saturation and side effects in perioperative period.

Observation and results- The mean timeof onset of sensory block in group A was 12.96±4.305 mins while that in group B was11.82±5.08 mins, the mean time of onset of motor block in group B 15.72±6.10 mins as compare to group A 19.14±5.96 mins, the mean duration of sensory block in group B 705.02±234.13 mins as compare to group A 525.96±171.61 mins, the mean duration of motor block was 478.98±161.49 mins in group A and 634.08±206.38 mins in group B. Themean duration of analgesia in group B 810.78±275.67 mins as compare to group A 588.72±204.66 mins. The mean of modified Ramsay sedation score for dexmedetomidinegroup B 3.04±0.76 while that for group A was 2.16±0.54. All the patients in both the groups add stable hemodynamic parameter including PR, SBP, DBP, SPO2, MAP except bradycardia observed in 3 patients in dexmedetomidine group and 1 patient.

Conclusion-Dexmedetomidine as an adjuvant to ropivacaine in the supraclavicular brachial block for upper limb surgery significantly prolongs the duration of sensory and motor blocks with longer duration of post-operative analgesia, faster onset of motor block,there was no difference in onset of sensory without any significant side effects.

Key words- Brachial Plexus Block, Dexmedetomidine, Ropivacaine

INTRODUCTION:

Regional anaesthesia is one of the most preferred modalities used by surgeons and anaesthesiologists because of its simplicity, preservation of consciousness, avoidance of airway handling, rapid recovery and significant postoperative analgesia. Brachial plexus block has been widely used for upper limb surgeries. The various routes described for brachial plexus approach are interscalene, supraclavicular, infraclavicular and axillary[1] . Supraclavicular brachial plexus block called as "spinal anaesthesia of the upper extremity". It is a

preferred technique of anaesthesia for upper-limb procedures because it is cost-effective, performs well, has a high margin of safety, and provides good post- operative analgesia.[1,2] It provides rapid onset, dense anaesthesia of the upper limb with a single injection[3]. The brachial plexus block is also very much helpful in emergency cases where general anaesthesia is contraindicated. Regional anaesthesia can be a good alternative to general anaesthesia with the advent of accessories such as peripheral nerve stimulator and ultrasound. Use of ultrasound helps in providing real- time view of the block needle, the brachial nerve plexus and its relationship to the neighbouring vital structures. It has increased the success rates and also has brought down the complication.[4] Various adjuvants, which will prolong the duration of analgesia were tried in many trials with lesser side effects but yet the ideal adjuvant remains undiscovered. Dexmedetomidine is extremely selective (8 time more selective than clonidine)[5] and potent α2-adrenergic agonist. When used in systemic route it has analgesic, antihypertensive, sedative, and anaesthetic sparing effects[6].It has been proved that adding Dexmedetomidine to local anaesthetics during peripheral nerve blockade and regional anaesthetic procedures efficacy of the block is improved.[7] .Dexmedetomidine prolongs the sensory and motor duration of block and duration of postoperative analgesia when added to local anaesthetic in various regional blocks.[8] Hence here is an attempt through this study to look out for the effect of dexmedetomidine as an adjuvant with ropivacaine in upper limb surgeries with ultrasound- guided supraclavicular brachial plexus block.

MATERIALS AND METHOD:

A descriptive longitudinal observational study was conducted at department of Anaesthesiology in Pravara Rural Hospital, Loni. On 50 patients per group to increase the power and allowing for 10%dropouts, undergoing upper limb surgeries under USG guided supraclavicular brachial plexus blockof American Society of Anaesthesiologists (ASA) grade I and II.

Data was collected accordingly using a pre-validated and pre-tested study tool from all the study subjects who undergone upper limb surgeries under USG guided supraclavicular brachial plexus block, with Ropivacaine 0.75% or Ropivacaine 0.75% with Dexmedetomidine 1µg/kg during a study period of 2 years.

- **Group A**- patients who will receive 20ml of 0.75% ropivacaine.
- **Group B**- patients who will receive 20ml of 0.75% ropivacaine with 1 micro gm per kg body weight dexmedetomidine.

After a pre-op evaluation and written informed consent, the patient was wheeled into the operating room. Ringer lactate infusion was started after intravenous access was established with 18 G venflon. Baseline Heart rate, Spo2, and blood pressure weremeasured.

STATISTICAL ANALYSIS:

Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. The Unpaired t test (for quantitative data to compare two independent two groups) was used for quantitative data comparison of all clinical indicators. Chi-square test was used for qualitative data whenever two or more than two groupswere used to compare. Level of significance was set at $P \leq 0.05$.

OBSERVATIONS AND RESULTS:

Mean age of the study subjects in group A is 34.2±10.85 and in group B is 36.34±12.68 years while mean weight in group A was 59.68 ±10.19 Kg and group B was 59.16±10.73kg. No significant statistical difference was observed among study groups withrespect to age (P value – 0.32) and weight distribution. (P value – 0.8)

Mean duration of surgery in Group A was 129.30±50.47 mins and in group B was 146.10±56.76 mins. No significant statistical difference was observed among study groups with respect to duration of surgery. (P value –0.12).

As shown in table 1 and graph 1, onset of sensory block was early in group B with mean time of 11.82±5.08 (minutes) as compare to 12.96±4.305 (minutes) in group A (P-0.22). There was no significant difference among two groups in the time for onset of sensory block. (P>0.05).

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Table 1. Mean comparison of time required for onset of sensory block and motorblock (mins) in both the groups

		Mean	Std. Devi	Minimum	Maximum	P value
Sensory	**Group A**	12.96	4.305	6	24	0.22
	Group B	11.82	5.086	6	27	
Motor	**Group A**	19.14	5.966	6	30	0.001 (S)
	Group B	15.72	6.108	6	30	

Table 2. Mean comparison of time of VAS Score (VAS> 4) in both the groups

	Mean	Std. Devi	Minimum	Maximum	P value
Group A	603.60	205.414	330	1140	0.001 (S)
Group B	819.00	270.527	360	1500	

The mean time for the VAS>4 was 603.60± 205.414 (min) in group A and 819.00± 70.52 (min) in group B. There was significant difference among two groups in the meantime for the VAS>4.(P<0.05)

Table 3: Comparison of mean duration of sensory block, motor block and analgesiain both the groups

		Mean	Std. Devi	Minimum	Maximum	P value
Sensory	Group A	525.96	171.614	288	888	0.001 (S)
	Group B	705.02	234.130	226	1254	
Motor	Group A	478.98	161.493	225	876	0.001 (S)
	Group B	634.08	206.384	333	1128	
Analgesia	Group A	588.72	204.661	318	1125	0.001 (S)
	Group B	810.78	275.673	336	1488	

The mean duration of sensory block was 525.96±171.61 (minutes) in group A and 705.02±234.13 (minutes) in group B. There was significant difference among two groups in the sensory block duration. (p-0.001). Thus, mean duration of sensory block was higherin group B as compare to group A. The mean duration of motor block was 478.98±161.49 (minutes) in group A and 634.08±206.38 (minutes) in group D. There was significant difference among two groups in the motor block duration (p-0.001). Thus, mean duration of motor block was higher in group B as compare to group A. The mean duration of analgesia was 588.72±204.66 (minutes) in group A and 810.78±275.67 (minutes) in group B. There was significant difference among two groups in the duration of analgesia. (p-0.001) Thus mean duration of analgesia was higher in group B as compare to group A. The mean pulse, systolic and diastolic blood pressure at the above different times between the two groups are not statistically significant. (P>0.05)

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Table 4: Mean comparison of sedation score in both the groups

	Group A		Group B	
	N	%	N	%
1	3	6	1	2
2	37	74	11	22
3	9	18	23	46
4	1	2	15	30
Mean	2.16		3.04	
SD	0.54		0.76	
P value	0.001 (S)			

In group A, sedation score corresponding to score 2 was observed in 74% of patients and sedation score of 3 in 18% of patients, whereas in group B, sedation score corresponding to 2 was observed in 22% of patients and sedation score of 3 in 46% of patients. The mean sedation score was 2.16±0.54 in group A and 3.04±0.76 in group B. The difference in sedation score between the two groups was found to be significant ($p<0.05$)

Table 5: Complication

			Complication		Total
			Bradycardia	**Nil**	
Groups	**Group A**	**N**	1	49	50
		%	2.0%	98.0%	100.0%
	Group B	**N**	3	47	50
		%	6.0%	94.0%	100.0%
Total		**N**	4	96	100
		%	4.0%	96.0%	100.0%
P value-0.3					

Bradycardia observed in 3 patients in dexmedetomidine group and 1 patient in Group A which responded to single dose of injection atropine sulphate 0.6mg. But the association within the groups did not have any significance ($P>0.05$). There was no incidence of headache, nausea, vomiting, hypotension, chest pain, coughing, convulsion and respiratory depression, and procedure related complication.

DISCUSSION

Regional anaesthesia is associated with multiple benefits including decreased mortality and morbidity, greater postoperative analgesia, cost efficiency and a decreased rate of major complications as compared to general anesthesia[9]. Peripheral nerve blocks are multimodal analgesic technique to provide safety for post-operative pain management with less side effect as well as decrease requirement of systemic opioids without any complications. Other than this, Peripheral nerve blocks include reduction in resource utilization, improved postoperative recovery, early rehabilitation and improvement in patient satisfaction resulting in growing interest in practice of regional techniques and in particular peripheral nerve blocks.[10]

Nowadays,Ultrasonography has brought revolution in the method for performing nerve blocks in recent years. Ultrasonography has an additional advantage of being able to picture the nerves and the needle during the performance of a nerve block over other techniques. Ultrasound imaging techniques enable the anaesthesiologist to visualize the local anaesthetic delivery in real time, with the potential benefit of improving nerve block efficiency, shortening block latency,

and reducing the minimum volume needed to achieve a good nerve block.[11] considering the above facts, we used USG guided supraclavicular brachial plexus block with 22G, 50mm long needle for administering the block

We found no difference in time of onset of sensory block between two groups. (12.96±4.3 min in Group A and 11.82± 5.08 min in group B [P > 0.05]) P value obtained on applying students unpaired t test was P=0.22.(Table 1) Similar findings to our study were observed by the study done by Gurajala I et a[12] ,Morhofer et al[13] and Yu Zhang et al [13,14] Nema et al[15] [137] compared 30 ml Ropivacaine (0.75%) Group A and 29 ml Ropivacaine (0.75%) with 1 ml Dexmedetomidine (50µg) Group B for supraclavicular block and found onset of sensory was significantly faster in group B with mean time of onset of sensory block was 7.20±2.483 mins and 14.20 ±5.229 mins in group B and Group A respectively. The results of this study contradict with the findings of our study. The difference in the observation of onset of sensory block might be due to different concentrations, the volume of drug used and different criterion for assessment of onset time, but it needs to be re-examined in subsequent studies.

We found that onset of motor block was early in group B with mean time of 15.72±6.10 (minutes) as compare to group A 14±5.96 (minutes) in group A. There was significant difference among two groups in the time for onset of motor block (P<0.05) (Table 1 and Graph 1). This result was concurrent with the study conducted by Mangal et al[16] Nema et al[15] and Khemka et al. The results of our study also correlate with the study done by D. Morhofer et al[13] We found that there is a difference in the duration of sensory block between two group (525.96 ± 171.61 min in group A compared to group B which was 705.02 ± 234.13 minutes. [P <0.05]) (Table 3 and Graph 3). This result was concurrent with the study conducted by Mangal, et al, Nema et al[15], and Khemka et al. The data from our study, reveals that duration of motor blockade was longer in Group B (634.08± 206.38) compared to Group A (478.98 ± 161.49) ((P < 0.05). similar to results found by Mangal et al[16] and Nema et al[15] and thus keeping with trend of previous study by Khemka et al[17]

In our study, mean duration of analgesia was higher in group B than group A (588.72 ±204.66 mins in group A and 810.78±275.67 mins in group B [P < 0.05].) The mechanism by α-2 agonists produce analgesia by reducing release of norepinephrine and causing α-2 receptor-independent inhibitory effects on nerve fibre action potentials. Centrally α-2 agonists cause analgesia and sedation by inhibition of substance P release in the nociceptive pathway at the level of the dorsal root neuron and by activation of α-2 adrenoceptors in the locus coeruleus[13] The increase in duration of analgesia due to dexmedetomidine is dose dependent and effect is peripheral (i.e. not due to centrally mediated or systemic analgesia).[18.]The effect on the peripheral nerve were found to be likely mediated through blockade of the hyperpolarization – activated cation current (Ih current)[19]

This result was concurrent with the study conducted by – Mangal et al[16] and Nema et al.[15] The data from study of Khemka et al[17] reveals that mean duration of analgesia in Group R was 298.33 ± 70.36 min and in Group R + D was 406.17 ± 73.15 min (P <0.05). The results of our study also correlates with the study done by D. Morhofer et al[13], Gurajala I et al[12] and Yu Zhang et al.[14]

Sedation scores were higher in patients receiving dexmedetomidine (Group B) as compared to the (group A). No patient experienced any airway compromise or required any airway assistance because of sedation. Dexmedetomidine induces sleep by activating endogenous non-rapid eye movement pathways. Stimulation of α-2A receptors in the nucleus coeruleus inhibits noradrenergic neurons and disinhibits GAB Anergic neurons in the ventrolateral preoptic nucleus (VLPO). Dexmedetomidine provides dose dependant increase in sedation[20.] Results of our study are in keeping with trend of previous study by Mangal et al[16]

In Khemka et al[17] study, blood pressure, heart rate, respiratory rate, and SPO2 remained stable throughout the procedure and postoperatively as they did not differ clinically significant during the study period, but statistically, significant difference was observed in both groups, in heart rate and systolic blood pressure (P < 0.05) There was no incidence of headache, nausea, vomiting, hypotension, chest pain, coughing, convulsion and respiratory

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depression and procedure related complication. There was no any CNS and CVS toxicity seen in either group patients. The present study indicates that Dexmedetomidine added to Ropivacaine in performing supraclavicular brachial plexus block provides prolonged post-operative analgesia and markedly reduces the rescue analgesia in both the early and late post- operative period.

CONCLUSION

Based on the results of this study, it can be concluded that after administration of Inj.Ropivacaine 0.75% in Group A and Inj.Ropivacaine 0.75 % with Inj.Dexmedetomidine1µg/kg in Group B:

- The duration of analgesia with Inj.Ropivacaine 0.75 % with Inj.Dexmedetomidine 1µg/kg (Group B) was prolonged compared to Inj.Ropivacaine 0.75% (Group A).
- No any significant difference was found in onset of sensory block between the twogroups.
- The onset of motor block was faster with Inj.Ropivacaine 0.75% withInj.Dexmedetomidine 1µg/kg (Group B) than Inj.Ropivacaine 0.75% (Group A).
- The duration of sensory block and duration of motor block was prolonged with Inj.Ropivacaine 0.75 % with Inj.Dexmedetomidine 1µg/kg (Group B) compared toInj.Ropivacaine 0.75% (Group A).
- No any significant complications or side effects were seen in both the groups.

  Thus, we can conclude that both the concentrations are effective in producing supraclavicular brachial plexus block. Group B patients; however, had significantly longer duration of analgesia, longer duration of sensory and motor block and a faster onset of motor block Hence, our study favors, the use of 0.75% ropivacaine with 1µg/kg Dexmedetomidine over 0.75% ropivacaine alone for upper limb surgery under ultrasound- guided supraclavicular brachial plexus block.

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