

## A Comparative Study of Ropivacaine and Ropivacaine with Dexmedetomidine during Interscalene Brachial Plexus Block in Upper Arm Surgeries

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### Abstract

### Original Research Article

Pain is a complex multidimensional human perception. It is divine to allay pain, Says Galen. In treatise on gout and rheumatism English physician Thomas Sydenham in 17<sup>th</sup> century wrote-“Among the remedies, which it has pleased Almighty God to give man to relieve his suffering none is so universal and as efficacious as opium.” Specifically, we tested the hypothesis that adding dexmedetomidine significantly prolongs the duration of analgesia. Another objective of the study was to assess the extent to which the duration of analgesia and Anaesthesia is prolonged with the addition of Dexmedetomidine. Ropivacaine 0.50% used in brachial plexus block is well tolerated and provides effective surgical Anaesthesia as well as relief of postoperative pain. Dexmedetomidine as an adjuvant to ropivacaine enhances the quality of ISB block by faster onset of sensory and motor block. Dexmedetomidine increases the duration of both sensory and motor blockade. Duration of analgesia was significantly increased by dexmedetomidine when added to ropivacaine in brachial plexus block. Though statistically insignificant, addition of dexmedetomidine results in more intraoperative hemodynamic stability. Both dexmedetomidine and ropivacaine do not cause any major side effects in anaesthesia techniques. Thus, this study shows that dexmedetomidine 150 µg added to ropivacaine 0.50% in an appropriate technique has low side effect profile with considerable therapeutic benefit and enhances the quality of ISB block.

**Keywords:** Ropivacaine, Dexmedetomidine Interscalene.

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## INTRODUCTION

Pain is a complex multidimensional human perception. It is divine to allay pain, Says Galen. In treatise on gout and rheumatism English physician Thomas Sydenham in 17<sup>th</sup> century wrote-“Among the remedies, which it has pleased Almighty God to give man to relieve his suffering none is so universal and as efficacious as opium [1].”

Pain after orthopaedic surgery can be intense [2]. In particular; managing pain after shoulder procedures poses a challenge to both anaesthesiologists and orthopaedic surgeons. The use of an interscalene block as the primary anaesthetic increases the proportion of patients suitable for post-anaesthesia care unit (PACU) bypass and decreases immediate postoperative pain [3]. However, analgesia is usually lasting less than 24 h. Brachial plexus block provides

both intraoperative anaesthesia and postoperative analgesia without any systemic side-effects [4]. There has always been a search for ideal adjuvant to local anaesthetics for regional nerve block that prolong the analgesia with lesser adverse effects [5].

### Pharmacology of Ropivacaine

Ropivacaine is an amino amide local anaesthetic, which is structurally similar to bupivacaine. The decreased cardiovascular and central nervous system toxicity makes ropivacaine interesting alternative to bupivacaine in procedures requiring large doses of local anesthetic [6, 7].

### Pharmacology of Dexmedetomidine

Dexmedetomidine is highly selective (8 time more selective than clonidine) [8], specific and potent  $\alpha$  adrenergic agonist having analgesic, sedative,

antihypertensive, anxiolytic, and anesthetic sparing effects when used in systemic route. Adding dexmedetomidine to local anesthetics during peripheral nerve blockade and regional Anaesthesia procedures may also prove efficacious for the surgical patients. It acts on both pre and post synaptic sympathetic nerve terminal and central nervous system thereby decreasing the sympathetic outflow and norepinephrine release, causing sedative, antianxiety, analgesic, sympatholytic and hemodynamic effect [9].

### Need for the study

Clinical studies have shown that dexmedetomidine can prolong the duration of analgesia when used in combination with local anaesthetic agents like ropivacaine. Previous studies on the effect of adding dexmedetomidine to ropivacaine has shown conflicting result in different nerve blocks. As further research is required on this, we planned to evaluate the effect of adding dexmedetomidine to ropivacaine in interscalene brachial plexus block. Specifically, we tested the hypothesis that adding dexmedetomidine significantly prolongs the duration of analgesia. Another objective of the study was to assess the extent to which the duration of analgesia and Anaesthesia is prolonged with the addition of dexmedetomidine.

## MATERIAL & METHODS

### Study area

The present study was conducted in the Department of anesthesiology at Dr Ram Manohar Lohia Combined Hospital, Lucknow (U.P). The hospital caters to urban and rural population including those from Lucknow and nearby rural areas belonging to different strata giving a cross sectional study.

### Study population

Study was done on the patients who were undergoing elective upper arm surgery. Patients who gave informed consent for participation in study were included.

### Sample size & sampling technique

Total 80 patients in the age group of 18-60years in ASA Gr I & II undergoing elective shoulder surgery were enrolled for the study. The enrolled patients were randomized in two groups of 40 each (n=40) using random number table.

**GROUP A (n=40):** had received 0.5 % Ropivacaine 30 ml

**GROUP B (n=40):** had received 0.5 % Ropivacaine 30 ml + Dexmedetomidine 150µg.

### Data collection technique and tools

Data collection technique is by using Pre-designed Proforma for data collection (Annex I)

## DATA ANALYSIS

Results were expressed by standard methods i.e as mean  $\pm$  standard deviation. Chi-square test was applied for demographic data, haemodynamic parameters. Onset and duration of sensory and motor blockade and duration of analgesia was analyzed by unpaired t- test. Statistical analysis was performed by SPSS (VERSION 20.0). P-value was considered significant if  $<0.05$  and highly significant if  $<0.001$ .

## RESULTS

Brachial plexus block provides both intraoperative anaesthesia and postoperative analgesia without any systemic side-effects. Ropivacaine has lower lipid solubility and have produced less central nervous system toxicity and cardiotoxicity than bupivacaine for which it is gaining popularity over bupivacaine for peripheral nerve blocks. There has always been a search for ideal adjuvant to local anaesthetics for regional nerve block that prolong the analgesia with lesser adverse effects. Several clinical studies have shown that dexmedetomidine can prolong the duration of analgesia when used in combination with local anaesthetic agents like bupivacaine.

**Table-1: Mean of Various parameter in Group A & Group B**

Variables	Group A	Group B	T Value	P Value
Onset of sensory block (min)	11.1 $\pm$ 2.18	10.10 $\pm$ 1.56	1.142	0.022
Onset of motor block (min)	14.7 $\pm$ 2.18	13.4 $\pm$ 1.67	1.253	0.014
Onset of surgical Anaesthesia (min)	18.5 $\pm$ 2.44	17.2 $\pm$ 1.54	1.468	0.016
Duration of Sensory Block (min)	371.8 $\pm$ 42.71	443.0 $\pm$ 34.39	8.15	<0.001
Duration of motor block (min)	391.5 $\pm$ 41.96	461.2 $\pm$ 34.5	7.51	<0.001
Duration of Analgesia (min)	440.0 $\pm$ 41.91	520.8 $\pm$ 34.21	9.75	<0.001

The addition of 150 µg dexmedetomidine to ropivacaine 0.5% for peripheral nerve stimulator (PNS) guided interscalene brachial plexus blockade increased the duration of both sensory and motor blockade, and the need for analgesic in post-operative period was also reduced significantly. The duration of analgesia in

dexmedetomidine group was significantly longer than Ropivacaine group alone (p value  $<0.001$ ).

### Hemodynamic Characteristics

#### Intraoperative

We recorded that hemodynamic changes in the cases of two groups A & B intra-operatively. A fall in

the pulse rate (per minute ) for first 10 minutes was observed on start of operation, then after there was a slight fluctuation in the pulse rate (per minute ) as the operation progressed in the cases of both the groups A & B . Mean pulse rate (per minute) after 15 min. of start of operation were  $78.1 \pm 9.68$  &  $78.2 \pm 7.43$  beat/ min, whereas the reading after 90 minutes decreased to  $75.3 \pm 9.44$  &  $73.8 \pm 7.08$  beat/ min for cases of group A & B respectively. The Intra-operative variations in the mean pulse rate (per minute) were not significant at any time interval between the cases of the two groups.

During intra-operative period a fluctuation in the mean SBP was observed as the operation progressed. Mean SBP after 15 min of start of operation was  $116.9 \pm 7.23$  &  $113.4 \pm 6.33$  (mmHg) whereas the readings of SBP, after 45 min. intra - operative fluctuated to  $111.8 \pm 7.07$  &  $109.2 \pm 6.36$  (mmHg) for cases of group A & B respectively. Then again the mean SBP registered a gradual upward trend in the cases of both the groups A & B which was recorded to be  $114.2 \pm 6.35$  &  $112.0 \pm 4.60$  (mmHg) after 120 minutes of start of operation. Intra-operative variations in the mean systolic blood pressure (mmHg) between the cases of two groups was significant after 5 minutes, 10 minutes, 15 minutes of commencement of operation as  $P < 0.05$ .

Mean DBP after 15 min. of start the operation were  $75.3 \pm 5.73$  &  $73.1 \pm 5.18$  (mmHg) whereas the reading after 30 min. fluctuated to  $75.7 \pm 5.68$  &  $74.3 \pm 5.29$  (mmHg) for cases of group A & B respectively. Then again mean DBP registered a down-

ward trend in cases of group A & B and mean DBP reading at 120 minutes intraoperative was  $70.9 \pm 6.18$  &  $71.7 \pm 5.92$  (mmHg). Intra- operative variations in the mean diastolic blood pressure between the cases of the two groups was significant at time interval of 60 min as  $P < 0.05$ .

Intra- operative variations in the Mean arterial pressure (mmHg) between the cases of the two groups were significant at 5 min, 10 min, 15 min & 60 min during the operation as  $P < 0.05$ .

### Post-Operative

The post-operative variations in the mean pulse rate of two groups were significant at 1 hr post-operatively as  $P < 0.05$ . Post-operative variations in the mean systolic blood pressure (mmHg) between the cases of the two groups was not significant at time intervals as  $P > 0.05$ . Post-operative variations in the mean diastolic blood pressure (mmHg) between the cases of the two groups A&B was not significant at any time interval post operatively as  $P > 0.05$ . Post-operative variations in the mean arterial pressure (mmHg) between the cases of the two groups A & B were significant at time intervals of 1 hr & 3 hrs. as  $P < 0.05$ . The difference in the sedation score between the cases of the two groups was highly significant at time intervals of 1 hour, 2 hours, 3 hours, 8 hours and Immediately post-op as  $P < 0.001$  & it was significant at time interval of 6 hr as  $p < 0.05$ . The variation in the VAS score between the members of the two groups was highly significant at time intervals of 3 hours to 8 hours post-operatively as  $P < 0.001$ .

**Table-2: Effect of dexmedetomidine group and ropivacaine dexmedetomidine group**

Complication	Group A (n=40)		Group B (n=40)		P Value
	No of Patients	Percentage	No of Patients	Percentage	
Pneumothorax	0	0	0	0	NS
External Jugular vein puncture	1	2.5	1	2.5	0.158
Intraarterial injection	0	0	0	0	NS
Nerve Injury	0	0	0	0	NS
Dry Mouth	0	0	0		NS
Nausea	1	2.5	3	7.5	0.6153
Pruritus	0	0	0	0	NS
Vomiting	0	0	2	5	0.493

All hemodynamic parameters were comparable, although after giving block the mean pulse rate in dexmedetomidine group was low as against mean pulse rate in plain ropivacaine group at all time intervals, but was statistically not significant. No patient in ropivacaine group suffered bradycardia except one in dexmedetomidine group. However, when the changes in mean blood pressures were compared between the groups, they were found comparable, and no significant patient in any group had hypotension.

## DISCUSSION

Pain is an unpleasant nociceptive sensation that originates from noxious stimulation due to disease process or injury including surgical incision which eventually causes impending or ongoing tissue damage in peri-operative period.

The present study was carried out on patients in the department of Anaesthesiology at Dr. Ram Manohar Lohia Combined Hospital, Lucknow (U.P.) as per inclusion & exclusion criteria. Total 80 patients in

two groups of 40 each (n=40) were included in this study. The demographic characteristics like mean age, mean weight and mean height, Gender and ASA score and Duration of surgery have been recorded and found no significant difference data between both groups.

We have recorded significant difference in onset of sensory block and onset of motor block between two parameters for group A & B respectively. Surgical anaesthesia has been statistically significant as P value <0.05. Similar results were observed by H.D.Rashmi *et al*. [10].

In our study, we also recorded the duration of sensory block and found highly significant difference between two parameters as P value is <0.001. Duration of motor block & duration of analgesia for groups A & B respectively with highly significant difference between two parameters as P value is <0.001. Duration of analgesia was highly significant difference between two parameters as P value is <0.001 for groups A & B respectively. Similar results were observed by H.D. Rashmi *et al*. [1, 62] & Fritsch G *et al*. [11].

In our study, it has been observed that addition of 150 µg dexmedetomidine to ropivacaine 0.5% in interscalene brachial plexus blockade shortens the onset of sensory & motor block. The onset of surgical anaesthesia is also shortened. The duration of both sensory and motor blockade is increased significantly and the need for analgesic in post-operative period was also reduced significantly. In our study, it has been observed that the analgesic effect of ropivacaine is potentiated by dexmedetomidine. Rancourt MP *et al*. [12], observed that posterior tibial nerve sensory blockade duration prolonged by adding dexmedetomidine to ropivacaine. Marhofer D *et al*. [13] found prolongation of ulnar nerve block duration after addition of dexmedetomidine in ropivacaine used for the block by approximately 60%. The difference in the duration observed in various studies can be explained by the difference in the strength and volumes of drug used in these studies.

In our study, the addition of dexmedetomidine to ropivacaine in interscalene brachial plexus block lead to further prolongation of analgesia, less requirement of rescue analgesia and lower VAS score. The variation in mean visual analogue score between the two groups is statistically significant after 2 hr as P value is <0.05, and highly significant after 3 hr to 8 hr as P value is <0.001. Similar to our findings many investigators reported that the addition of dexmedetomidine to different type of LA agents in various types of peripheral nerve blocks resulted in prolongation of analgesic effect [14-15]. Similar results with addition of dexmedetomidine to ropivacaine were observed by Fritsch G *et al*. [11] and Abdallah FW *et al*. [16].

The mechanism of action of  $\alpha$ -2 agonists on the peripheral nerve has been elucidated in basic science studies, but has often failed to be translated to clinical literature. Clinical researches have written about (i)  $\alpha$ -2 adrenoceptor mediated vasoconstriction in the periphery, or (ii) centrally mediated analgesia. Dalle C *et al*. [17] demonstrated that peripheral effects of  $\alpha$ -2 mediated clonidine are through inhibition of the hyperpolarization-activated cation current ( $I_h$  current). This current normally functions to restore nerves from a hyperpolarized state to resting potential for a subsequent action potential. The effect appears to be more profound on C-fibers (pain fibers) than A $\alpha$ -fibres (motor fibers) [18], thereby making the effects potentially more sensory specific. As described in a study by Yoshitomi *et al*. [19],  $\alpha$ -2 adrenoceptor agonists prolonged the time of local anesthesia of lidocaine in a dose-dependent manner.

Hemodynamic parameters were observed throughout the operation and up to 8 hrs post-operatively. It has been found that the mean pulse rate was lower in group B than the mean pulse rate of group A but the intra-operative variations in the mean pulse rate (per minute) were not significant at any time interval between the cases of the two groups as p>0.05. Mean systolic blood pressure was also lower in group B and it was significant after 5 minutes, 10 minutes, 15 minutes of commencement of operation as P<0.05. Similarly mean diastolic blood pressure and mean MAP were recorded and it has been found that the variations in mean DBP were significant at 60 min as p value is <0.05 & the variations in the mean arterial pressure were significant at 5 min, 10 min, 15 min & 60 min during the operation as P<0.05. Similar results were observed by Fritsch G *et al*. [11] after addition of dexmedetomidine to ropivacaine in interscalene block.

Post-operatively hemodynamic parameters were observed up to 8 hrs and it has been found that the variations in the mean pulse rate post-operatively were significant at 1 hr as p value is <0.05. Variations in the mean SBP & mean DBP were not significant at any time interval post-operatively as P value is >0.05, while the variations in the mean arterial pressure were significant at time intervals of 1 hr & 3 hr as P<0.05. Our observations are similar with Rancourt MP *et al*. [12] in their study they reported that systolic and diastolic blood pressure levels were stable throughout the study period in ropivacaine group, and in group ropivacaine with dexmedetomidine, a noticeable decrease in systolic and diastolic blood pressure was observed. Our observations have been found same without any hemodynamic instability.

Almarakbi WA *et al*. [20] in their study noticed a significant fall in the HR 60 min following the administration of dexmedetomidine opposite to the control group. This effect persisted for 4 hr, but without any hemodynamic instability. The decrease in pulse rate

might be related to the post-synaptic activation of central  $\alpha$ -2 adrenoceptors, leading to decreased sympathetic activity and slower heart rate.

The variation in mean Sedation score between the two groups has been found statistically highly significant till 3 hr post operatively & at 8 hr post operatively as P value is <0.001. Rastogi B *et al*. [21] in their study observed that, sedation scores were higher in the dexmedetomidine group with statistically highly significant difference. The baseline sedation score was comparable between the groups.

Bharti N *et al*. [22] in their study on addition of dexmedetomidine in supraclavicular block noticed that patients receiving dexmedetomidine were more sedated for 2 hours than the control group patients (P<0.0001). No episode of bradycardia, hypotension, respiratory depression, or dizziness was reported.

In the present study, side effects like nausea and vomiting are not significant between group A & B as P value is >0.05. We have also not observed any hemodynamic side effect in our study except one case of bradycardia & one case of hypotension in group.

B. Bradycardia and hypotension which are the most dreaded side effects of  $\alpha$ -2 adrenoceptors agonist can be attributed to peripheral block use of dexmedetomidine. Ropivacaine also has been shown to be a better drug in terms of cardiovascular and hemodynamic control [23].

There is no incidence of shivering observed in either of the groups, which might be due to the anti-shivering property of the  $\alpha$ -2 adrenergic agents used for at least group B and similar findings were observed by Talke *et al*. [24] & Krishnappa MS *et al*. [25, 15] in their study they did not observe any side effects other than a few cases of bradycardia in both groups, which were successfully managed with atropine 0.6 mg iv.

## LIMITATION

The limitations of present study were:

1. Single centric study.
2. Small sample size. We suggest future studies to be undertaken with a larger population size.
3. Lack of proper assessment of success rate of interscalene brachial plexus block procedure.
4. Ropivacaine or dexmedetomidine was not used as per body weight in kg.
5. Another issue of concern is that prolongation of motor blockade by higher dose of dexmedetomidine though is useful for long duration surgeries, but it is detrimental in outpatient settings where early mobilization is desirable.
6. Dependence upon the skills of the investigators.

## CONCLUSIONS

- Ropivacaine 0.50% used in brachial plexus block is well tolerated and provides effective surgical Anaesthesia as well as relief of postoperative pain.
- Dexmedetomidine as an adjuvant to ropivacaine enhances the quality of ISB block by faster onset of sensory and motor block. Dexmedetomidine increases the duration of both sensory and motor blockade. Duration of analgesia was significantly increased by dexmedetomidine when added to ropivacaine in brachial plexus block.
- Though statistically insignificant, addition of dexmedetomidine results in more intraoperative hemodynamic stability. Both dexmedetomidine and ropivacaine do not cause any major side effects in anaesthesia techniques.
- Thus, this study shows that dexmedetomidine 150  $\mu$ g added to ropivacaine 0.50% in an appropriate technique has low side effect profile with considerable therapeutic benefit and enhances the quality of ISB block.

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