

Original Research Article

To Compare the Effect of Dexmedetomidine and Clonidine as Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgery

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Abstract

Background and Aim: Alpha-2 agonists as adjuvant to local anaesthetic agents for PNB enhance the quality and duration of analgesia. Aim of this prospective, double blind, randomised placebo controlled study was to compare the affect addition of Dexmedetomidine and clonidine to Ropivacaine with respect to onset, peak, and duration of sensory-motor block and duration of analgesia in Supraclavicular brachial plexus block.

Materials and methods: Ninety ASA grade I or II patients of either sex, aged 18-60 years age scheduled for elective upper limb surgery were equally divided in three groups (n=30). Group R received 0.75% Ropivacaine 30 ml + 1ml NS, Group RC received 0.75% Ropivacaine 30ml +1µgm/kg of clonidine, Group RD received 0.75% Ropivacaine 30ml + 1µgm/kg of Dexmedetomidine in Supraclavicular plexus block by using nerve locator.

Results: Onset (sensory= 7.6 ± 1.56 , 6.13 ± 1.59 , 4.13 ± 1.35 , in motor 10.23 ± 1.79 , 9.03 ± 2.31 , 6.50 ± 1.57 respectively), peak (sensory 17.33 ± 2.89 , 13.66 ± 3.16 , 10.63 ± 2.89 , in motor 21.76 ± 2.56 , 18.46 ± 3.0 , 15.66 ± 3.20 respectively) and duration (sensory 239.83 ± 39.96 , 322.0 ± 58.21 , 375.0 ± 53.69 , in motor 206.0 ± 40.71 , 285.0 ± 56.30 , 332.50 ± 57.84 respectively) of sensorimotor block and duration of analgesia (279.0 ± 43.67 , 357.16 ± 55.85 , 412.16 ± 50.06 respectively) were prolonged in Dexmedetomidine group as compared to other both group. VAS and sedation score was better in dexmedetomidine group than clonidine group. Hemodynamic stability was comparable in all three groups and no complications were seen in any of the group.

Conclusion: Dexmedetomidine ($1 \mu\text{g}/\text{kg}$) is better than clonidine as adjuvant to 0.75% Ropivacaine in supraclavicular brachial plexus block for upper limb surgeries.

Key words

Ropivacaine, Dexmedetomidine, Clonidine, Supraclavicular block.

Introduction

The peripheral nerve block [1] has gained popularity in providing intraoperative anaesthesia & prolonged analgesia in post-operative period. It also grants ease on the patients reducing hospital stay, financial burden and helps in avoiding undesirable effects of general anaesthesia [1].

The past few decades have brought a whole new era of advanced techniques in regional anaesthesia. This enlists- long acting local anaesthesia drugs, newer adjuvants, nerve locator and USG guidance [2], making the block safe and successful.

For upper extremities surgery, brachial plexus block is a safe and reliable anaesthetic technique, provides satisfactory surgical condition with complete motor and sensory block [3].

Many techniques are used to improve the quality of block and increase duration of analgesia i.e. insertion of peripheral nerve catheter or adding an adjuvant to local anaesthetics.

As the complications are more with perineural catheter insertion [4] we prefer α_2 agonist as an adjuvant to Ropivacaine for Supraclavicular brachial plexus block.

Alpha-2-adrenergic [5] agonists were chosen as an adjuvant for their sedative, analgesic, antihypertensive and antiemetic properties along with decreased requirement of local anaesthetics drugs.

Clonidine [6] a partial alpha-2 agonist has been shown to prolong the duration of anaesthesia and analgesia in peripheral nerve blocks.

Dexmedetomidine [7] a selective alpha-2 agonist, with affinity eight times that of clonidine, also has been shown to prolong the sensory and motor duration when added as an adjuvant to local anaesthetic in peripheral nerve blocks.

Therefore, we designed this controlled, randomised, double blind clinical study to evaluate and compare the effect of addition of dexmedetomidine and clonidine to Ropivacaine for supraclavicular brachial plexus block.

Materials and methods

After approval from institutional ethical committee and written informed consent, this clinical study was carried out on 90 ASA grade I and II patients of either sex, aged 18-60 years scheduled for various elective bony orthopaedic upper limb surgery under Supraclavicular block in the year of 2015 to 2016.

All patients underwent pre-anesthetic evaluation day before the scheduled surgery and received Tab alprazolam 0.5 mg and tab ranitidine 150mg at night. Before the procedure, visual analogue scale (VAS) on 0-10 cm was explained to the patient for the assessment of pain where 0 denotes no pain and 10 denotes worst pain.

Patients were randomly selected and equally divided into three groups by 'chit in box' method.

Group R= 0.75% Ropivacaine (30 ml) + 1ml NS,

Group RC=0.75% Ropivacaine (30ml) +1µgm/kg of clonidine,

Group RD=0.75% Ropivacaine (30ml) + 1µgm/kg of Dexmedetomidine.

Exclusion

Patient with pre-existing disease peripheral neuropathology of upper limb, blood disorders, infection at injection site, patient on adrenoceptor agonist or antagonist therapy, known allergy to drugs used in study, a history of respiratory, neuromuscular disorder, cardiovascular disease and shock were excluded from the study.

After confirmation of fasting status all Patients received standard monitoring (non-invasive BP, SpO₂, ECG) and IV line secured in non-operated limb and Ringer lactate was started @ 1ml/kg/hr.

After disinfection of skin and sterile preparation of nerve locator; block was performed by anaesthesiologist other than one assessing the patient's intra and post operatively. Neural localization was achieved by a nerve locator (NERVE MAPPER-LOCATOR, NM-20,MFG By INMED EQUIPMENT PVT LTD) connected to a 22 G, 50-mm-long stimulating needle. The location end point was a distal motor response with an output 0.5 mA in the distribution of ulnar, median, radial and musculocutaneous nerve region.

After negative aspiration, 31mL of local anaesthetic combined with NS, clonidine or dexmedetomidine was injected. A 3-min

massage was performed to facilitate an even drug distribution.

Evaluation of sensory scores

A pinprick test by blunt 23G hypodermic needle in comparison with the contra-lateral area of the median,radial ulnar and musculocutaneous nerve was performed at per minute till complete sensory block.

Sensory block was graded as

- **Grade 0:** Sharp pin felt
- **Grade 1:** Analgesia, dull sensation felt
- **Grade 2:** Anesthesia, no sensation felt.

Evaluation of motor scores

Motor block was determined according to a modified Bromage scale for upper extremities at each minute till complete motor block.

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

Definitions of time points

Sensory onset: time from performance of the block to dull sensation to pin prick in all sensory areas.

Complete sensory block: complete loss of sensation to pin prick in all sensory areas.

Duration of sensory block:the time interval between the end of drug administration and the complete resolution of sensation on all above nerves territories.

Onset of motor block:time from performance the block to Grade 1.

Peak motor block: - Grade 2 motor blockades.

Duration of motor block: time interval between the end of drug administration and the recovery of complete motor function of the hand and forearm.

Duration of analgesia: The time between the end of local anaesthetics administration to demand for rescue analgesic when Visual

Analogue Score (VAS) of 3 or >3 after drug administration.

The block was considered incomplete when any of the segments supplied by all above mentioned nerves did not have analgesia even after 30 min of drug injection. In this case, general anesthesia was given. Hemodynamic variables such as heart rate, blood pressure, respiratory rate and oxygen saturation were recorded at 0 min, 5 min, 10 min, 20 min, 30 min and then every 30 min intraoperatively and every 30 min post-operatively till recovery of sensory & motor function. Intraoperative sedation was assessed by Ramsay sedation score. The VAS was recorded post-operatively every 30 min till the score of 3 or >3. The rescue analgesia was given in the form of inj. IV Paracetamol at the visual analogue scale >3 and the time of administration were noted.

All patients were observed for any side-effects like nausea, vomiting, dryness of mouth and complications like pneumothorax, hematoma and drug toxicity and treated with appropriate measures.

Statistical analysis

The obtained data was tabulated and analyzed using one-way analysis of variance (ANOVA). ANOVA is used to determine whether there are any statistically significant differences between the means of two or more independent (unrelated) groups. Results are expressed as mean \pm standard deviation. ANOVA test was applied for onset and duration of sensory and motor blockade and duration of analgesia, demographic data, and hemodynamic parameters. The INDO-STAT software was used. CD-value was considered significant if less than difference of mean of 2 groups.

Sample size

Study sample size was estimated based on the pilot study ($n = 15$) for mean time to first demand bolus of 420 min in dexmedetomidine group and 310 min in control group. With SD of 23.5, our sample size came out to be 29 per group at a power of 80% and confidence interval of 95%. For possible dropouts, it was decided to include 30 patients per group.

Results

Patient's characteristics data are present in **Table - 1**. All three groups were comparable with respect to age weight and sex. Male predominance was seen in all groups.

Table – 1: Characteristic data of patients.

Characteristics	Group R	Group RC	Group RD
Number	30	30	30
Gender Ratio M/F	26/4	27/3	26/4
Age*	36.10	34.96	31.50
Weight*	59.73	58.53	56.20

*= Mean

Table – 2: Statistical analysis of Onset and Peak time of sensory and motor block.

Effect		Group R		Group RC		Group RD		CD
		Mean	SD	Mean	SD	Mean	SD	
Sensory	Onset	7.60	1.56	6.13	1.59	4.13	1.35	0.776
	Peak	17.33	2.89	13.66	3.16	10.63	2.89	1.536
Motor	Onset	10.23	1.79	9.03	2.31	6.50	1.57	0.986
	Peak	21.76	2.56	18.46	3.0	15.66	3.20	1.51

Table – 3: Comparison of duration of sensory and motor block and analgesia in min.

Effect	Group R		Group RC		Group RD		CD
	Mean	SD	Mean	SD	Mean	SD	
Duration of sensory block	239.83	39.96	322.0	58.21	375.0	53.69	26.33
Duration of motor block	206.0	40.71	285.0	56.30	332.50	57.84	26.83
Duration of Analgesia	279.0	43.67	357.16	55.85	412.16	50.06	25.76

There was a uniform trend of decrease in mean pulse rate in all three groups from baseline value. Significantly lower pulse rate was observed at 30, 60 and 90 min in group D (Difference of mean > CD) but not less than 60bpm.

Statistical analysis of Mean Pulse Rate (bpm) between groups (intra-operatively) was as per **Figure – 1**. Statistical analysis of Mean Pulse Rate (bpm) between groups (post-operatively) was as per **Figure – 2**.

Mean arterial pressure were found to be significantly lower than base line from 30 to 210 min in group D (Difference of mean > CD). Hemodynamic stability was observed in group RD as compared to other groups. The hemodynamic parameters were comparable at end of 210 min.

Statistical analysis of Mean Arterial Pressure (mmHg) between groups was as per **Figure – 3, 4**.

Figure – 1: Statistical analysis of Mean Pulse Rate (bpm) between groups (intra-operatively).

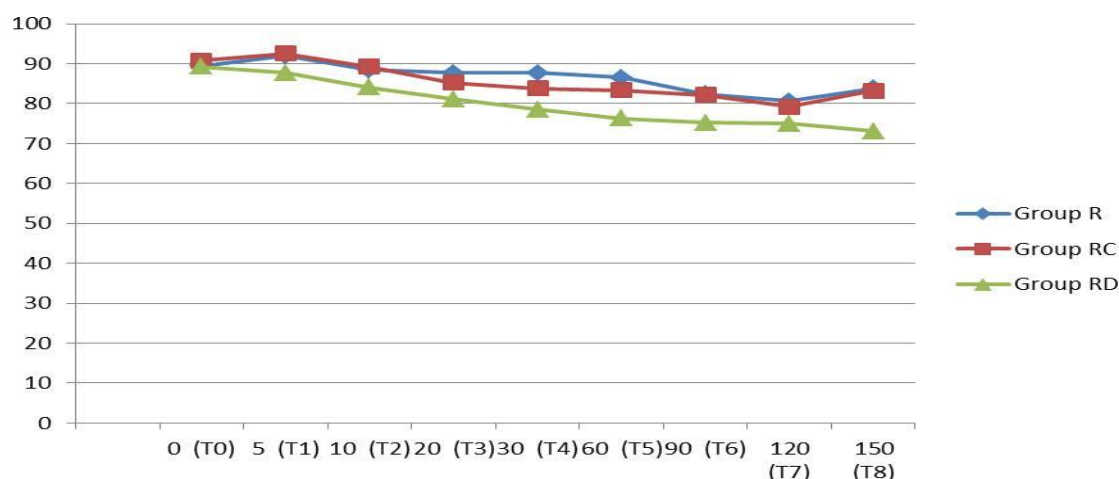


Figure – 2: Statistical analysis of Mean Pulse Rate (bpm) between groups (post-operatively).

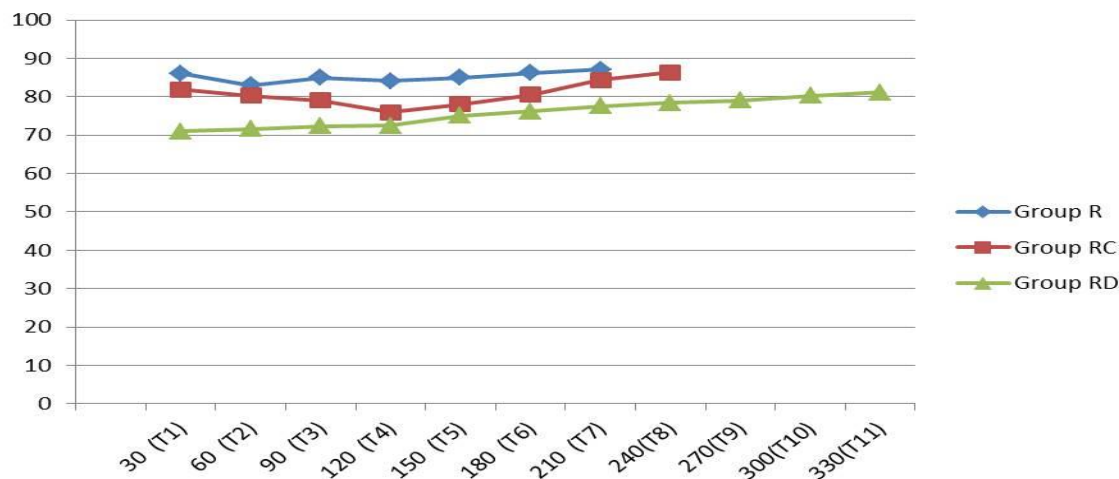


Figure – 3: Statistical analysis of Mean Arterial Pressure (mmHg) between groups.

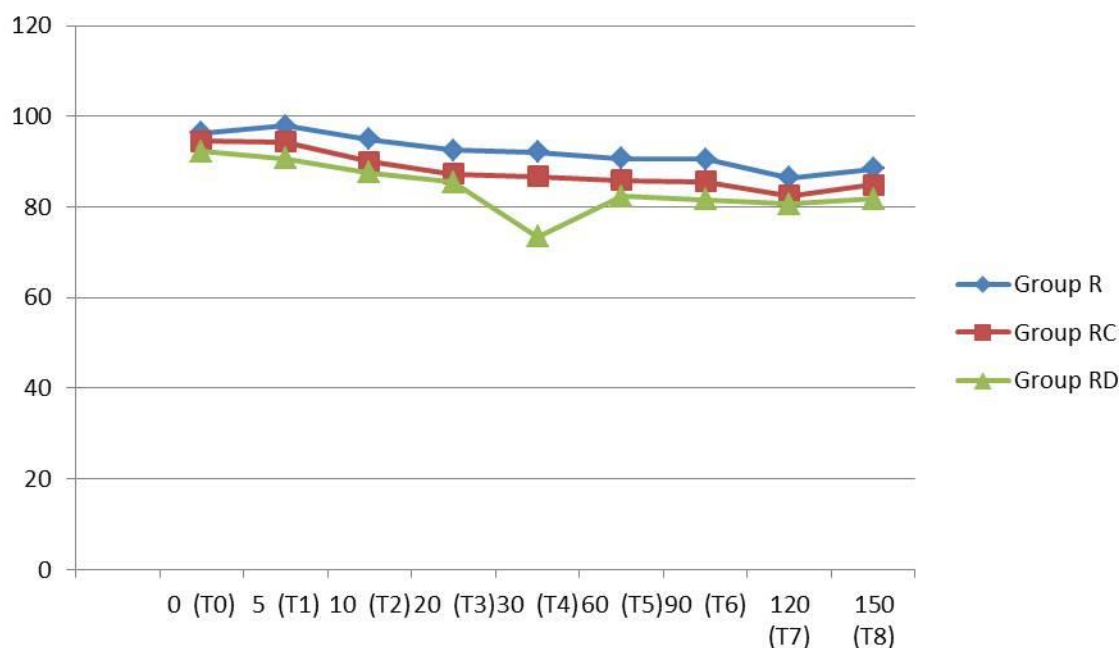
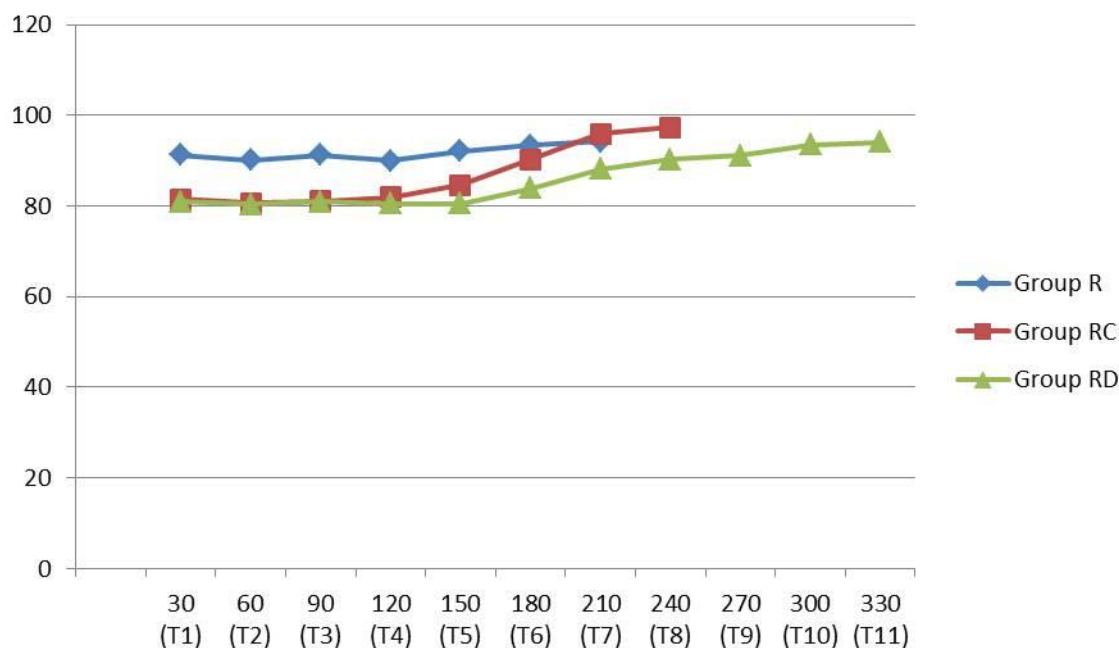


Figure – 4: Statistical analysis of Mean Arterial Pressure (mmHg) between groups.



The sensory and motor block onset was significantly faster in group RD than group RC and R (Difference of mean > CD).

The mean sensory onset time was 4.13 ± 1.35 min in group RD as compared to 6.13 ± 4.13 min and 7.60 ± 1.56 min in group RC and R respectively.

The mean motor block onset time was 6.50 ± 1.57 in group RD as compared to 9.03 ± 2.31 min in group RC and 10.23 ± 1.79 min in group R (**Table – 2**).

Mean duration of sensory block was maximum in group RD (375 ± 53.69) followed by group RC (322 ± 58.71) and group R (239.83 ± 39.96) min.

The duration of motor block was also maximum in group RD (332.50 ± 57.84) followed by group RC (285.0 ± 56.30 min) & group R (206 ± 40.71 min).

Mean duration of analgesia was significantly prolonged in group RD (412 ± 50.06) when compared with group RC (357 ± 55.85) & group R (279.0 ± 43.67) as per **Table – 3**.

Group RD patients had highest Sedation Score (RSS 4 and 5 in 48%) as compared to other 2 groups.

The VAS was 3 or >3 in group R at 210 min, in group RC at 240 min and in group RD at 330min postoperatively.

Bradycardia was observed in only one patient in group RD intra-operatively that was treated with inj.atropine sulphate 0.6mg IV. No episode of hypotension, hypoxemia or respiratory depression was seen in any group.

Discussion

To avoid GA disadvantages peripheral nerve block is preferred now days. Supraclavicular [8] route is preferable for brachial plexus block because the brachial plexus blocked at the level of distal trunk where almost the entire innervations of the upper extremities is confined in a very small surface area and provide rapid, dense & predictable anaesthesia of entire upper limb.

Many adjuvants are used for faster onset, denser block and prolonged duration of analgesia. In which α_2 agonists are one of them.

Clonidine is α_2 agonist and its analgesia property have been demonstrated when administered intrathecally or epidurally. Its action on large number α_2 receptors present in locus ceruleus in central nervous system [9], and dorsal horn of spinal cord is the main mechanism of centrally mediated sedation and analgesia. Specific peripheral effect of clonidine appears less

obvious because α_2 adrenoceptors are not present on the axon of the peripheral nerve.

A V Singh, et al. [10] conducted a study in which addition of 150 μ g of inj.clonidine to 40ml (0.75%) inj.Ropivacaine, for brachial plexus block via axillary approach prolongs duration of motor block, sensory block and post-operative analgesia, with acceptable sedation and without an increased incidence of side effects and any change in the onset times of sensory and motor blocks.

Birbal Baj, et al. [11] evaluated the effect of clonidine with ropivacaine for brachial plexus block has almost same onset time of both sensory and motor block as compared to plain ropivacaine but increases the duration of both sensory and motor blockade. Duration of analgesia was significantly increased by clonidine without any complication.

C Patel, et al. [12] adding 2 mcg/kg clonidine with 0.75% Ropivacaine in supraclavicular brachial plexus block and found that it does not alter the onset of block but prolongs the duration of analgesia.

The above studies show clonidine potentiates the sensory and motor block and also prolonged duration of analgesia.

Dexmedetomidine is also selective α_2 agonist and acts similar mechanism of action like clonidine and has more α_2 selectivity ($\alpha_2:\alpha_1:1620:1$) thus decreasing the unwanted effects of α_1 receptors.

The peripheral action of α_2 agonist has been proposed by four mechanism of action. These are centrally mediated analgesia, α_2 adrenoceptor mediated vasoconstriction effect, attenuation of inflammatory response and direct action on peripheral nerve.

Dalle, et al. [13] proposed that α_2 agonists by enhancing activity-dependent hyperpolarisation

generated by the Na/K pump during repetitive stimulation, increases the threshold for initiating the action potential causing slowing or blockage of conduction. Kosugi, et al. examined the effects of various adrenoceptor agonists including dexmedetomidine, on compound action potential (CAP) recorded from frog sciatic nerve, and found that CAPs were inhibited by α_2 adrenoceptor agents so that they are able to block nerve conduction.

Sarabjit Kaur, et al. [14] evaluate the effect of dexmedetomidine was better with regards to prolonged duration of sensory block, postoperative analgesia with reduced doses of rescue analgesic required and better patient satisfaction score.

SS Swami, et al. [15] found that dexmedetomidine prolongs the duration of sensory and motor block and enhances the quality of block as compared with clonidine when used as an adjuvant to Bupivacaine in peripheral nerve block.

Don Sebestin, et al. [16] adding Dexmedetomidine (50 μ g) as adjuvant to ropivacaine in supraclavicular brachial plexus block has faster onset of sensory and motor blockade and, prolonged duration of sensory and motor blockade and duration of analgesia, when compared with clonidine(50 μ g). No significant side effects were noted.

In our study Dexmedetomidine gave better results than clonidine and Ropivacaine alone. Dexmedetomidine gave faster onset and increased duration of sensory motor block and prolonged duration of analgesia.

Most of the studies show that dexmedetomidine and clonidine both prolongs the effects of local anaesthetics and improves the quality of local anaesthesia.

In our study, the onset of sensory and motor block was significantly shortened by addition of α_2 agonists to Ropivacaine.

Our results were consistent with most of the trails performed [12-16].

The prolongation of analgesia observed in addition of α_2 agonists in our study is consistent with other trail performed

Our study showed stable perioperative hemodynamics with the use of α_2 agonists. Most of the studies conducted using α_2 agonists in regional anaesthesia did not report any adverse effect. Rajani Gupta, et al. reported hypotension and Arvind Pal, et al. reported bradycardia with Dexmedetomidine in their studies.

Limitation

Unavailability of USG in our institute was the limitation of this study.

Conclusion

Receptors agonists (Dexmedetomidine and Clonidine) when added to Ropivacaine (0.75%) in Supraclavicular brachial plexus block for upper limb surgery provides effective surgical anaesthesia as well as prolonged relief of post-operative pain. Dexmedetomidine (1 μ g/kg) as an adjuvant to ropivacaine significantly enhances the quality of sensory and motor block and increased duration of analgesia as compared to clonidine(1 μ g/kg) that too without any significant side effects.

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