Original Research Article

Comparative Study of Ropivacaine 0.75% Alone and Ropivacaine 0.75% with Dexmedetomidine 50 µg as Adjunct in Supraclavicular Brachial Plexus Block Using Peripheral Nerve Stimulator

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Abstract

Introduction: Supraclavicular brachial plexus block is preferred for its rapid onset, reliable anesthesia and as a safe technique for any surgery in the upper extremity that does not involve the shoulder. **Aim:** The aim of the present study is to compare haemodynamic, sensory and motor effects of Ropivacaine alone and Ropivacaine along with Dexmedetomidine in Supraclavicular Brachial Block in upper limb surgery. **Methods and materials:** The present study was carried out on patients undergoing elective upper limb surgery during the period from January- 2018 to August-2019. The study included total 60 patients belonging to ASA grade I and II of either sex with age between 18-60 years posted for various elective upper limb surgery.**Results:** There was no significant difference in the study groups with regards to demographic profile and duration of surgery. The onset of sensory and motor blockade was faster in group-RD than group-R. Onset of sensory block: (group-R=14.133± 1.676 min & group-RD=12.667± 1.213min) (p=0.000), Onset of motor block :(group-R=25.967± 2.748min & group-RD=23.333± 3.467min) (p=0.002). Also total duration of sensory blockade {Group R=547.833± 26.152mins, Group RD =811.667± 25.405 mins (p value = 0.000)}, motor blockade {Group R=509.667± 24.703mins, Group RD = 760.667± 28.062mins (p value = 0.000)} and number of rescue injections in 24 hours {Group R=2.733± 0.450, Group RD=1.400± 0.498 (p value = 0.000)} was significantly different in two groups. There was good haemodynamic stability in both groups. There was no incidence of any side effects in both groups.**Conclusion:** Dexmedetomidine in a dose of 50µg added to ropivacaine in supraclavicular brachial block for upper limb surgery significantly shortens the onset time and prolongs the duration of sensory and motor blocks without producing sedation in patients. Total number of rescue analgesics required in postoperative period is also less with use of Dexmedetomidine as an adjuvant to Ropivacaine.

Keywords:Dexmedetomidine , Ropivacaine, Supraclavicular Brachial Block

Introduction

Pain is "an unpleasant sensory or emotional experience associated with actual or potential tissue damage or described in terms of such damage". It is an unpleasant effect associated with significant psychological and physiological changes during surgery and post-operative period. Regional anaesthetic techniques have specific advantages both for standalone anaesthesia and as analgesic supplements for intraoperative and postoperative care.[1]

Supraclavicular brachial plexus block is preferred for its rapid onset, reliable anesthesia and as a safe technique for any surgery in the upper extremity that does not involve the shoulder. Among these approaches supraclavicular and infraclavicular techniques are more effective in producing complete anaesthesia of all the branches of the brachial plexus as the narrowest part of the plexus is encountered by these techniques. Supraclavicular approach is easier than the infraclavicular approach as the plexus is more superficial above the clavicle.

Various local anesthetics have been used to produce brachial plexus block. Ropivacaine, a long-acting amide local anaesthetic related structurally to bupivacaine, has been used for supraclavicular block in upper limb surgery. It provides pain relief with less motor blockade and is less cardiotoxic than bupivacaine, which makes it a more suitable agent for supraclavicular brachial plexus block.

A variety of adjuvant has been studied for brachial plexus blockade including opioid and non-opioid agents. Patients undergoing upper limb surgeries with supraclavicular brachial plexus blocks are frequently hospitalized overnight due to inadequate pain relief after resolution of their blocks. For 0.75% ropivacaine previous studies report an average analgesic duration of 11 hours without epinephrine and approximately 12 hours with epinephrine. One promising approach is use of adjuvant drugs that prolong block duration when added to the local anesthetic.[2]

Many drugs have been studied as adjuvants for regional anesthetic techniques. Alpha-2 adrenoceptor agonists are routinely used by the majority of anaesthetists due to its many desirable effects, like anxiolysis, analgesia, sedation, anaesthetic-sparing and peri-operative haemodynamic-stabilising effects. Dexmedetomidine is an isomer and the active component of medetomidine.[3] The aim of the present study is to compare haemodynamic, sensory and motor effects of Ropivacaine alone and Ropivacaine along with Dexmedetomidine in Supraclavicular Brachial Block in upper limb surgery.

Material and methods

It was prospective, randomized and single blinded study carried out on patients undergoing elective upper limb surgery at MGM Hospital Warangal, in the department of Anaesthesiology during the period from January- 2018 to August-2019. The study was carried out to compare haemodynamic, sensory and motor effects of Ropivacaine alone and Ropivacaine along with Dexmedetomidine in Supraclavicular Brachial Block in upper limb surgery. Institutional Ethical Committee approval

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was obtained. The study included total 60 patients belonging to ASA grade I and II of either sex with age between 18-60 years posted for various elective upper limb surgery. Most of the past studies on brachial plexus block were done with the sample size of total 60patients. After observing results of various similar studies, it was considered that a clinically significant benefit of using dexmedetomidine would be a prolongation in sensory block duration of 15% (minimum) compared with the control group. Based on these estimates, we calculated a sample size that would permit a type I error of $\alpha = 0.005$ and power of 80%. Enrollment of 25 patients in each group was required. Considering the dropouts, 30 patients were selected in each of the group Informed consent was taken from each patient who meets inclusion criteria. Patients meeting the inclusion criteria during the preanaesthetic evaluation were randomly assigned into two groups of 30 each with the help of a computer generated table of random numbers by simple randomization method. Total 31 milliliter of solution for supraclavicular brachial plexus blockade was administered as follows-

Group-R: - Ropivacaine alone: Patients of this group received injection Ropivacaine (0.75%) 30 milliliters + 1 milliliter normal saline.

Group-RD: - Ropivacaine with Dexmedetomidine: Patients of this group received injection Ropivacaine (0.75%) 30 milliliter+ Dexmedetomidine50ug (0.5ml) diluted in 1 milliliter normal saline.

Inclusion criteria: ASA I-II adult subjects, Age 18-60 years of either sex elective upper limb surgery, Plan for supraclavicular brachial plexus block.

Exclusion criteria: Age < 18, Age > 60, ASA III ,IV or V adults, Any upper limb surgery involving shoulder, Chronic pain requiring daily opioids > 15 mg oral morphine equivalents, Daily use of gabapentin, pregabalin, tricyclic antidepressant, serotonin- norepinephrine reuptake inhibitor, tramadol, Hypersensitivity to amide local anesthetics, Schizophrenia or bipolar disorder, Preexisting nerve damage (sensory or motor) in the extremity to be blocked, Peripheral neuropathy, cardiovascular disease, Pregnancy and Patchy or Partial block Pre-anaesthetic evaluation was done on the evening before surgery.

Results

Our study was conducted on 60 patients who were randomly allocated into group-R and group-RD consisting of 30 patients each. The P value signifies that the two groups were comparable with regards to age, weight and height [Table 1].

In Group R, 56.67% patients were male and the remaining 43.33% cases were female. In Group II, 46.67% cases were male and 53.33% cases were female. Difference between them was comparable in both groups. In Group R, 56.67% patients were ASAPS I and the remaining 43.33% cases were ASAPS II. In Group RD also 56.67% cases were ASAPS I and 43.33% cases were ASAPS II. There was statistically no difference between two groups. Thus the patients in our study groups were comparable with respect to Sex and ASAPS eliminating bias (if any) which can occur due to these factors [Table 2].

The total duration of surgery was also comparable in both groups with mean duration in group R 101.633 ± 31.012 mins and group RD 103.500± 33.040 mins. The P value was insignificant (0.822). Thus there was no significant difference among the two groups with respect to the duration of surgery [Figure 1].

Table 1: Demographic profile of patients

Parameters	Group R	Group RD	P-value
	MEAN ± SD	MEAN ± SD	
AGE IN YEARS	38.233 ± 11.723	35.633±9.661	0.352
WEIGHT IN KGS	58.1 ± 6.472	58.4 ± 5.763	0.850
HEIGHT IN CMS	159.5 ± 4.632	159.8 ± 3.881	0.787

Table 2: Comparison of Sex and ASAPS in two Groups.

Groups	Sex		ASAPS	
	Male	Female	I	II
GroupR (n=30)	17	13	17	13
	56.67%	43.33%	56.67%	43.33%
Group RD (n=30)	14	16	17	13
	46.67%	53.33%	56.67%	43.33%
P Value	0.446		1.000	

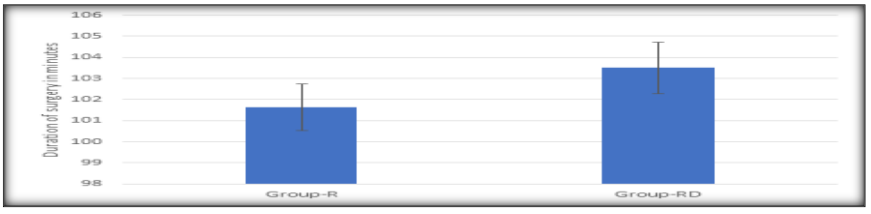

Fig 1: Comparison of duration of surgery

Table 3: Comparison of onset of sensory and motor block

Onset of Sensory block (In Min)	Group R	Group RD	P Value
	Mean ± SD	Mean ± SD	
	14.133± 1.676	12.667± 1.213	0.000
Onset of motor block (In Min)	25.967± 2.748	23.333± 3.467	0.002
Duration of motor block	509.667±24.703	760.667± 28.062	0.000
Duration of sensory block (In Min)	547.833±26.152	811.667±25.405	0.000

Table 4: Comparison of number of rescue injections in 24 hours.

Total number of rescue injections in 24 hours	Group R	Group RD	P Value
	Mean ± SD	Mean ± SD	
	2.733± 0.450	1.400± 0.498	0.000

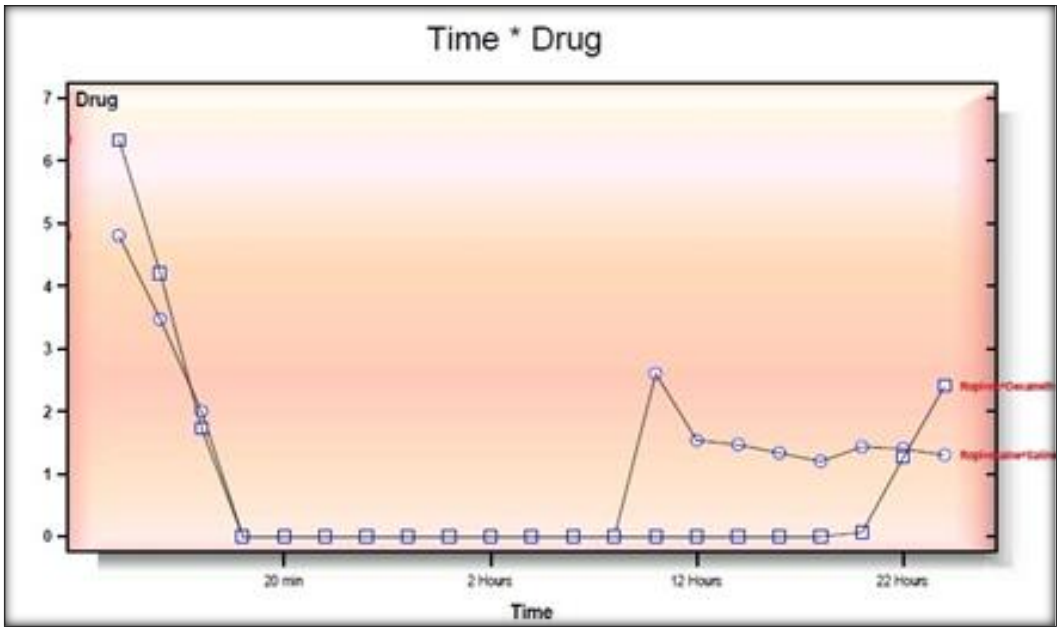

Figure-2: Visual analogue scale (VAS) scores in 24 hours

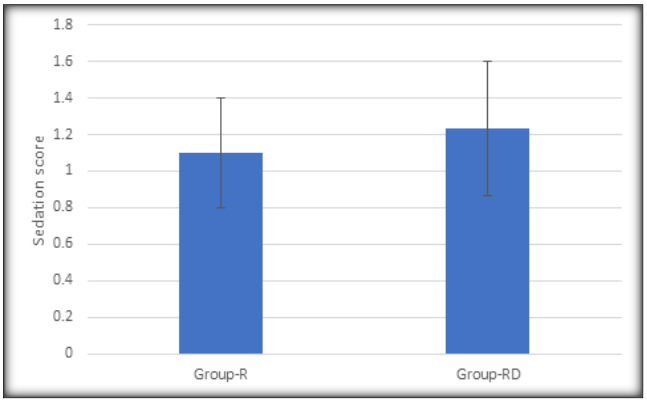

Fig 3: Comparison of sedation score between both groups

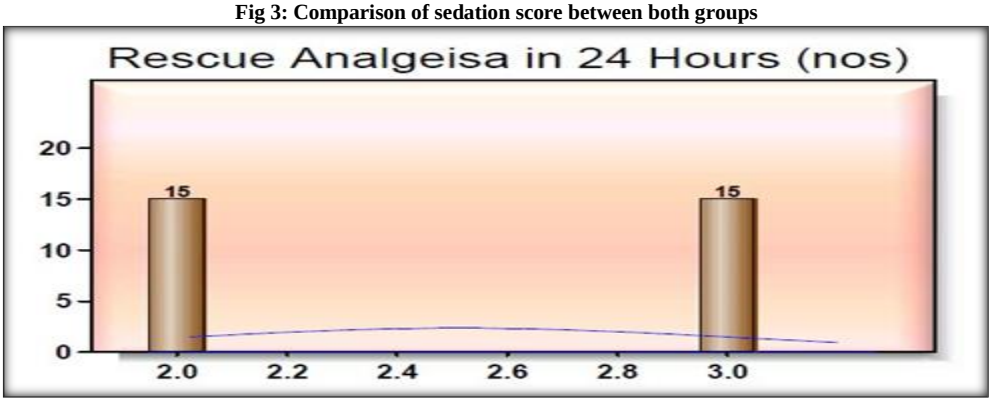

Figure-4: Requirement of Rescue analgesia

Onset time is the time from the completion of injection of study drug to first loss of pinprick sensation in any of the dermatomes C5-T1. In group R; it was 14.133± 1.676 min and 12.667± 1.213 min in group RD. This shows that ropivacaine with the total time required to achieve complete paralysis of the upper limb was considered as onset of motor block. In group R, it was 25.967± 2.748 min and 23.333± 3.467 min in group RD. P value is 0.002 which is a significant. This shows that ropivacaine with dexmedetomidine provides faster motor block than ropivacaine alone. Duration of motor blockade was longer in group RD (760.667± 28.062min) compared to group R (509.667± 24.703min) and this difference was statistically significant. Duration of sensory blockade was longer in group RD (811.667± 25.405min) compared to group R (547.833± 26.152min) and this difference was statistically significant [Table 3].

The requirement of rescue injections in 24 hours was less in group RD (1.400± 0.498) than group R (2.733± 0.450). The difference was statistically significant. Haemodynamic parameters (HR, SBP, and DBP) were recorded at 0,5,10,15, 20,25,30,45 minutes, 1st hr, 2nd hr and thereafter every second hourly till 24 hrs to record any incidence of bradycardia or hypotension. Heart rate in Group R and Group RD were comparable. The difference was statistically not significant. (P=0.476) There was no fall or rise in heart rate more than 15 beats than previous observation. SBP in Group R and Group RD were comparable. The difference was statistically not significant (P=0.416). DBP in Group R and Group RD were comparable. The difference was statistically not significant (P=0.784). Thus in the present study we found that there was no significant difference among the two groups in total 24 hours of duration with respect to parameters like HR, SBP, and DBP [Table 4].

Visual analogue scale (VAS) scores were also recorded at 0,5,10,15,20, 25,30,45 minutes, 1st hr, 2nd hr and thereafter every hourly till 24 hrs. Patients in Group RD had 0 VAS score for a longer duration than those in Group R. Differences in VAS scores of the two groups was statistically significant. (P=0.000). Thus in our present study we found that VAS scores were significantly higher in Group R as compared to Group RD. [Figure 2]

The sedation score in Group R is 1.1 whereas in Group RD is 1.233. Thus in our present study we found out that sedation scores where Not Significant. [Figure 3]

In the postoperative period, patients were given i.m injection diclofenac 75 mg as rescue analgesic when they started feeling pain and the time and dose of such requirement was recorded. Postoperative VAS scores were recorded upto 24 hours. Total number of rescue injection in this time frame was noted. The total number of diclofenac doses required in 24 Hrs in Group R was more (2.733± 0.450) as compared to Group RD (1.400± 0.498). The difference was statistically significant (P=0.000). There were no incidences of hypotension, bradycardia, respiratory depression, nausea or vomiting in any of 60 patients of these both study groups. Incidence of pneumothorax, heamatoma, accidental intravascular injection, convulsions and neuralgia were nil in either group. Perioperative parameters were also normal in both groups requiring no intervention [Figure 4].

Discussion

A variety of receptors mediate anti-nociception on peripheral sensory axons. The peripheral administration of appropriate drugs (Adjuncts) may have analgesic benefit and reduce systemic adverse effects. In an attempt to improve perioperative analgesia, a variety of adjuncts such as opioids, verapamil, neostigmine and tramadol have been administered concomitantly with local anesthetics into the brachial plexus sheath. Many drugs have been used as adjuvants to local anesthetic agents to prolong the duration of peripheral nerve blocks. Clonidine, a partial α-2 adrenoceptor agonist has been reported to prolong the duration of anesthesia and analgesia during such blocks. The α2:α1 selectivity of dexmedetomidine is eight times that of clonidine and its high specificity for α2 subtype makes it a much more effective sedative and analgesic agent. The aim of this study was to evaluate whether additional anesthetic and analgesic effects could be derived from administration of Alpha-2 adrenoceptor agonist Dexmedetomidine, into brachial plexus sheath. Dexmedetomidine is being used for intravenous regional anesthesia (Bier's block), intravenous (i.v.) sedation and analgesia for intubated and mechanically ventilated patients in intensive care units and nonintubated patients for surgical and other procedures. It has been reported to improve the quality of intrathecal and epidural anesthesia. Its use in peripheral nerve blocks has recently been described. However, the reports of its use in supraclavicular brachial plexus block are limited [4]. In this study, we investigated whether adding dexmedetomidine to bupivacaine for supraclavicular brachial plexus block would affect the sensory and motor blocks and duration of analgesia. it was considered that a clinically significant benefit of using dexmedetomidine would be a prolongation in sensory block duration of minimum 15% compared with the control group. Based on these estimates, we calculated a sample size that would permit a type I error of α = 0.005 and power of 80%. Enrollment of 25 patients in each group was required. Considering the dropouts, 30 patients were selected in each of the S group. Patients meeting the inclusion criteria during the preanaesthetic evaluation were randomly assigned into two groups of 30 each with the help of a computer generated table of random numbers by simple randomization method. Total 31 milliliter of solution for supraclavicular brachial plexus blockade was administered. In our study we used only 50 microgram dexmedetomidine as adjunct to ropivacaine because there are more chances to have bradycardia and hypotension with higher doses of dexmedetomidine. In our study, we observed that onset time was 14.133± 1.676 min in group R and 12.667± 1.213 min in group RD. (P value<0.05) Here onset time is the time from the completion of injection of study drug to loss of pinprick sensation. This observation well matches with study of Sandhya Agarwal et al [5] onset of sensory 13.20±1.848min and 19.04±3.195 min in dexmedetomidine group and control group respectively. Similar observation was made by Aliye Esmaoglu et al [6] where the onset time of sensory block was much faster in dexmedetomidine group, 9.03 ±1.15 min compared to that of placebo (10.46 ± 1.30 min). This shows that ropivacaine with dexmedetomidine provides faster sensory block than ropivacaine alone. In our study, we observed that onset of motor block was earlier in study group of dexmedetomidine having the mean value of 23.333± 3.467min and in comparison; the control group had a mean value of 25.967± 2.748min. Which is statistically significant (p = 0.002). This observation matches well with the study conducted by Sandhya Agarwal16, who had earlier onset of motor blockade in dexmedetomidine group compared to control group, 16.3±1.7min and 22.7±2.8 min respectively. Similar observation was made by Aliye Esmaoglu et al [6] where the onset time of motor block was much faster in dexmedetomidine group compared to that of placebo. The duration of motor block, in our study was 760.667± 28.062min with dexmedetomidine group-RD and 509.667± 24.703 min for control group-R, which is statistically significant (p= 0.000). This observation matches well with the study conducted by Rachana Gandhi et al [7] who had longer duration of motor blockade in dexmedetomidine group compared to control group, 660.2 ± 60.4min and 100.7 ± 48.3min respectively. Similar observation was made by Aliye Esmaoglu [6] where the duration of motor block was much longer in dexmedetomidine group-RD- 773.00 ±67.62 min compared to that of placebo group-R(575.00 ±65.00 min). This observation also well matches with study of Sandhya Agarwal [5], duration of motor block 702.0±111.6min and 208.0±22.7 min in dexmedetomidine group-RD and control group-R respectively. This shows that dexmedetomidine also prolongs total duration of motor block if added to local anaesthetics. In our study duration of sensory blockade is the time from the onset of sensory blockade to till the patient's complaints of pain at the site of surgery and rescue analgesia was given. So it is also considered as "duration of analgesia" in our study. The duration of sensory blockade, in our study was 811.667± 25.405 min with dexmedetomidine group-RD and 547.833± 26.152 min for control group-R, which is statistically significant (p=0.000). Aliye Esmaoglu [6] in his study, found that the duration of sensory block was longer in dexmedetomidine group compared with placebo 887 ± 66.23min versus 673.00 ±73.77min. These observations were similar to our study. In a study conducted by Rachana Gandhi[7] the duration sensory block was 732.4 ± 48.9min in the dexmedetomidine group, compared with 146.5 ± 36.4min in the control group. This shows that dexmedetomidine prolongs sensory block of supraclavicular brachial plexus block very significantly. Sedation in our study was assessed by Ramsay sedation scale. Patients from both the study groups were not sedated at any specific time during 24 hours. Their sedation score were either 1 or 2. The mean Ramsay sedation scores of Group R was almost equal to Group RD. This shows that dexmedetomidine at low doses if used in supraclavicular block will not produce any sedation in patients. As we have already seen that dexmedetomidine prolongs total duration of sensory block means it extends total duration of analgesia too. Because of this, patient may require less number of rescue

analgesic injections in post-operative period. In our study we found that total number of rescue analgesic injections in 24 hours was higher in group-R (2.733± 0.450) than in group-RD (1.400± 0.498). In our study haemodynamic parameters (HR, SBP, and DBP) were recorded at 0,5,10,15,20,25,30,45 minutes, 1st hr, 2nd hr and thereafter every second hourly till 24 hrs. There was no any incidence of fall in blood pressure more than 20mmhg compare to baseline reading. No patient had bradycardia or tachycardia. This shows that dexmedetomidine is not producing its well-known side effects like bradycardia and hypotension if it is used in small doses(less than 30 microgram) as an adjuvant with local anesthetics in supraclavicular brachial plexus block. In our study no patient in either groups had drop in mean arterial pressure. Sedation in our study was assessed by Ramsay sedation scale which showed that patients were not sedated because of dexmedetomidine (50mcg). The incidence of heamatoma, pneumothorax, accidental intravascular injection, post block nausea and vomiting, convulsion and neuralgia were nil in both the groups. No patients in either group required any interventions. The results in our study showed that dexmedetomidine 50µg can be used safely as an adjuvant to Ropivacaine to prolong the duration of sensory blockade /analgesia.

Swami et al [8] concluded that dexmedetomidine (1 µg/kg) when added to local anesthetic (35cc, bupivacaine 0.25%) in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia. The time for rescue analgesia was prolonged in patients receiving dexmedetomidine. Zhang et al [9] also reported prolonged sensory and motor blockade duration in patients who received dexmedetomidine (50 µg) in 40 ml of 0.33% ropivacaine when compared to control group for axillary brachial plexus blockade. However, dexmedetomidine was also associated with an increased incidence of side effects such as bradycardia, hypertension, and hypotension. Suneet Kathuria et al[2] concluded that Dexmedetomidine as an adjuvant to 0.5%ropivacaine in ultrasound guided brachial plexus block shortens the sensory as well as motor block onset time, prolongs sensory and motor block duration and also increases the duration of analgesia. The action of dexmedetomidine most probably is local rather than centrally mediated

Conclusion

Dexmedetomidine in a dose of 50µg added to Ropivacaine in supraclavicular brachial plexus block for upper limb surgery significantly shortens the onset time and prolongs the duration of sensory and motor blocks without producing sedation in patients. Total number of rescue analgesics required in postoperative period is also less with use of Dexmedetomidine as an adjuvant to Ropivacaine.

Conflict of Interest: Nil
Source of support: Nil

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