Original Research Article

Indian Journal of Anesthesia and Analgesia
January – February 2020; 7(1) (Part - I): 46-52
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.7120.7

Comparison of Dexmedetomidine as an Adjuvant to Levobupivacaine Versus Levobupivacaine (Plain) in Supraclavicular Brachial Plexus Block: A Clinical Study

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Abstract

Context: Adjuncts to local anesthetics for brachial plexus block may enhance the quality and duration of analgesia. Dexmedetomidine, an α-2 adrenergic agonist is known to produce anti-nociception and enhance the effect of local anesthetics in various peripheral nerve blocks. *Aims:* To evaluate the effects of the addition of Dexmedetomidine (1μ/Kg) to Levobupivacaine (0.5%) for supraclavicular brachial plexus block in upper limb surgeries. *Study Design:* A prospective, randomized double-blinded study. *Methods:* The patients included in the study were randomized into two equal groups. Patients in Group L (n = 30) were administered 29 ml of 0.5% of Levobupivacaine and 1ml of normal saline and Group LD (n = 30) were given 29 ml of 0.5% Levobupivacaine with Dexmedetomidine (1μ/Kg). The onset and duration of sensory and motor block, Hemodynamic variables, Visual Analog Score (VAS), Patient Satisfaction Score (PSS) were recorded for 24 hours postoperatively. *Statistical analysis used:* Chi-square test and Student's unpaired *t*-test. *Results:* Onset of sensory block and motor block in Group LD was (5.30 ± 1.02 min) and (7.87 ± 1.33 min), whereas in Group L (10.83 ± 1.05 min) and (13.87 ± 1.33 min) respectively. Duration of sensory block and motor block in Group LD was (11.42 ± 0.6 hrs) and (10.10 ± 0.68 hrs), whereas in Group L (8.01 ± 0.64 hrs) and (6.69 ± 0.65 hrs) respectively. Mean Pulse rate and mean Blood Pressure was lower in Group LD ($p < 0.05$). VAS was lower in Group LD ($p < 0.05$). PSS was higher in Group LD ($p > 0.05$). *Conclusion:* Dexmedetomidine (1μ/kg) in combination with Levobupivacaine (0.5%) has early onset of sensory and motor block and prolonged duration of sensory and motor block with minimal hemodynamic variables.

Keywords: Supraclavicular brachial plexus block; Dexmedetomidine; Levobupivacaine.

How to cite this article:
Hassaan Muhammed, Shishir KR. Comparison of Dexmedetomidine as an Adjuvant to Levobupivacaine Versus Levobupivacaine (Plain) in Supraclavicular Brachial Plexus Block: A Clinical Study. Indian J Anesth Analg. 2020;7(1 Part -I):46–52.

Introduction

Brachial plexus block provides a useful alternative to general anesthesia for upper limb surgeries by achieving ideal operating conditions with muscular relaxation maintain stable hemodynamics intraoperatively and sympathetic block. It is gaining popularity over general anesthesia due to its effectiveness in terms of cost, performance and good postoperative profile. Brachial plexus block can be performed using several approaches and its preference is determined by innervations of the

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Received on 21.10.2019, **Accepted on** 28.11.2019

surgical site, risk of regional anesthesia-related complications as well as preference and experience of an anesthesiologist. A supraclavicular approach to brachial plexus can provide excellent anesthesia. Compared to the axillary approach it provides an additional advantage of blockage at a level where brachial plexus are tightly grouped which facilitates a single-point injection using less local anesthetic and is believed to result in very rapid onset gives the most effective block for upper extremity.[1]

Levobupivacaine a long-acting amide local anesthetic with good clinical profile, lesser neurotoxicity, and cardiotoxicity compared to bupivacaine is being favored Local anesthesia for regional anesthesia.[2]

Various adjuvants such as midazolam, dexamethasone, clonidine, opioids, have been employed to local anesthetics in search of ideal agents to prolong analgesia with variable results and advantages.[3] Recently, α_2 agonists, dexmedetomidine is eight times more selective towards α_2 adrenergic receptors than Clonidine.[4] It has shown to prolong the duration of block and postoperative analgesia when added to local anesthetics in various regional blocks.

Materials and Methods

A double-blinded randomized prospective study was carried out on 60 patients undergoing upper limb surgeries aged between 18–55 years under the paresthesia technique supraclavicular block in Medical College Hospital after obtaining ethical committee approval. The objective was to compare the effects of the addition of Dexmedetomidine (1μ/Kg) to Levobupivacaine (0.5%) for supraclavicular brachial plexus block in upper limb surgeries. The effects were studied in terms of onset and duration of sensory and motor block; hemodynamic variables; visual analog score (VAS); Patient Satisfaction Score (PSS).

Patients between the age group of 18–55 years weighing 55–82 kgs with ASA1 and ASA2 undergoing elective upper limb surgeries were included in the study. Patients with known allergy to local anesthetic drugs, anticoagulant medications, those with neuromuscular disorders, bleeding disorders, hepatic/renal/respiratory/cardiac diseases, pregnant individuals were excluded from the study. Patients having an infection at the site of block, those who refused to give consent for regional technique, ASA3, ASA4 were also excluded.

A total of 60 patients were randomized into two groups of 30 each by using "slips in the box technique" and assigned as Group LD and Group L. Patients in Group LD received 29 ml of mixture of Levobupivacaine (0.5%) and dexmedetomidine (1μ/Kg), Group L received 29 ml of Levobupivacaine (0.5%) and 1 ml normal saline.

The preanesthetic check-up was done for all patients which included basic demographic characteristics, history, general physical and systemic examination. The relevant investigations are done and patients were kept nil per oral 8 hours before surgery. Patients were shifted to the operating room with written informed consent for regional anesthesia and confirming nil per oral status. IV cannula was secured in the non-operating arm of the patient and ringer lactate started half an hour before surgery. In the operating room, patients baseline pulse rate, blood pressure, SpO_2, heart rate were noted. Heart rate, mean blood pressure and oxygen saturation were recorded after the block every 5 min, 10 min, 15 min, 30 min, 45 min, 60 min, 90 min, 2 hrs, 6 hrs, 12 hrs, 24 hrs. Adverse events such as bradycardia, hypotension, hypoxia, perioperative nausea, and vomiting were recorded.

The patient placed in the supine position with the head slightly turned to the opposite side from the site to be blocked, arm abducted to form an approximately 90^o angle at the elbow joint. With aseptic precautions in supraclavicular area, at a point 1.5 to 2 cm posterior and cephalad to midpoint of clavicle, subclavian artery pulsations felt and skin wheal was raised with local anesthetic, next a 22 gauge 5 cm needle mounted on 10 ml syringe passed through same point parallel to head and neck, in a caudad, slightly medial and posterior direction until paresthesia is elicited in the arm or hand. If the rib is encountered needle moved over the first rib until paresthesia is elicited. After eliciting paresthesia and negative aspiration of blood local anesthetic medication is injected.

The sensory block was assessed each minute using a 23 G hypodermic needle by pinprick method along the C4-T2 dermatomes till complete sensory blockade. Sensory onset was considered when there was a dull sensation to pinprick along the above-said dermatomes. A complete sensory block was considered when there was a complete loss of sensation to pinprick. Sensory block graded as Grade 0 (sharp pain felt), Grade 1 (analgesia, dull sensation felt), Grade 2 (Anesthesia, no sensation felt). Assessment of motor block was carried out at each minute till complete motor block after drug injection.

The onset of motor block was considered when there was a Grade 1 motor block. Peak motor blockwas considered when there was a Grade 2 motor block. Motor block was determined according to the Bromage scale for upper extremities on a three-point scale. Motor block graded as, Grade 0 (normal motor function; full flexion and extension of the elbow, wrist, fingers), Grade 1 (decreased motor strength with the ability to move fingers only), Grade 2 (complete motor block with the inability to move fingers).

The pain was assessed by Visual Analog Scale (VAS) i.e., 0-no pain; 2-annoying (mild pain); 4-uncomfortable (moderate pain); 6-dreadful (severe pain); 8-horrible (very severe pain); 10-agonising (worst possible pain).

The duration of sensory block was considered from the onset of sensory block (VAS Score 0) until the patient feels pinprick (VAS Score 2). The duration of motor block was considered from the onset of motor block and complete recovery of motor power

Statistical analysis was done using a student's unpaired *t*-test for quantitative data, Chi-square test for qualitative data. A *p* - value of less than 0.05 was considered statistically significant.

Results

The study was carried out in Sixty ASA 1 and ASA 2 of either sex aged between 18 and 55 years, posted for upper limb surgeries under supraclavicular brachial plexus block by paresthesia technique to evaluate efficacy of Dexmedetomidine (1 μg/kg) as adjuvant to Levobupivacaine (0.5%) in comparison with plain Levobupivacaine (0.5%). The minimum age of patients selected for study was 18 years and the maximum age was 55 years. The mean age of patients in Group L was 33.87 ± 9.86 and in group LD was 33.67 ± 11.59 years. Age incidences between the two groups were comparable. There were 24 patients in Group L and 23 patients in Group LD belonging to ASA Grade 1, and 6 patients in Group L and 7 patients in Group LD belonging to ASA Grade 2. There was no statistically significant difference between the two groups with respect to age distribution and ASA grading ($p > 0.5\%$).

The mean time for onset of sensory and motor block was 5.30 ± 1.02 min and 7.87 ± 1.33 min respectively in Group LD when compared to 10.83 ± 1.05 and 13.87 ± 1.33 min respectively in Group L. Thus, the onset of both sensory and motor block was significantly faster in Group LD than with Group L ($p < 0.001$), (Table 1).

Table 1: Time of onset of sensory and motor block (min)

Study Group	Onset Time; Mean ± SD		*p* - Value	Significance
	Sensory	Motor		
L	10.83 ± 1.05	13.87 ± 1.33	$p < 0.001$	HS
LD	5.30 ± 1.02	7.87 ± 1.33	$p < 0.001$	HS

Statistical analysis: Student's Unpaired *t*-test; HS - Highly Significant; SD - Standard Deviation.

The mean duration of sensory block and motor block was 11.42 ± 0.6 hours and 10.10 ± 0.68 hours respectively in Group LD when compared to 8.01 ± 0.64 hours and 6.69 ± 0.65 hours respectively in Group L. Thus, the duration of sensory block and motor block was significantly longer in Group LD compared to Group L ($p < 0.0001$), (Table 2).

Table 2: Duration of sensory and motor block (hrs)

Study Group	Duration of Block; Mean ± SD		*p* - Value	Significance
	Sensory	Motor		
L	8.01 ± 0.64	6.69 ± 0.65	$p < 0.001$	HS
LD	11.42 ± 0.6	10.10 ± 0.68	$p < 0.001$	HS

Statistical analysis: Student's Unpaired *t*-test; HS - Highly Significant; SD - Standard Deviation.

The mean pulse rate in Group L ranged from 72.36 ± 5.95 to 75.41 ± 4.80 beats/min and in Group LD ranged from 61.36 ± 4.77 to 73.03 ± 5.34 beats/min which showed a significant statistical difference between two Groups ($p < 0.05$) from 10 mins after the block that extended till 2 hours of the block. Bradycardia (HR < 60) was observed in 4 patients in Group LD with none requiring treatment, (Fig. 1).

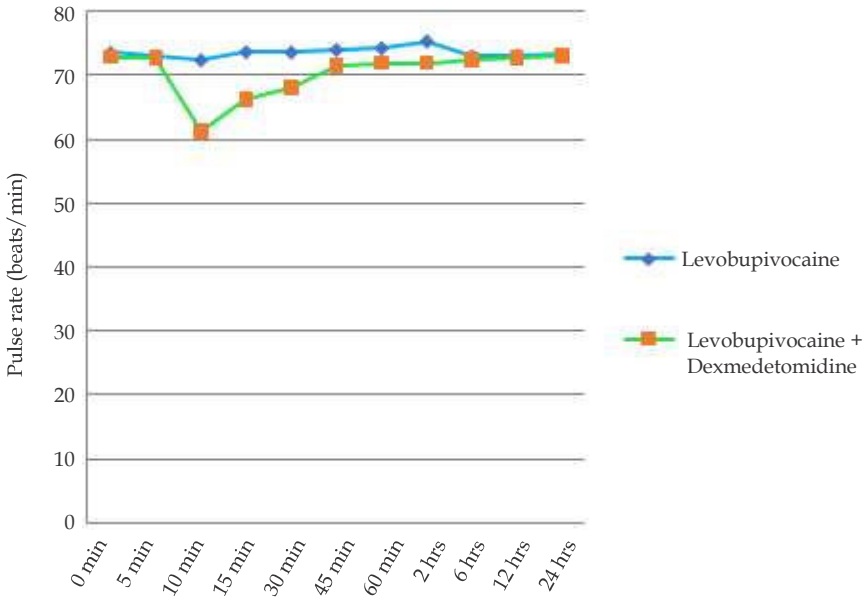

Fig. 1: Pulse rate (beats/min)

The mean systolic blood pressure in Group L ranged from 115.93 ± 8.00 to 117.87 ± 9.39 mm of Hg and in Group LD ranged from 102.27 ± 9.37 to 116.93 ± 8.08 mm of Hg which showed a significant statistical difference between two groups ($p < 0.05$), (Fig. 2).

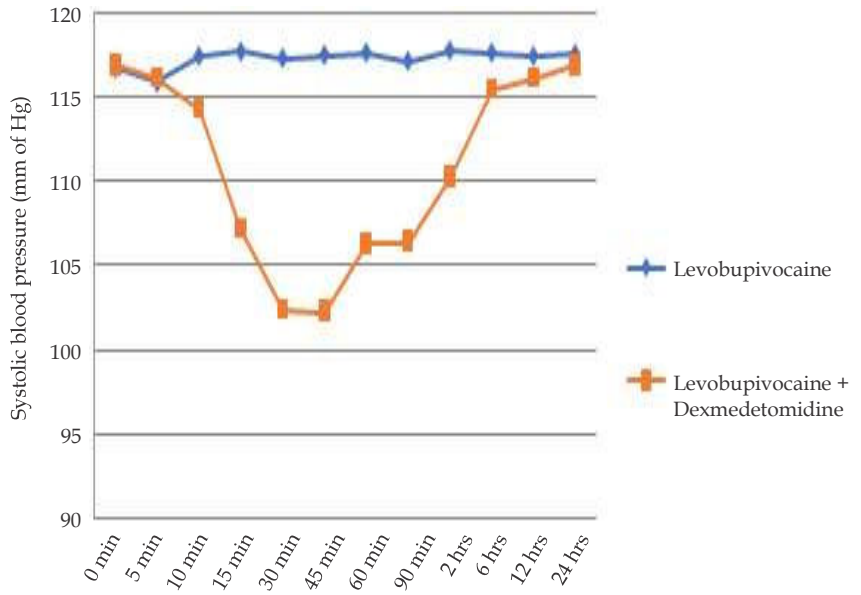

Fig. 2: Systolic blood pressure (mm of Hg)

The mean diastolic blood pressure in Group L ranged from 74.00 ± 6.17 to 74.60 ± 6.08 mm of Hg and in Group LD ranged from 62.26 ± 5.82 to 74.60 ± 5.10 mm of Hg which showed a significant statistical difference between two Groups ($p < 0.05$), (Fig. 3).

VAS SS Scores were less in Group LD at each interval and statistically significant ($p < 0.05$) at 1 hr, 2 hr, 24 hrs, (Table 3). In Group LD 69% of patients had a PSS of 5, whereas Group L 63% had a PSS of 5. Though more number of patients in Group LD had a greater PSS, it was statistically insignificant ($p > 0.05$), (Table 4).

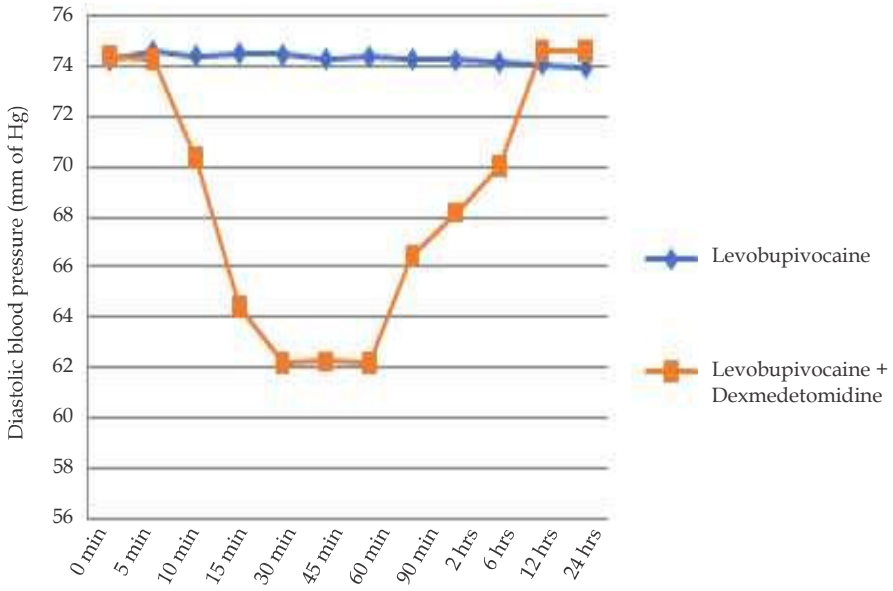

Fig. 3: Diastolic blood pressure (mm of Hg)

Table 3: Visual Analog Scale (VAS) score

Time (hrs)	Mean VAS ± SD		*p* - Value
	Group L	Group LD	
1 hour	2 ± 0.53	1.57 ± 0.57	0.006
2 hours	2.07 ± 0.58	1.63 ± 0.60	0.003
6 hours	2.23 ± 0.77	1.8 ± 0.66	0.11
12 hours	2.53 ± 1.33	2 ± 1.08	0.05
24 hours	3.63 ± 1.49	2.8 ± 1.18	0.01

Statistical analysis: Student's Unpaired *t*-test; SD - Standard Deviation.

Table 4: Patient Satisfaction Score (PSS).

PSS	Group L (n = 30)	Group LD (n = 30)	p - value
4	9 (27%)	7 (21%)	0.559
5	21 (63%)	23 (69%)	

Statistical analysis: Chi-square test; $p > 0.05$ not significant.

Discussion

Local anesthetic agent selection, dose, concentration, volume and physical modification can affect the onset, spread, quality and duration of anesthesia. Considering greater toxicity potential and cardiovascular effects of the racemic mixture, levobupivacaine seems a good indication for brachial block.[5] Various adjuvants such as opioids, α_2 agonists, steroids were added to local anesthetics to improve the block quality. Clonidine, the prototype of α_2 agonists which was synthesized in early 1970 when added to local anesthetics improved the block quality. Dexmedetomidine a new α_2 agonist that received USFDA approval in 1999 was reported to be safe and effective in peripheral nerve blocks when compared to clonidine.[6] The brachial plexus block is one of the commonly used peripheral nerve block techniques. The supraclavicular approach provides a successful blockade as it causes the homogenous spread of anesthetic agents throughout the plexus.

In our study, we observed that the onset of sensory and motor block was earlier in patients who received a combination of Dexmedetomidine and Levobupivacaine. Which was similar to the study conducted by Grewal[7] and FW Abdallah who demonstrated that this could be due to a local direct action of dexmedetomidine and its synergistic action with local anesthetics.

In our study, duration of sensory and motor block was prolonged when dexmedetomidine was

added to levobupivacaine. The studies of Kosugi et al. on the sciatic nerve of the frog demonstrated that high concentrations of dexmedetomidine inhibit Compound Action Potential (CAP) without α^2 adrenoceptor activation. Dexmedetomidine reduced the peak amplitude of CAPs reversibly and in a concentration-dependent manner. This action was not antagonized by α_2 adrenoceptor antagonists such as yohimbine and atipamezole. The studies of Brumett et al. showed that dexmedetomidine enhances the duration of bupivacaine anesthesia and analgesia of sciatic nerve block in rats without any damage to the nerve. Histopathological evaluation of nerve axon and myelin were normal in control and dexmedetomidine + bupivacaine Groups at 24 hours and 14 days. Atul Dixit et al.[8] evaluated the effect of adding Dexmedetomidine (1 mcg/kg) to 0.5% Levobupivacaine for supraclavicular brachial plexus block in upper limb surgeries. They concluded that the addition of dexmedetomidine to Levobupivacaine for supraclavicular brachial plexus block shortens sensory, motor block onset time and prolongs their duration. Kaygusuz et al. evaluated the effect of adding dexmedetomidine (1 μg/mg) to 0.5% Levobupivacaine for axillary brachial plexus block and observed significantly decreased sensory block onset time, increase in sensory and motor block duration. Our results are comparable with the above studies, hence, we conclude that the addition of dexmedetomidine to Levobupivacaine has a faster onset and longer duration of sensory and motor block compared to Levobupivacaine alone.

In our study mean, pulse ratein Group LD was lower compared to Group L from 10 mins of initiation of blockup to 2 hours of administrating the block which was statistically significant. However, four patients who received Dexmedetomidine in our study group developed clinically significant bradycardia, with none of them requiring treatment. Aliye Esmaoglu et al. evaluated the effect of adding dexmedetomidine (100 μg) to 0.5% Levobupivacaine for axillary brachial plexus block. They observed that Heart rate levels in Group LD were significantly lower than those in Group L. In Group LD bradycardia was observed in 7 patients who required treatment although no bradycardia in Group L. Sarita S Swamy et al.[9] and Haramritpal Kaur et al.[10] evaluated effect of adding dexmedetomidine (1 mcg/kg) to Levobupivacaine for supraclavicular brachial plexus block and they observed that statistically significant difference in Heart rate between two groups from 10 minutes after block. Bradycardia (HR < 60) was observed in two patients of the Dexmedetomidine Group. Our results with respect to changes in Heart rate in both groups were similar to findings of Sarita S Swamy et al. and Haramritpal Kaur et al. The incidence of bradycardia was lesser in our study than that of Aliye Esmaoglu et al. as their study used a higher concentration of dexmedetomidine (100 mcg).

In our study mean, blood pressure in Group LD was lower compared to Group L for 20 minutes of initiation of block time up to 2 hours of administrating block, which were statistically significant. However, none of the patients in Group LD developed significant hypotension. Postsynaptic activation of α_2 adrenoceptors in the central nervous system inhibits sympathetic activity and thus decreases blood pressure and Heart rate. Our results with respect to changes in mean systolic and diastolic blood pressure were similar to findings of Atul Dixit et al, and Sarita S Swamy et al. The mean heart rate and blood pressure were lower in Group LD but it did not warrant any medical intervention. Hence, we conclude that hemodynamic parameters were relatively stable in our patients of both groups throughout the intraoperative and postoperative period.

In our study, we found that the VAS scores were less on the dexmedetomidine group at each interval compared to the levobupivacaine (plain) group, and none of the patients required opioids. The duration of analgesia was statistically longer in the dexmedetomidine group. In our study, PSS was higher in the dexmedetomidine group compared with the control group which was not statistically significant. VAS and PSS scores of our study correlated with observations of Haramritpal Kaur et al.[10]

Conclusion

From our study, we conclude that the addition of dexmedetomidine (1 μ/kg) to 0.5% levobupivacaine 29 ml in supraclavicular brachial plexus block significantly decreases onset time of sensory and motor block, prolongs the duration of sensory and motor block. It is a good alternative to other additives due to its profound anesthetic and analgesic properties combined with minimal side effects. Dexmedetomidine will expand the scope and improve the reliability and efficacy of regional anesthesia.

Acknowledgement: None.

Conflict of interest: Nil.

Abbreviations

ASA - American Society of Anesthesiologists

Inj - Injection

mg - milligram

cm - centimeter

ml - milliliter

μg - microgram

G - Gauge

HR - Heart Rate

HS - Highly Significant

VAS - Visual Analog Scale

mm of Hg - millimeter of mercury

Min - Minutes

Hrs - Hours

PSS - Patient Satisfaction Score

SD - Standard Deviation

References

1. Chun Woo Yang, Hee Uk Kwon, Choon Kyu Cho, et al. A comparison of infraclavicular and supraclavicular approaches to the brachial plexus using neurostimulation. Korean J Anesthesiol 2010;58(3):260–66.
2. Foster RH, Markham A. Levobupivacaine: A review of its pharmacology and use as local anesthetic. Drugs. 2000 Mar;59(3):551–79.
3. Murphy DB, Mccartney CJ, Chan VW. Novel analgesic adjuncts for brachial plexus block: A systemic review. Anesth Analg. 2000 May;90(5):1122–128.
4. Raimo V, Juha M, Veijo S, et al. Characterization of selectivity, specificity and potency of dexmedetomidine as α_2 adrenoceptor agonist. Eur J Pharmacol. 1988 May 20;150(1-2):9–14.
5. Ohmura S, Kawada M, Ohta T. Systemic toxicity and resuscitation in bupivacaine, levobupivacaine or ropivacaine infused rats. Anesth Analg. 2001 Sep;93(3):743–48.
6. Kataria AP, Jarewal V, Singh G, et al. Comparison of Dexmedetomidine and clonidine as an adjuvant to Levobupivacaine in supraclavicular brachial plexus block. Int J Med Res Rev 2017;5(04):399–404.
7. Grewal A. Dexmedetomidine: New avenues, Journal of anesthesiology clinical pharmacology 2011;27(3):297–301.
8. Atul Dixit, Shakti Singhal, Charu Neema, et al. An evaluation of the addition of Dexmedetomidine to Levobupivacaine for supraclavicular brachial plexus block in upper limb orthopedic surgeries. Asian Pacific J Health Sci 2015;2(2):148–53.
9. Sarita S Swami, Varshali M Keniya, Sushma D Ladi, et al. Comparison of dexmedetomidine and clonidine as an adjuvant to local anesthesia in supraclavicular brachial plexus block: A randomized double-blind prospective study. Indian Journal of Anesthesia 2012 May–Jun; 56(3):243–49.
10. Haramritpal Kaur, Gurpreet Singh, Sunita Rani, et al. Effect of dexmedetomidine as an adjuvant to levobupivacaine for supraclavicular brachial plexus block. Journal of Anesthesiology and Clinical Pharmacology 2015 Jul–Sep;31(3):333–38.