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Infraclavicular Brachial plexus block in upper limb surgeries with local anaesthetic agent and dexmedetomidine as adjuvant for improving quality of analgesia

Feny Thakkar[1], Vandana Parmar[2*], Vrinda Oza[3] and Shilpa Sarathy[4]

*Correspondence: drvandanapithadia@yahoo.com

[1]Senior Resident Doctor, P.D.U. Medical College Rajkot, Guru krupa, Ravi ratna park 1 A, University road, Rajkot.
[2] Head of Department of Anaesthesiology, P.D.U. Medical College Rajkot, Gurukrupa 4A Shardanagar Society, University road, Rajkot.
[3] Associate professsor Department of Anaesthesiology, P.D.U. Medical College Rajkot, F-201, SadguruVatika, Maruti Nagar 2, Airport road, Rajkot.
[4]3rd Year Resident Doctor, P.D.U. Medical College Rajkot, 4 N Jamal's Plazzo, 47medavakkam main road,Keelkattalai,Chennai-600117, India.

Abstract

Context: To provide intraoperative and postoperative analgesia for upper limb surgeries the infraclavicular brachial plexus block (ICB) is very safe and reliable approach. α2 agonists are added to local anaesthetic agents as an adjuvant to extend the duration of nerve blocks.

Aims: Aim was to compare the efficacy of infraclavicular block with dexmedetomidine added to bupivacaine, xylocaine adrenaline mixture and bupivacaine, xylocaine adrenaline mixturealone with respect to duration of motor, sensory blockade and duration of analgesia in form of VAS (visual analogue scale).

Objective was to note the time for first rescue analgesic,sedation level of the patients and hemodynamic parameters.

Methods and material: A prospective randomized controlled study including 50 patients who were given vertical ICB using Peripheral nerve locator were divided into two equal groups. Control group (Group L) received Inj. Bupivacaine (0.5%) 15 ml+xylocaine adrenaline (1:200000) (2%) 10 ml+normal saline 10ml. Dexmedetomidine group (Group LD) received Inj. Bupivacaine (0.5%) 15 ml+xylocaine adrenaline (1:200000) (2%) 10 ml+normal saline 8 ml+dexmedetomidine 1.5 microgram/kg making total 35ml.

For data analysis t test was applied.

Results: The onset of sensory and motor blockade were faster in LD group than L group ($p<0.05$). The duration of sensory and motor blockade and duration of analgesia were significantly longer in LD group ($p<0.001$). Patients in group LD were sedated with no adverse effects except bradycardia in three patients.

Conclusions: Dexmedetomidine as an adjuvant to local anaesthetic agents in infraclavicular block hastens the onset and prolongs the duration of sensory and motor blockade along with duration of postoperative analgesia.

Keywords: Infraclavicular brachial plexus block, dexmedetomidine, bupivacaine, lignocaine, post-operative analgesia

Introduction

Brachial plexus blocks are very useful alternative to general anaesthesia for upper limb surgeries. It is useful in patients with significant co-morbidities such as severe cardiovascular and respiratory diseases [1]. The two most common approaches of infraclavicular block are the medial approach also called vertical ICB and the lateral approach. Advantages of vertical ICB are less painful arm positioning, easily palpable landmarks, minimal risk of pneumothorax and vascular puncture [2-4]. Dexmedetomidine - α2- adrenergic receptor agonists has seda-

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tive, analgesic, sympatholytic and cardiovascular stabilizing effects with reduced anaesthetic requirements [5], prolongs the duration of the blockade and post-operative analgesia when added to local anaesthetic as an adjuvant in regional blocks. Onset of sensory and motor blockade, duration of sensory and motor blockade, duration of postoperative analgesia and haemodynamic parameters were noted.

Materials and method

The randomized double blind prospective study was carried out after obtaining ethics committee approval and written informed consent from the patient. All patients underwent a thorough pre-anaesthetic check-up which included history taking and examination. Routine investigations like complete blood count, blood sugar, blood urea, serum creatinine, Chest X-Ray, ECG were carried out for all patients. All patients were taught about pain scale(VAS scale) during their pre-operative visit.

Inclusion criteria includes all the cases between 15 and 65 years of age of either sex undergoing upper limb surgeries of ASA grade 1, 2 and 3.

Exclusion criteria includes patients with known coagulation abnormalities, known allergic reaction to drug, parental or patient refusal, systemic sepsis or local infection at the puncture point, injury at supraclavicular site or lymph node enlargement, neurological abnormalities such as brachial plexus injury, congenital anatomical deformities of upper limb or neck, shoulder or elbow joint replacement or any upper limb vascular surgeries with unduly prolong surgical duration and weight more than 75 kg.

On the day of surgery, after taking patient inside operation room, IV line was secured and Inj. dextrose normal saline was started. Standard monitors like Electro Cardio Gram (ECG) leads, Non-Invasive Blood Pressure (NIBP) cuff, and pulse oximeter were applied and baseline parameters like Pulse Rate (PR); Systolic, Diastolic and Mean Blood Pressure (SBP, DBP, and MBP respectively), SpO_2, sedation scores and pain score were recorded. Premedication was given for acid prophylaxis in form of inj.ondansetron 0.08mg/kg and inj.ranitidinehydrochloride 1mg/kg. Patients were randomly allocated into two groups using a computer generated random number and concealed by sealed opaque envelopes.

Group L: Brachial plexus block will be given Infraclavicular approach with Inj. Bupivacaine 0.5% (15 ml) with xylocaine adrenaline (1:200000) (2%) 10 ml with normal saline 10 ml making total 35 ml.

Group LD: Inj. Bupivacaine 0.5% (15 ml) with xylocaine adrenaline (1:200000) (2%) 10 ml with normal saline 8 ml+ dexmedetomidine 1.5 microgram/kg making total 35 ml.

The patient and observer (who assessed the patient intra and post operatively) were not aware of the drug given. The drugs were prepared and administered by two different anaesthesia residents who were not involved in study to avoid biased results. The brachial plexus was located using standard peripheral neurostimulator (Stimuplex®, B Braun) with 2-Hz and 1.0-mA. **Figures 1** and **2** showing landmark and technique of block. The site that triggered muscular response to a stimulus equal to or lower than 0.5x mA was located, and LA mixture was given in the increments of 5 ml after fixing the needle

Figure 1. Landmark of Infraclavicular block.

Figure 2. Technique of block.

and aspirating in between to avoid inadvertent intravascular injection. Heart rate, blood pressure, oxygen saturation was recorded before the procedure and there after every 5 min after the administration of block till half an hour, and then every 15 min till the end of procedure and postoperatively at 30 min, 1 hr, 2 hr, 4 hr, 6 hr and 12 hr. Simultaneously patient were monitored intraoperatively and postoperatively for sedation score, VAS (Visual analogue scale) score and any complications like nausea, vomiting, chest pain, coughing, convulsion, hypotension and bradycardia. Sensory and motor function were evaluated before the block and at 2, 5, 10, 15, 20, 25, and 30 min after the block, then every 15 min until 5h post block, every 30 min until 12 hr post block, and every 60 min until complete recovery. Intensity of post-operative pain was evaluated using VAS (visual analogue scale) with grade 0 (no pain) to 10 (worst pain). Analgesia was considered satisfactory if the score was 3 or less. If score was more than 4, analgesia was judged unsatisfactory and rescue analgesia

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was administered in the form of inj. Diclofenac sodium and time for need of first analgesia was noted. Both groups will compared for total duration of analgesia (time interval between injections of drug in infraclavicular brachial plexus to rescue analgesic given), total duration of sensory blockade (Time interval between injection of drug and complete recovery of sensation) and total duration of motor blockade (Time i terval between injection of drug and complete recovery of motor power).

Results

Table 1 shows Demographic characteristic like age, sex, weight distribution and duration of surgery for both groups which were statistically comparable.

As shown in **Table 2**, mean onset of sensory (9.24±1.738 Vs 11.48±2.063 minutes respectively) and motor block (14.12±2.04 Vs 16.16±2.544 minutes respectively) was faster in group D L than in group L (**Table 2**). It was statistically significant ($p<0.05$).

Table 3 shows duration of block and duration of analgesia in both groups. The duration of sensory and motor blockade was significantly longer in group DL as compared to group L. The mean time to requirement of first rescue analgesic (VAS>4) in Group DL was 560.4±93.962 min., and in Group L was 423.6± 62.907 min which was highly significant ($p<0.001$) both clinically and statistically.

Figure 3 shows mean pulse rate just before block, just after block and; at 5 min, 10 min, 15 min, 20 min, 30 min; and then every 15 minutes up to completion of surgery in both Groups. There was no statistically significant difference observed ex-cept between 90 to 150 minute, it was statistically significant ($p<0.05$).

As shown in **Figure 4**, there was no statistically significant difference observed in the intraoperative mean blood pressure changes in both groups.

As per **Figure 5**, the mean sedation scores were more in Dexmedetomidine group compared to control group. However, the patients were easily arousable and co–operative all the time.

Table 4 shows mean postoperative pulse rate just after completion of procedure, 30 min, 1 hour, 2 hour, 6 and 12 hour interval in both Groups. **Table 5** shows mean postoperative mean blood pressure changes. There was no statistically significant difference observed.

Discussion

The patients posted for upper extremity surgeries are preferably managed under brachial plexus block. Regional anaesthesia has many advantages over general anaesthesia like excellent postoperative analgesia, decrease in postoperative intensive care, decrease recovery time, shorter duration of hospital stay. In our study, elbow and below elbow surgical procedures we had preferred vertical infraclavicular block for several reasons:- Ability to perform block with patients head and arm in any position, avoidance of neurovascular structures of the neck, minimal risk of pneumothorax, it is ideal for continuous catheter placement and fixation as it is an area with little movement and therefore less chances of being displaced, successful musculocutaneous nerve block as compared to axillary block. It also provides excellent analgesia for an arm tourniquet.

Infraclavicular brachial plexus block (ICPB) was introduced

Table 1. Demographic Data.

	Group DL		Group L		P value	Significance
	Mean ± SD	CI	Mean ± SD	CI		
Age	40.08±14.47	34.11-46.05	36.92±11.09	32.34-41.5	0.39	Not significant
Sex Male: Female	17:8	--	20:5	--	--	--
Duration of surgery	99.6±29.3	87.49-111.71	90.6±31.6	77.53-103.67	0.30	Not significant

Table 2. Onset of block.

	Group DL		Group L		P value	Significance
	Mean ± SD	CI	Mean ± SD	CI		
Onset of sensory block	9.24±1.738	8.52-9.96	11.48±2.063	10.63-12.33	0.000138	Significant
Onset of motor block	14.12±2.04	13.27-14.97	16.16±2.544	15.11-17.21	0.00309	Significant

Table 3. Duration of block.

	Group DL		Group L		P value	Significance
	Mean ± SD	CI	Mean ± SD	CI		
Duration of sensory block	501.8±90.033	464.64-538.96	377.6±60.365	352.69-402.51	<0.001	Highly significant
Duration of motor block	441.6±71.686	412.01-471.19	331.2±56.44	307.91-354.49	<0.001	Highly significant
Duration of analgesia	560.4±93.962	521.61-599.19	423.6±62.907	397.64-449.56	<0.001	Highly significant

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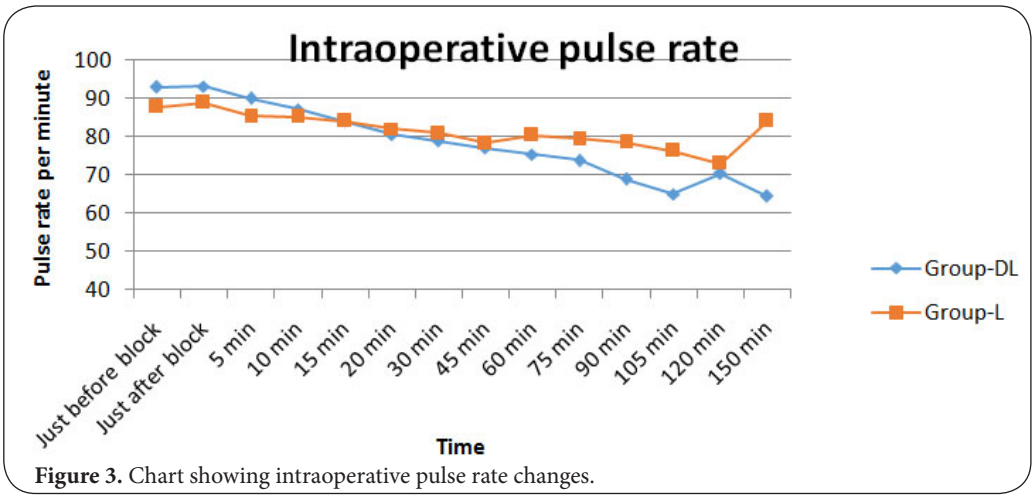

Figure 3. Chart showing intraoperative pulse rate changes.

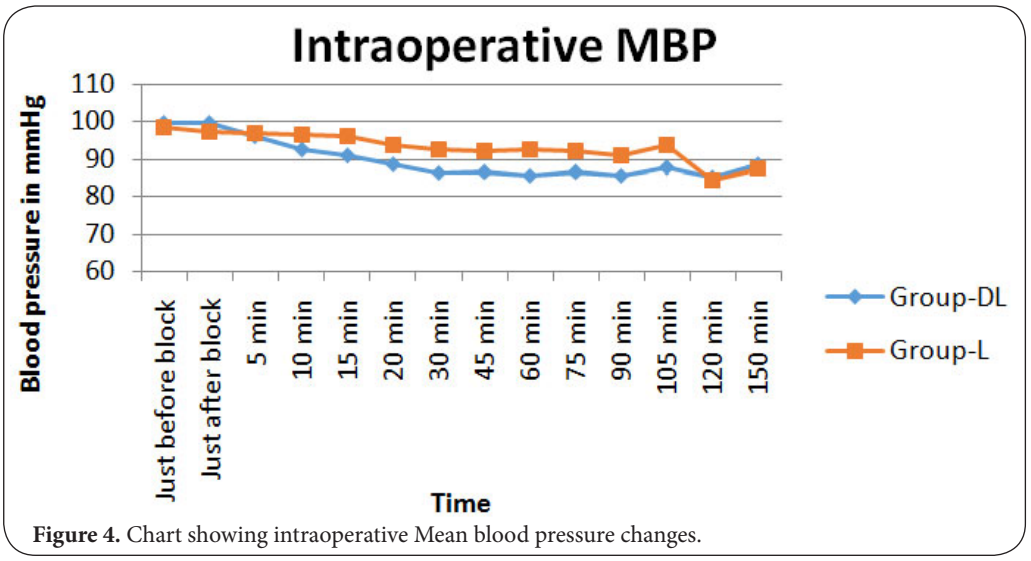

Figure 4. Chart showing intraoperative Mean blood pressure changes.

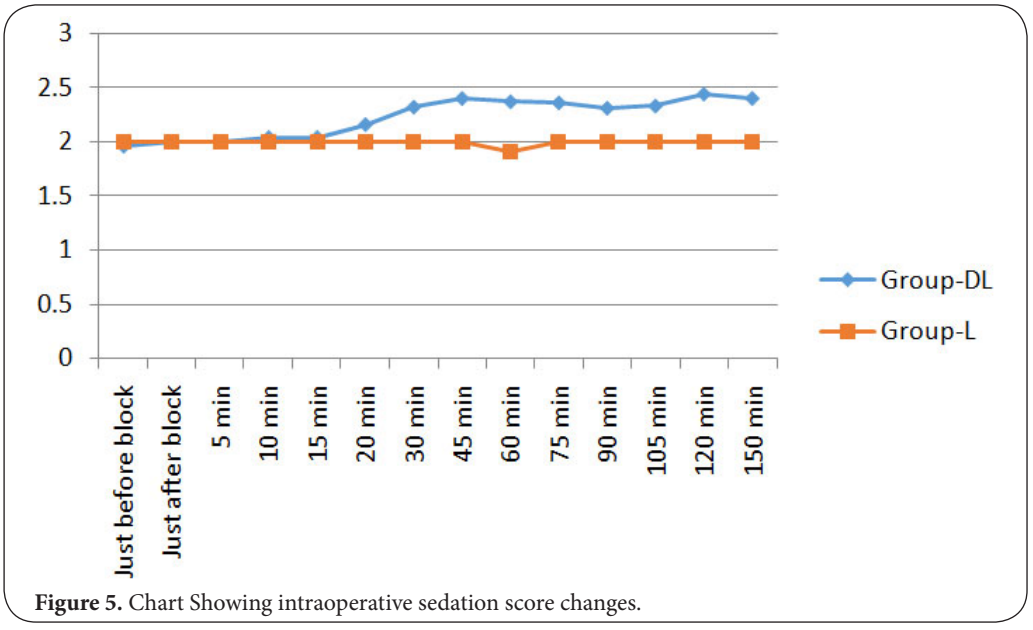

Figure 5. Chart Showing intraoperative sedation score changes.

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Table 4. Postoperative pulse rate changes.

	Group DL		Group L		P value	Significance
	Mean ± SD	CI	Mean ± SD	CI		
0 min	74.88±8.87	71.22-78.54	78.8±9.91	74.71-82.89	0.14	Not significant
30 min	74.48±9.50	70.55-78.41	78.88±8.60	75.25-82.35	0.09	Not significant
1 hour	77.2±9.93	73.10-81.30	80.32±9.53	76.39-84.25	0.2	Not significant
2 hour	79.28±9.88	75.20-83.36	81.48±9.54	77.57-85.39	0.4	Not significant
6 hour	83.52±7.62	80.37-86.67	86.16±10.81	81.70-90.62	0.3	Not significant
12 hour	84.16±10.34	79.89-88.43	83.37±12.40	76.76-89.98	--	--

Table 5. Postoperative Mean blood pressure changes.

	Group DL		Group L		P value	Significance
	Mean ± SD	CI	Mean ± SD	CI		
0 min	89.04±9.87	84.96-93.12	93.06±8.64	89.50-96.62	0.13	Not significant
30 min	88.34±9.88	84.26-92.43	91.84±6.22	89.28-94.40	0.14	Not significant
1 hour	89.92±9.68	85.92-93.91	94.21±7.07	91.30-97.12	0.08	Not significant
2 hour	91.49±10.75	87.05-95.93	94.4±7.47	91.30-97.12	0.27	Not significant
6 hour	98±10.10	93.83-102.17	99.70±7.52	96.60-102.80	0.50	Not significant
12 hour	98.90±11.48	94.17-103.65	--	42.74-82.54	--	--

in early 20th century as an alternative to axillary and supraclavicular approaches. More common approaches are the medial approach also called vertical ICB around the middle of clavicle and the lateral approach around the coracoid process. Others include parasagittal and pericoracoid approaches. Adjuvants are added to local anaesthetics (LA) that prolong the duration of analgesia and have less adverse effects so that long surgeries can be conducted with a single shot brachial Plexus block and a need for continuous catheter is avoided. Local anaesthetics and various adjuvants have been evaluated in conjunction with it to prolong the period of analgesia in brachial plexus block.

Use of a peripheral nerve locator allows a precise localization of nerve plexus. It improves accuracy and success rate and decrease chances of nerve injury. Taboada M. Et al [6] studied that ultrasound guidance and nerve stimulation provide similar onset time, success rate, and duration of motor blockade for infraclavicular block. However, ultrasound guidance reduces the time required to perform the block. In our study extension or flexion type of fingers response on peripheral nerve locator is associated with higher success rate. In our study block was considered inadequate when sensory anaesthesia was not achieved 30 minutes after block. There are such eight cases in our study, and subsequent general anaesthesia was given. These patients then excluded from the analysis.

Dexmedetomidine a highly selective α-2-adrenergic receptor agonist, clinically effective doses lacks respiratory depression, but maintains its analgesic properties that may make it useful and safe adjunct. The proposed mechanisms are centrally mediated analgesia, α2B-adrenoceptor mediated vasoconstrictive effects, attenuation of the inflammatory response, and direct action on a peripheral nerve. Both Intravenous and perineural or intrathecal dexmedetomidine can prolong duration of analgesia. Doses varied between 0.5μg/kg to 2μg/kg. In our study addition of 1.5μg/kg dose of dexmedetomidine perineurally to local anaesthetic mixture in infraclavicular brachial plexus block hastens the onset of sensory and motor blockade without significant side effects. It was statistically significant ($p<0.05$) (**Table 2**). A total volume of 35 ml of local anaesthetic agent was taken. Lomate P. et al [7] used 1μg/kg dose of dexmedetomidine added to the local anaesthetics in infraclavicular brachial plexus block and found the significant extension in duration of blockade ($p<0.0001$). Chaudhari M et al [8] added Dexmedetomidine to local anaesthetic agents in infraclavicular block and stated that it has faster sensory and motor blockade onset.

Waindeskar V, Jain A et al [9] studied dexmedetomidine as an adjuvant to bupivacaine in supraclavicular brachial plexus block and found mean duration time for sensory and motor blocks for group BD (Bupivacaine Dexmedetomidine) were 456.42±20.22 and 418.6±32.46 min respectively; but for the group B (Bupivacaine), the mean duration were 202±30.4 and 172.4±41.26 min respectively. There was no statistically significant difference observed in intraoperative mean pulse rate and mean blood pressure changes except between 90 to 150 minute when pulse rate was statistically significantly decreased in dexmedetomidine group ($p<0.05$). Postsynaptic activation of α_2 adrenoceptors in the central nervous system (CNS) inhibits sympathetic activity and thus can decrease blood pressure and heart rate.

In our study three cases developed bradycardia (20% decrease from baseline reading) which were managed by inj. glycopyrrolate/atropine sulphate. In dexmedetomidine group intraoperative systolic blood pressure decreases compare to control group but it was not statistically significant. Four cases developed hypotension (20% decrease from baseline reading) in which two were managed with Intravenous fluids and two require inj.mephentermine. There was no complications like pneumothorax, local anaesthetic drug toxicity, and respiratory paralysis in either of study groups. Kaur H., Singh G. et al [**10**] studied effect of dexmedetomidine as an adjuvant to levobupivacaine in supraclavicular brachial plexus block and observed a statistically significant difference ($P<0.05$) in HR between two groups from 10 min after the block, which extended in the postoperative period up to 24 h. Bradycardia (HR<60) was observed in two patients in B group but none of them required treatment. Agrawal P. et al [**11**] studied dexmedetomidine –as an adjuvant to lignocaine and bupivacaine in supraclavicular brachial plexus block and found that the patients in group dexmedetomidine maintained stable perioperative pulse rate, systolic blood pressure and diastolic blood pressure as compared to group c ($p<0.001$).

Our study showed significant increase in sedation score in the dexmedetomidine group ($P=0.02$) between 20 to 120 minute duration than in the control group. Locus ceruleus of the brain stem is the principal site for the sedative action of dexmedetomidine acting through α2 adrenergic receptor. Patients were comfortable throughout the surgery with arousable sedative effects. This could be explained bythe fact that some amount of systemic absorption of drug could be present. Eskandr A et al [**12**] reported more sedation score observed in dexmedetomidine group(D) in subtenon block in phacoemulsification cataract surgery ($P=0.022$). In absence of supplemental IV sedation, 7 patients out of 25 in Group D were sedated, scoring >3 on Ramsay sedation scale.

In our study postoperative pulse rate, systolic, diastolic and mean blood pressure changes in both groups showedno statistically significant difference between both the groups.

Duration of analgesia was higher in dexmedetomidine group 560.4±93.962 minutes vs 423.6±62.907 minutes in control group which was highly significant ($p<0.001$) both clinically and statistically. It also prolongs the time to first analgesic request, provides significantly lower postoperative VAS pain scores which was less than 3. Injection diclofenac sodium as a rescue analgesic was given when VAS score more than 4.Our findings are comparable with other studies. All patients in both groups were haemodynamically stable. Ammar et al [**13**] studied ultrasound guided infraclavicular brachial plexus block using bupivacaine alone and then combined with Dexmedetomidine for pain control in upper limp surgeries and demonstrated enhancement of onset of sensory and motor blockade, prolonged duration of analgesia, increased duration of sensory and motor block, lower VAS pain scores, and reduction in supplemental opioid requirements in dexmedetomidine with bupivacaine group which is similar to our study. The easy availability and lack of significant side effects like respiratory depression makes dexmedetomidine an attractive choice as an adjuvant to local anaesthetics in infraclavicular brachial plexus block for prolongation of postoperative analgesia.

Conclusion

From observations and results, graphs and tables of my study, I conclude that the addition of 1.5µg/kg dexmedetomidine as an adjuvant to local anaesthetics agent Inj.xylocaine with adrenaline (1:200000) 2% (10) ml with Inj. Bupivacaine 0.5% (15 ml) for infraclavicular brachial plexus block hastens the onset time and prolong the duration of sensory-motor blocks and also significantly prolongs the duration of postoperative analgesia and decreases requirement of opioid and non-opioid analgesics.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Authors' contributions	FT	VP	VO	SS
Research concept and design	✓	✓	✓	--
Collection and/or assembly of data	✓	--	--	✓
Data analysis and interpretation	✓	✓	✓	--
Writing the article	✓	✓	✓	✓
Critical revision of the article	--	✓	✓	--
Final approval of article	✓	✓	✓	--
Statistical analysis	✓	--	--	✓

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