



Original Research Article

Comparison of Dexmedetomidine and Fentanyl as an Adjuvant to 0.25% Bupivacaine in Supraclavicular Brachial Plexus Block

Authors

Bharat Kumar¹, Vaijayanti Gadre², Padara Basavaraj³

¹Senior Resident, Department of Anaesthesia, B.J.G.M.C & S.G.H, Pune

²Associate Professor, Department of Anaesthesia, B.J.G.M.C & S.G.H, Pune

³Assistant Professor, Department of Anaesthesia, GIMS, GADAG

Corresponding Author

Padara Basavaraj

Assistant Professor, Department of Anaesthesia, GIMS, GADAG, Karnataka

Email: drbasupadara@gmail.com

Abstract

Introduction: relief of intra and post operative pain has gained importance in recent years. Nerve blocks from the cornerstone in this arena. Brachial plexus block is a commonly used technique for majority of upper limb surgeries.

Aim: To evaluate the effect of dexmedetomidine and fentanyl as an adjuvant to low dose bupivacaine 0.25% in terms of onset, duration, and quality of sensory and motor block when used for supraclavicular brachial plexus block.

Materials and Methods: after the approval of ethical committee, 80 ASA grade I and II patients of either sex, between 18-60 years of age undergoing orthopaedic and plastic surgeries under supraclavicular block were studied after randomly assigning them into two groups of 40 each.

Group D: Bupivacaine 0.25% (34 ml) +dexmedetomidine 1 microgm/kg

Group F : Bupivacaine 0.25% (34 ml) +fentanyl 1 microgm/kg

After baseline investigations and preoperative routine assessment, the consenting patients were premedicated with inj midazolam 0.03 mg/kg and inj glycopyrrolate 5 microgm per kg Iv 10 minutes prior to surgery after putting ECG,NIBP ,SPO2 monitors and securing 18 G IV cannula in the non operative upper limb. Block was given using paresthesia technique. Onset ,duration and quality of both sensory and motor block in either group were studied .use of rescue analgesia in both the groups in post operative period was compared up to 24 hours.

Results: onset of both sensory and motor block was faster, 2.95 +/- 0.0693 minutes in group D versus 4.275+/-0.933 minutes in group F ; and 5.45+/-0.86 minutes in group D versus 6.025+/-0.861 minutes in group F respectively; total duration of block was prolonged, 608+/- 38.84 minutes in group D and 383+/- 27.66 minutes in group F

Conclusion: dexmedetomidine is superior to fentanyl as an adjuvant to low dose bupivacaine for supraclavicular brachial plexus block.

Keywords: dexmedetomidine, fentanyl, pain relief, nerve blocks, supraclavicular block.

Introduction

Supraclavicular approach of brachial plexus block is a very popular mode of anaesthesia for below mid arm surgeries due to its effectiveness in terms of cost and performance, margin of safety along with good post operative analgesia. This approach gives the most effective nerve block and blockade occurs at the distal trunk-proximal division of brachial plexus where it is most compact resulting in homogenous spread of anaesthetic throughout the plexus with a fast onset and complete block. However, limiting factors are onset of action and duration of analgesia. Increasing volume (dose) of local anaesthetics may prolong duration of analgesia but at the risk of systemic toxicity. To minimize these drawbacks there has always been a search for an ideal adjuvant. Till now many adjuvants have been tried with varying degree of success.^{1,2,3}

Dexmedetomidine is a highly selective alpha-2 agonist, has been found to be effective as an adjuvant in various regional anaesthesia techniques. Its use in peripheral nerve blocks has been recently described. However, the reports of its use in supraclavicular blocks is limited.

Addition of dexmedetomidine and fentanyl as an adjuvant to bupivacaine in supraclavicular block have shown to increase duration and quality of block in various studies but to best of our knowledge, the present study in which dexmedetomidine was compared with fentanyl with lesser concentration (0.25%) of bupivacaine in terms of onset time of sensory and motor block, time to achieve complete sensory and motor block, duration of analgesia and duration of sensory and motor block, along with any side effects or complications.

Materials and Methods

After ethical committee approval and written informed consent, a randomized controlled study was carried out on 80 ASA Grade I and II patients of either sex, aged 18-60 years, undergoing various orthopedic and plastic surgeries of 30-120 minutes duration involving elbow, forearm and

hand under supraclavicular brachial plexus block. The study was conducted after randomly assigning patients into two groups of 40 each as follows,

Group D: Bupivacaine 0.25% (34 ml) + dexmedetomidine 1 microgm/kg

Group F: Bupivacaine 0.25% (34 ml) + fentanyl 1 microgm/kg

Patients with uncontrolled DM, local infection at injection site, coagulation abnormalities, pre-existing peripheral neuropathy, liver and kidney diseases, IHD, valvular heart disease, allergic to local anaesthetics, pregnant women were excluded from the study.

On arrival of patients into the operating room intravenous access was obtained in the unaffected limb with 18 G IV cannula. Standard monitors like ECG monitoring, pulse oximeter, non-invasive blood pressure were connected. Baseline readings were recorded. Under aseptic precautions supraclavicular brachial plexus block was performed using paresthesia technique. After paresthesia in the forearm or hand was elicited and after negative aspiration for blood, appropriate drug solution was injected.

Sensory block was evaluated at each minute by Hollmen score

Score 1- normal sensation of pain/prick

Score 2- pin prick felt as sharp pointed but weaker compared with same area in the other upper limb

Score 3- pin prick recognised as touch with blunt object

Score 4- no perception of pin prick

Onset time of sensory block: the time between completion of local anaesthetic injection till the sensory block started appearing. I.e., Hollmen score > 1

Time for complete sensory block: the time between completion of the local anaesthetic administration till complete sensory block was achieved. I.e., Hollmen score = 4.

Duration of sensory block: time between onset of sensory block till the time when the Hollmen score reached < 4 postoperatively.

2. Assessment of motor block: It was carried out by the same observer at each minute till complete

motor blockade after drug injection. Onset of motor blockade was considered when there was Grade 1 motor blockade. Complete motor block was considered when there was Grade 2 motor blockade. Motor block was determined according to a modified Bromage scale for upper extremities on a 3-point scale.

Grade 0: Normal motor function with full flexion and extension of elbow, wrist and fingers

Grade 1: Decreased motor strength with ability to move the fingers only

Grade 2: Complete motor block with inability to move the fingers.

Onset time of motor block: time between completion of the local anaesthetic administration till grade 1 on modified Bromage scale

Time for complete motor block: time between completion of the local anaesthetic administration till grade 2 on modified Bromage scale

Duration of motor block: time between onset of motor block to recovery of complete motor function of hand and fingers

The block was considered to have failed if complete sensory and motor block was not achieved after 30 min of drug injection and failed block was converted to general anaesthesia. Such patients were excluded from study.

3 Quality Of Block: It was assessed by the following numeric scale

Grade 4 (excellent)-no complaints from the patient.

Grade 3 (good)-minor complaints with no need for supplemental analgesia.

Grade 2 (moderate)-complaint that required supplemental analgesia.

Grade 1(unsuccesful)-patient given general anaesthesia.

4 Duration of Analgesia: It was assessed using standard VAS (Visual analogue scale).

Time between onset of complete block to time of first request for analgesia ie. VAS \geq 4

0-1-Good analgesia.

1-4-Moderate analgesia.

4-7-mild analgesia.

7-10-no analgesia

Patients were monitored for haemodynamic variables such as heart rate, blood pressure and oxygen saturation every 5 min for first 15 min and thereafter every 15 min after the block intraoperatively and every 30 for first 2 hours and thereafter every 1 hour postoperatively.

Assessment of blood loss was done and fluid was administered as per the loss. Duration of surgery was noted. Rescue analgesics was given in the form of inj. diclofenac (1.5mg/kg) intramuscularly when VAS score is \geq 4 on patients request and the time of administration was noted.

Intra-operative complications, if any, including vessel injury, haematoma, nausea and vomiting, dyspnea, fall in respiratory rate or oxygen saturation, any symptom/sign of LA toxicity, ECG changes, Horner's syndrome, sedation, etc were recorded, with their respective management.

Statistical Analysis

Results on continuous variables were presented as Mean \pm SD (standard deviation) and results on categorical measurements were presented in Number (%) and median.. Student t test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups. Mann Whitney U test was used to find the significance between two groups for parameters on non-interval scale. Chi square/Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups.

In this study we analyzed statistical significance of the difference between Group D (Dexmedetomidine) and Group F (Fentanyl).

A P- value of $<$ 0.05 was considered statistically significant and a value $<$ 0.001 was highly significant

Results

The groups were comparable with respect to age, gender, weight and duration of surgery. (table I)

Onset of sensory block and time for complete sensory block was faster in group D than in group

F and was statistically significant (table II) (P< 0.001)

Onset of motor block was faster in group D than in group F and was statistically significant (table II) (p=0.004). time for complete motor block was faster in group D than in group F but was statistically not significant.(table II) (P=0.593)

There was significant prolongation of duration of sensory block, motor block and duration of analgesia in group D compared to group F (table II) (P<0.001).

Quality of block was better in group D as compared to group F and difference was statistically highly significant (table III) (P< 0.001)

Baseline hemodynamic parameters were comparable in both the groups .systolic blood pressure was found to be significantly lower than baseline from 10 minutes to 90 minutes intraoperatively from and from 60th to 600th

minutes postoperatively in group D as compared to group F (figure I) (p<0.05). Diastolic blood pressure was found to be significantly lower at 10,15,45,60, 90th minutes intraoperatively and at 30th minutes postoperatively in group D as compared to group F (figure II) (p<0.05). Pulse rate was found to be significantly lower at 10,15,30,45,60,90,120th minutes intraoperatively and 30th minutes to 600th minutes postoperatively also in group D as compared to group F (figure 3) (p<0.05)

Group D had significantly better VAS score compared to group F (p<0.001) (figure 4) and the requirement of inj diclofenac in the first 24 hours was significantly lower in group D as compared to group F.

No side effects and complications were seen during the first 24 hours in the postoperative period in both the groups.

Table 1: patient and surgical characteristics

	Group D	Group F	P -Value
Age (years) (Mean+/-SD)	36.68+/-7.59	35.65+/-7.21	0.538
Weight (kg)	57.33+/-7.30	57.63+/-7.47	0.856
Gender (m/f)	19/21	21/19	0.823
Duration of surgery(min)	90.95+/-10.82	88.1+/-9.77	0.220

Table 2: characteristics of sensory and motor block

	Group D	Group F	P -value
Onset of sensory block(min)	2.95+/-0.693	4.275+/-0.993	<0.001
Time for complete sensory block (min)	11.025+/-1.70	12.65+/-1.74	<0.001
Onset of motor block (min)	5.450+/-0.875	6.025+/-0.861	0.004
Time for complete motor block(min)	16.075+/-1.384	16.250+/-1.528	0.593
Duration of sensory block (min)	529.5+/-43.41	355.2+/-28.90	,0.001
Duration of motor block(min)	608.25+/-38.84	383.27.66	<0.001
Duration of analgesia (min)	574.13+/-40.43	371.7+/-27.92	<0.001

Table 3: Quality of block

		Group		Total	P -value
		Group D	Group F		
QOB (GRADE)	3	14(35%)	30(75%)	44	<0.001
	4	26(65%)	10(25%)	36	
TOTAL		40 (100%)	40(100%)	80	

Figure 1: Comparison of mean systolic blood pressure

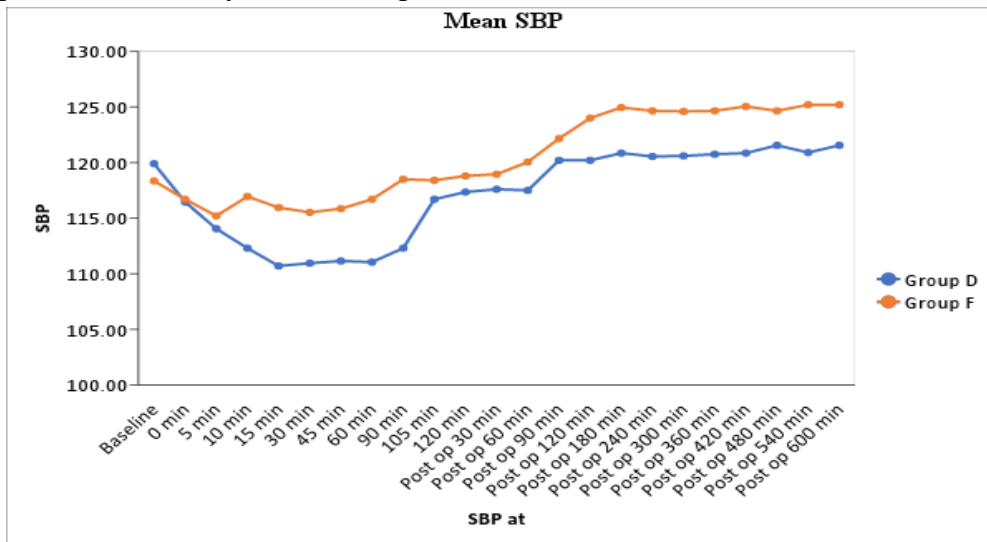


Figure 2: comparison of diastolic blood pressure

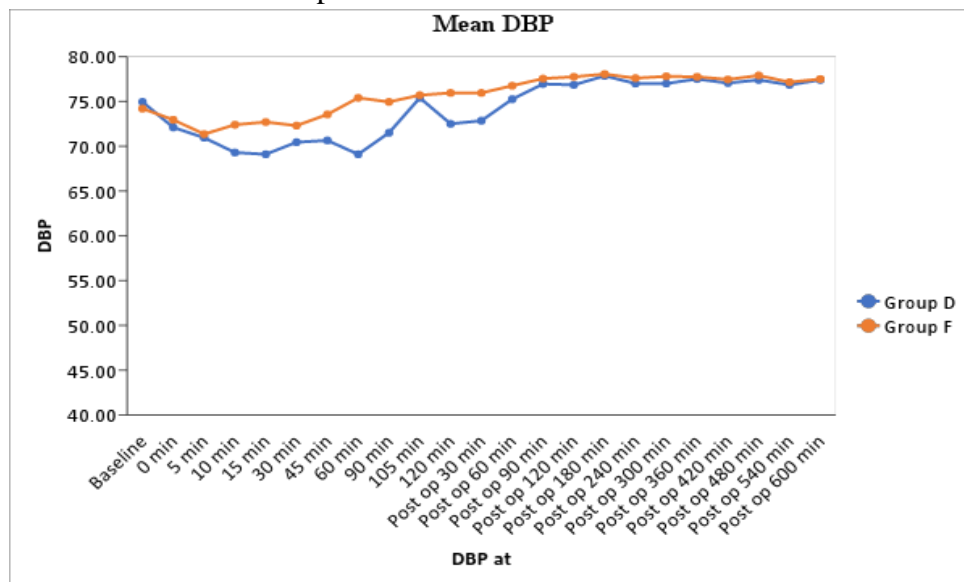


Figure 3: comparison of mean pulse rate

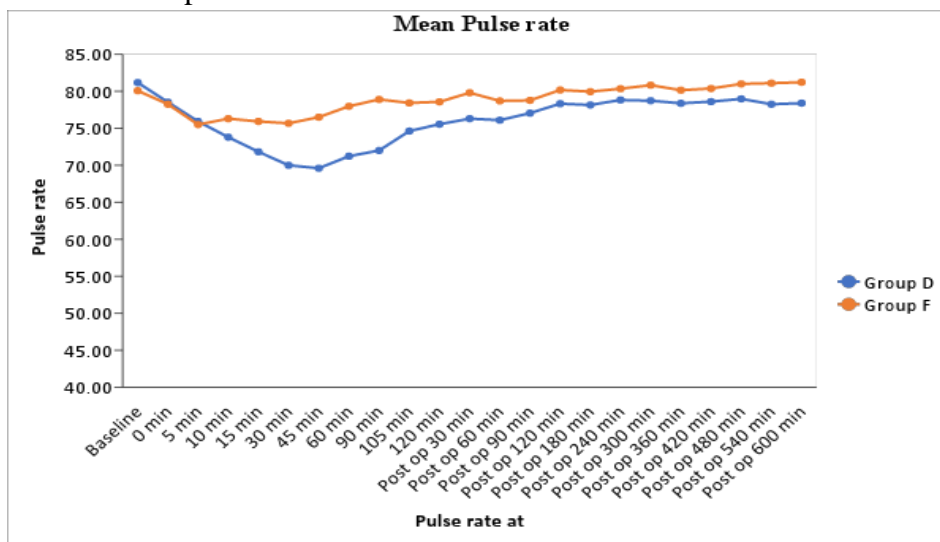
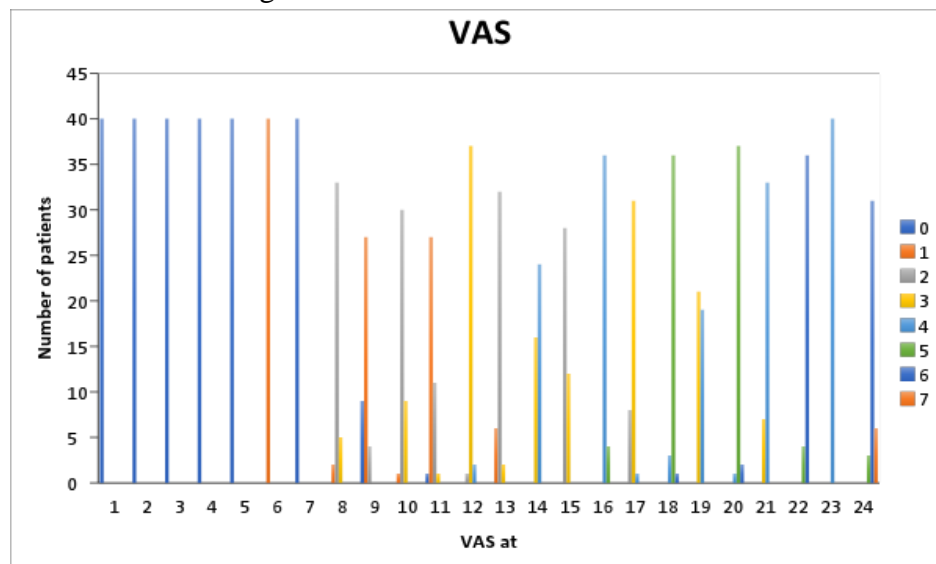


Figure 4: comparison of visual analog scale score

Discussion

Majority of upper limb surgeries are safely performed under regional anaesthesia. Compactness of plexus and resulting homogenous spread of local anaesthetic, along with quicker onset with complete good quality block are very important features of brachial plexus block. Its popularity due to cost effectiveness and ease of approach have encouraged various observers to study it with various local anaesthetic agents in combination with different adjuvants to prolong the block duration according to the length of surgery and effective postoperative analgesia. This study compares dexmedetomidine and fentanyl 1 microgm/kg each, added to 0.25% bupivacaine using supraclavicular approach. Dexmedetomidine produces block with faster onset; sensory block, 2.95 ± 0.0693 minutes in group D versus 4.275 ± 0.933 minutes showed early onset and prolonged duration 529 ± 43.41 minutes in group D versus 355.2 ± 28.9 minutes in group F. Motor block was also of faster onset, 5.45 ± 0.57 minutes in group D compared to 6.025 ± 0.861 minutes in group F and prolonged duration of 608.25 ± 38.84 minutes in group D versus 383.2 ± 27.66 minutes in group F. These results are comparable with those of Sarita SS et al⁴, Harshwardhan H S⁵, Keshav et al⁶. Early onset sensory block was obtained by Sarita SS using dexmedetomidine 1 microgm/kg (1.77 ±

1.28) and clonidine 1 microgm/kg (2.33 ± 1.21 minutes) added to 35 ml of 0.25% bupivacaine. Keshav et al⁶ reported 1.70 ± 1.28 and 2.33 ± 1.21 minutes. Harshwardhan H S⁵ reported 2.59 ± 2.2 minutes sensory onset and 4.12 ± 1.6 minutes motor onset with dexmedetomidine versus 3.26 ± 1.4 minutes and 5.36 ± 3.2 minutes using clonidine respectively.

Use of dexamethasone and fentanyl 100 mcg 2ml was added to 40 ml 1% lidocaine in axillary plexus by Saimak Y et al⁷ showed onset of sensory and motor block at 1.73 ± 0.51 and 2. ± 0.43 minutes respectively.

Complete sensory and motor block in our study was found to be earlier in group D (11.025 ± 1.70 minutes) and (16.075 ± 1.384) minutes as compared to group F (12.65 ± 1.74 minutes and 16.250 ± 1.528) minutes. Similarly Kenan et al⁸ obtained such findings as 7.75 ± 2.2 minutes and 14.25 ± 3.92 minutes in dexmedetomidine group vs 10.75 ± 2.55 and 15.75 ± 4.06 minutes in control group respectively.

Total duration of sensory and motor block in our study was longer in group D (529 ± 43.41 minutes and 608.25 ± 38.84 minutes) compared to group F (355.2 ± 28.9 minutes and 383.2 ± 27.66 minutes). Gandhi R et al⁹ added 30 mcg dexmedetomidine in 30 ml of 0.25% bupivacaine. Sensory and motor block duration was 732.4 ± 48.9 minutes and 660.2 ± 60.4 minutes

respectively in group D versus 146.5+/-36.4 minutes and 100.7+/-48.3 minutes respectively in control group.

Total duration of analgesia as reported by Gandhi R et al was 732.4+/- 95.1 minutes in group D versus 194.8+/-60.4 minutes in control group ; as reported by sarita SS et al it was 452.21+/-9.7 minutes in dexmed group vs 289.67+/-62.5 minutes in clonidine group and that Keshav et al it was 732.4+/- 95.1 in dexmed group vs 289+/-60.01 minutes.

Our study showed comparable values of 574+/-40.43 minutes in group D VS 371+/- 27.92 minutes in group F.

As regards with quality of block ,sarita SS et al reported grade 4 quality in 80% patients ,compared to 40% in clonidine group ,where as our study grade 4 block was found in 65% patients in group D and 25% in group F .

Esmaoglu et al¹⁰ reported bradycardia in 7 patients out of 30 in dexmed group; no side effects were observed in our study.

In our study, chosen concentration of 0.25% bupivacaine is undoubtedly highly beneficial for high risk patients .the volume of 35 ml ensures complete spread of local anaesthetic in the brachial plexus;1 mcg /kg dose of adjuvants dexmed and fentanyl has also proved effective without postoperative bradycardia and comfortable and arousable patient throughout.

Conclusion

Dexmedetomidine is superior to fentanyl when used as an adjuvant t low dose bupivacaine (0.25%) in suprclavicular block in terms of onset of sensory and motor block ,time for complete sensory block,duration of sensory block and motor block ,duration of analgesia and quality of block .and also dexmedetomidine provides better hemodynamic stability than fentanyl.

References

1. Damien B, Muhy, Collin JL, Cartney, Vincent WS ,Novel analgesic adjuvants

- for brachial plexus block; A systemic review. *Anesth Analg* 2000;90:1122-8
2. Lennart Christiansson. Update on adjuvants in regional anaesthesia. *Periodicum biologorum*.2009;111(2);161-170
3. Ghanshyam Biyani , Anjolie Chhabra, Dalim Kumar Baidya, Rahul Kumar Anand. Adjuvants to local anaesthetics in regional anaesthesia -should they be used ? part I .*Pros .Trends in Anaesthesia and critical care* 4 . 2014;19-24
4. Sarita SS ,Keniya VM, Ladi SD, ,Rao R. comparison of dexmedetomidine and clonidine (alpha -2 agonist) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block ; A randomised double blind prospective study. *Indian J A naesthesiology* 2012 may ;56(3) ;243-9
5. Harshwardhana HS, Efficacy of dexmedetomidine compared to clonidine added ropivacaine in supraclavicular nerve blocks : A prospective Randomised Double Blind Study .*Int J Med Health Sci*.A pril 2014; 3(2): 127-132
6. Keshav Govind rao , pawan Kapoor, Manoj Kumar chaurasiya and Aparna Shukla. A randomised controlled study to compare clonidine and dexmedetomidine as an adjuvant in supraclavicular brachial plexus block.*Indian J of Fundamental and Applied Life Sciences* 2014;4(1) : 226-229
7. Siamak Yaghoobi, Mahyar seddighi, Zohreh Yazdi Razieh Ghafouri , and Marzieh Beigom Khezri . comparison of postoperative analgesic effect of dexamethasone and fentanyl added to lidocaine through axillary block in forearm fracture. *Hindwai publishing corporation pain research and treatment volume* 2013, Article ID 761583
8. Kenan Kaygusuz., Iclal Ozdemir Kol , Cevdet Duger, Sinan Gursoy, Hayati Ozturk, Ulku Kaycan, Rukiye Aydin and Caner Mimaroglu. Effect of adding Dexmedetomidine to levobupivacaine in

axillary brachial plexus block . Current
Thes Res Clin Exp .2012;73: 103-111

9. Gandhi R, Shah A, Patel I .Use of dexmedetomidine along with bupivacaine for brachial plexus block. National J med Res 2012;2:67-9
10. Esmaoglu A , Yegenglu F , Akin A , Turk C. dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anaesth Analg 2010;111:1548-51.