

Low Dose Dexmedetomidine As An Adjuvant To Bupivacaine In Supraclavicular Brachial Plexus Block

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Abstract

Aim: This study was designed to compare the efficacy of dexmedetomidine 30µgms added to Bupivacaine in supraclavicular brachial plexus block regarding onset and duration of sensory and motor blockade and postoperative analgesic efficacy.

Methodology: This prospective double blind study was conducted in 60 patients of age 18 to 60 years posted for various upper limb surgeries and are randomly allocated into two equal groups of 30 each. Control group C received 40ml of 0.25% bupivacaine (20ml of 0.5% bupivacaine + 20ml of distilled water) and group D received 40ml of 0.25% bupivacaine with 30µmg of dexmedetomidine (20ml of 0.5% bupivacaine + 19.70ml of distilled water + 0.30ml of dexmedetomidine). The following parameters are observed: onset and duration of motor and sensory blocks, block durations, duration of analgesia and incidence of complications following the procedure.

Results: It was observed that the onset time of both sensory and motor blocks are faster in groups D than group C and duration of both sensory and motor blockade and duration of analgesia are longer in groups D than Group C.

Conclusion: Dexmedetomidine even in low doses 30 micrograms added to the bupivacaine as an adjuvant hastens the onset and prolongs the duration of sensory and motor blocks and duration of analgesia with no adverse effects.

Keywords: Supraclavicular brachial pluxus block, dexmedetomidine, bupivacaine

I. Introduction

Brachial plexus block is a popular and widely employed regional nerve block of upper extremity that provides anaesthesia for surgery of the hand, forearm, elbow, and distal humerus which avoids the unwanted effect of anaesthetic drugs used during general anaesthesia and the stress of laryngoscopy and tracheal intubation. Patients can also enjoy a post operative period free from nausea, vomiting, cerebral depression and immediate post operative pain.

Bupivacaine is the most commonly administered drug in brachial plexus blocks, however, onset of action and duration of anaesthesia are the limiting factors. Onset times of approximately 14 minutes for lidocaine and mepivacaine have been reported, versus approximately 23 minutes for bupivacaine. To minimize these drawbacks many drugs including opioids such as morphine, fentanyl, tramadol, buprenorphine, sufentanil and calcium channel blockers such as verapamil, steroids like dexamethasone and Neostigmine were tried¹⁻⁴. Recently there is a renewed interest on alpha₂ agonists like clonidine and Dexmedetomidine as an adjunct to local anesthetics⁵. Dexmedetomidine has shown greater affinity as an alpha₂ adrenoreceptor agonist than clonidine. Dexmedetomidine via α₂ adrenoreceptor induced vasoconstriction in the forearm along the site of injection, delay the absorption of local anaesthetic and therefore prolongs its action⁶. The present study was planned to evaluate the efficacy of dexmedetomidine (30µg) added to 0.25% bupivacaine with regards to onset and duration of sensory, motor blockade, hemodynamic variables, postoperative analgesia, and adverse effects.

II. Materials And Methods

This study was a prospective randomised double blind study carried out in our hospital after obtaining permission from hospital ethics committee. Sixty adult patients (18-60 years) of either sex, weight range (40-90 kg), ASA grade I and II patients scheduled for upper limb surgeries were randomly allocated into two groups. These patients were scheduled for elective orthopaedic, plastic and reconstructive operations in the upper limb under supraclavicular brachial plexus block. The procedures were of moderate duration and included implant removal, both bone plating, fixation of lower third of humerus and olecranon fixation, plastic and reconstructive surgeries. Patients receiving chronic analgesic therapy, those with severe cardiopulmonary disease, thyroid

disorders, diabetes mellitus, central or peripheral neuropathies, history of allergy to local anaesthetics, or other contraindications to regional anaesthesia were excluded from the study.

Group D received 40ml of 0.25% Bupivacaine with 30µg of dexmedetomidine(20ml of 0.5% bupivacaine +19.70ml of distilled water +0.30ml of dexmedetomidine). Group C received 40ml of 0.25% bupivacaine (20ml of 0.5% bupivacaine +20ml of distilled water). The syringes were loaded with drug by another author not involved in administering the injections and in further evaluation of the patients.

The supraclavicular brachial plexus block was performed using Paresthesia Technique for nerve localization, and subclavian artery as a guide, with 22 gauze and 38 millimetre short bevel needle. After obtaining paresthesia and free aspiration, 40 millilitre of coded solution was administered. The surgical procedure was performed by using a standard arm tourniquet inflated to 70 mmHg higher than systolic blood pressure.

Sensory block was assessed by pin prick test using 3 point scale:

- 0 Normal sensation,
- 1 Loss of pin prick sensation
- 2 Loss of anaesthesia

Motor blockade was assessed by Bromage three point score:

- 1 Normal motor function with full flexion and extension of elbow, wrist and fingers
- 2 Decreased motor strength with ability to move fingers only
- 3 Complete motor block with inability to move finger

Sensory and motor blocks were evaluated every 5 minutes until 30minutes after injection and then hourly even after surgery until the resolution of block. Onset of sensory block is defined as the time interval between the injection of total local anaesthetic and complete sensory block. Duration of sensory block is defined as the time interval between the complete sensory block and resolution of anaesthesia of all nerves. Onset of motor block is defined as the time interval between the total local anaesthetic administration and complete motor block. Duration of motor block is defined as the time interval between the total motor block and complete resolution of motor blockade.

Heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP) and saturation of oxygen (SpO₂) were recorded at every 5 minutes for first 30 minutes and thereafter every 10 minutes till the end of surgery. Postoperatively motor and sensory blockade and vitals of the patients were noted every half hourly. Adverse events like hypotension (20% decrease in relation to baseline) and bradycardia (heart rate <50 beats per minute) were treated with appropriate measures. Duration of motor and sensory blockade after surgery was recorded.

Postoperative pain was assessed using the visual analogue scale (VAS) (0 – no pain to 10 – worst pain) every hour till the block lasted. The end - point of the study was time from performance of the block to the onset of pain as determined by VAS score of 4 or more. Rescue analgesia was provided with 1g paracetamol infusion or tramadol 2 mg/kg intravenously.

III. Observations And Results

This prospective double blind study was conducted on 60 patients of age 18 to 60 years posted for various upper limb surgeries and randomly allocated into two equal groups of 30 each. Statistical analysis is done with student t test, Mann Whitney U test, Chi square test to find the significance between two groups. A p value of <0.05 was taken as statistically significant.

Table 1: Comparison of demographic and other relevant parameters at baseline between the two groups

BASELINE CHARACTERISTICS	GROUP D n=30	GROUP C n=30	P value
AGE(years)	41.70± 9.54	41.54± 10.54	0.985
SEX(Male : Female)	20:10	21:9	1.000
Height(Cm)	152± 10.87	153± 10.97	0.765
Weight(Kg)	60± 6.78	61± 7.35	0.287
Duration of surgical procedure(min)	117± 16.7	114± 17.8	0.292

Table 2. Time profiles of sensory and motor blocks and duration of analgesia in study groups

BASELINE CHARACTERISTIC	GROUP D	GROUP C	P value
Onset of sensory block (min)	10.4 ± 2.5	13.2 ± 4.1	<0.0001
Onset of motor block (min)	19.4 ± 3.6	23.4 ± 2.5	<0.0001
Duration of sensory block (min)	550± 48.8	150.5± 36.4	<0.0001
Duration of motor block (min)	480 ± 45.9	110.7± 23.3	<0.0001
Duration of analgesia (min)	550 ± 48.8	150.5 ± 36.4	<0.0001

The results regarding the characteristics of sensory block and motor block are summarized in table 2. The onset of both motor and sensory block was faster in Group D than in group C. The duration of sensory and motor block was longer in Group D than Group C. The duration of analgesia in control group is 210±60.4 minute and dexmedetomidine group-D is 600±30 minutes, which is statistically significant (p <0.001). Vital parameters like mean pulse rate, systolic blood pressure, mean respiratory rate and mean arterial saturation values were similar in the three groups

Table 3: Suspected adverse drug reaction profile in the study groups

SUSPECTED ADVERSE REACTIONS	GROUP C	GROUP D	P VALUE
Bradycardia (heart rate <50)	0	0	1.000
Hypotension (fall in MAP>20% of baseline)	0	0	0.766
Oxygen saturation<90%	0	0	
Sedation score (mean± standard deviation)	1.7±0.53	3.7±0.32	<0.001
Postoperative arm weakness	0	0	1.000

The side effects were found to be insignificant and incidental. Only one case of bradycardia and one case of hypotension were noticed in Group D.

IV. Discussion

Regional anesthesia is becoming increasingly popular and brachial plexus block for upper limb surgeries is one of the commonly used nerve blocks. Selecting appropriate local anesthetics for a given regional technique requires consideration of a number of factors including speed of onset, duration of action of local anaesthetics, duration of surgery, potency, degree of muscle relaxation required and duration of analgesia.

The peripheral administration of appropriate adjuvants may have analgesic benefit while reducing systemic adverse effects. In an attempt to improve perioperative analgesia many adjuncts such as opioids, verapamil, neostigmine, tramadol, and alpha₂ agonists like clonidine have been administered concomitantly with local anesthetics during brachial plexus block. Dexmedetomidine pharmacologically active d-isomer of medetomidine is highly specific, selective alpha₂ agonist with α₂:α₁ binding selectivity ratio of 1620:1 compared to 220:1 of clonidine thereby reducing unwanted side effects of α₁ binding.⁷ The aim of this study was to evaluate whether additional anesthetic and analgesic effect with minimum side effects could be derived from administration of α₂ adrenoceptor agonist dexmedetomidine in concentration 30 µg into brachial plexus block.

In this study 40ml drug was chosen as 40ml of local anaesthetic agent was associated with a more complete spread for brachial plexus block⁸. 0.25% Bupivacaine was used to minimise total dose of drug to avoid local anesthetic toxicity. Total dose used in this study was 100mg. 30µg of dexmedetomidine was used in this study as previous studies reported high incidence of side effects such as bradycardia hypotension with high doses of 100µg.⁹ Parameters observed include onset of sensory block, onset of motor block, duration of sensory and motor block, duration of analgesia, sedation scores and untoward side effects.

Onset of sensory block: The mean onset time of sensory block in group C was 18.5min and in group D it was 13.24min which is statistically significant. These results are comparable with Esmagolu et al⁹, Ammar and Mohmoud¹⁰, Agarwal S et al¹¹ studies with significant decrease in onset of sensory block in dexmedetomidine group. However in study conducted by Rachana Gandhi et al¹² onset of sensory block plain bupivacaine group was significantly faster (18.4min) compared to bupivacaine and dexmedetomidine group (21.4min). Esmagolu et al⁹ has used higher dose (100µg) of dexmedetomidine which would explain faster onset of sensory block (9.03min).

Onset of motor block: The mean onset of motor block in group C was 21.5min and in group D 17.20min indicating faster onset of motor block in dexmedetomidine group. These results were similar to the studies of Esmagolu et al⁹, Ammar and Mohmoud¹⁰, Agarwal S et al¹¹ showing significant shortening in on set of motor block. However in study of Rachana Gandhi et al¹² onset of motor block was significantly delayed in dexmedetomidine group which can be explained by the difference in defining onset of motor block.

Duration of sensory block: In our study the duration of sensory block significantly prolonged in dexmedetomidine group (741min) compared to plain bupivacaine group (153.66min). These results coincide with studies of Esmagolu et al⁹, Ammar and Mohmoud¹⁰, Agarwal S et al¹¹, Rachana Gandhi et al¹². The sensory block is prolonged to a longer duration in Esmagolu et al⁸ study (887.0±66.23min) compared to our study group which can be explained by higher dose of dexmedetomidine (100µg) and levobupivacaine(200mg) used.

Duration of motor block: There is a significant increase in duration of motor block in our study with dexmedetomidine group (672.33min) compared to 111.83 min of plain bupivacaine group. There was more prolongation of duration of motor block in studies of Esmagolu et al⁹, Agarwal S et al¹¹ (773.0±67.62min and 702min respectively which can be explained by higher doses of dexmedetomidine (100µg) used. These studies suggest that dexmedetomidine as adjuvant to local anesthetic prolong the duration of motor block.

Duration of analgesia: The mean duration of analgesia in group I was 167.6min and in group II it was 770.3min indicating statistically significant prolongation of analgesic duration in dexmedetomidine group which coincides with results of other studies. In studies of Esmagolu et al⁹ (duration of analgesia was 1008.69min) which can be explained by larger doses of levobupivacaine (200mg) and dexmedetomidine (100µg) used.

Level of sedation: There is statistically significant difference in level of sedation in both groups with scores 2.1 and 2.67 respectively which is similar to that of Agarwal S et al.¹¹

Hemodynamic parameters: In this study there was no significant difference in heart rate, mean systolic and diastolic blood pressure, peripheral oxygen saturation in both groups. Similar results were obtained in the study of Rachana¹² Gandhi et al. However in studies of Esmagolu et al⁹, Agarwal S et al¹¹ there was significant fall in heart rate and mean systolic and diastolic blood pressure values which are recorded in regular intervals might be due to larger doses of dexmedetomidine used. In our study and that of Rachana Gandhi et al¹² the stable hemodynamic parameters might be due to lower doses of dexmedetomidine (30µg) used

Adverse effects: Adverse effects like nausea, vomiting, bradycardia, hypotension, pruritis, urinary retention were not observed in both groups of this study. But cases of hypotension and bradycardia are reported in studies conducted with 100µgms dexmedetomidine in supraclavicular brachial plexus block.^{11,12}

The results of our study suggests addition of dexmedetomidine in low doses (30µg) to bupivacaine has definitive role in shortening onset time, in prolonging duration of motor and sensory block with stable hemodynamics without adverse effects.

V. Conclusion

Dexmedetomidine even in low doses 30 micrograms added to the bupivacaine as an adjuvant hastens the onset and prolongs the duration of sensory and motor blocks and duration of analgesia without any adverse effects.

References

- [1]. Bone HG, VanAkenH, BrookeM. Enhancement of brachial block by coadministration of neostigmine . *RegAnesth Pain Med* 1999;24: 405-10.
- [2]. Bourke DL, Furman WR. Improved post operative analgesia with morphine added to axillary block solution. *J ClinAnesth* 1993;4:114,7.
- [3]. Kardash K, Schools A. Effects of brachial plexus Fentanyl on supraclavicular block. *Reg Anesth* 1995; 20 :311-5.
- [4]. Wajima Z, Nakajima Y, Kim N. IV butarphanol compared with brachial plexus infusion of butarphanol for postoperative analgesia. *Br. J. Anesth* 1995; 74: 392-5.
- [5]. Duma A, Urbenek B, Sitzwohl C, Kreiger A, Zimpfer M, Kapral S: Clonidine as an adjuvant to local anaesthetic axillary brachial plexus block: A randomized, controlled study. *Br J Anaesth* 2005;94: 112-6.
- [6]. Masuki S, dinenno FA, joyner MJ, Eisenach JH. Selective alpha2 adrenergic properties of dexmedetomidine over clonidine in the human forearm. *J Appl Physiol* 2005;99: 587-92.
- [7]. Harshavardana H S. Efficacy of dexmedetomidine compared to clonidine added to ropivacaine in supraclavicular nerve blocks: A randomised double blind prospective study *Int J Med Health Sci.* April 2014, VOL-3; Issue-2.
- [8]. Winnie AP, radonjic R, Akkineni SR, et al, Factors influencing distribution of local anaesthetic injected into the brachial plexus sheath. *AnesthAnalg* 1979;58: 225-234.
- [9]. Esmagolu A, yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anaesth Analg* 2010; 111:1548-51.
- [10]. Ammar AS, Mahmoud KM. Ultrasound guided single injection infraclavicular brachial plexus block using bupivacaine alone or combined with dexmedetomidine for pain control in upper limb surgery: A prospective randomized controlled trial. *Saudi J Anaesth* 2012; 6:109-14.
- [11]. Agarwal S, Aggarwal R, Gupta P. Dexmedetomidine prolongs the effect of bupivacaine in supraclavicular brachial plexus block. *J Anaesthesiol Clin Pharmacol* 2014; 30:36-40.
- [12]. Rachana Gandhi, Alka Shah, Ila Patel, Dexmedetomidine added to Bupivacaine in supraclavicular block prolongs the duration of block and postoperative analgesia *Natl J of medical research* Volume 2 Issue 1 Jan- March 2012 ISSN 2249 4995.
- [13].