Original Article

Indian Journal of Anesthesia and Analgesia
2017, 4 (4, Part-II), 1180-1184
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.4417.43

Evaluation of Low Dose Dexmeditomedine as an Adjuvant to Bupivacaine 0.25% in Supraclavicular Brachial Plexus Blocks

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Abstract

Context: The assessment of the efficacy of low dose (30 micrograms) of dexmeditomedine added to 0.25% bupivacaine was studied for the prolongation of the duration of sensory and motor block in supraclavicular brachial plexus block was the aim of our study. *Methods:* This was a prospective double blind randomized study conducted on sixty patients posted for upper limb surgeries between the age group of 18 to 60 years, the patients were randomly allocated to two groups of 30 each. The control group (C) received 37 ml of 0.25% bupivacaine with 3 ml of normal saline; while the study group (S) received 37 ml of 0.25% bupivacaine with 3 ml of normal saline containing 30 micrograms of dexmeditomedine. Assesment of sensory and motor block was done with the monitoring of heart rate, blood pressure and peripheral oxygen saturation throughout the procedure and postoperatively till the waning of block effect. The duration of analgesia and occurance of various side effects was noted. *Results:* It was observed that the onset time for sensory and motor block was similar in both the groups. The duration of sensory and motor block and post operative analgesia was longer in the study group and was statistically significant. Adverse effects like bradycardia, hypotension, nausea and vomiting were insignificant, occurred in one or two cases. *Conclusion*: Dexmeditomedine in the doses of 30 µg added to bupivacaine as an adjuvant prolongs the duration of sensory and motor block with no significant side effects.

Keywords: Dexmeditomedine; 0.25% Bupivacaine; Supraclavicular Brachial Plexus Block.

Introduction

Regional anesthesia is widely used technique in recent years, as it provides many advantages over general anesthesia like reduced side effects, excellent pain control and shortened stay in post-anesthesia care unit. However, the advantages are of short duration with currently available local anesthetic agents.

Brachial plexus block is being used increasingly for surgery of the hand, forearm, elbow and distal humerus: which avoids the side effects of general anesthesia including laryngoscopy and endotracheal intubation. Bupivacaine is the most commonly administered drug in the brachial plexus block. Delayed onset time is the limiting factor, as compared to the onset time of lignocaine, and potentially resulting in block resolution before the period of the worst post operative pain is over. Increasing the volume/dose of local anesthetic agent can prolong the duration of analgesia, but may increase the risk of systemic toxicity [1]. Using continuous block techniques by placement of peripheral catheter requires additional time and skill, also increases the cost of anesthesia.

A number of adjuvants are used to prolong the duration of peripheral nerve blocks, suchas Buprenorphine, Dexamethasone, Midazolam, Clonidine, Opiates, Neostigmine (anticholinesterase

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Received on 21.07.2017, **Accepted on** 04.08.2017

)and Verapamil (calcium channel blocker) [2,3 & 4]. Use of Clonidine , a partial α_2 adrenoreceptar agonist has been reported to be safe and beneficial in prolonging the duration of anesthesia and analgesia.

Dexmeditomedine is an α_2 adrenoreceptar agonist. Its α_2/α_1 selectivity is eight times more than Clonidine. Dexmeditomedine delays absorption of local anesthetic agent by inducing vasoconstriction in the forearm [5] and thus prolonging the duration of anesthesia. It has been reported to improve the quality of intrathecal and epidural anesthesia [6]. However; the reports of use of Dexmeditomedine in supraclavicular brachial plexus block are limited.

Materials and Methods

This study was carried out at JIIU's Indian Institute of Medical Science &Research Warudi (Jalna, Maharashtra) during the period of August 2016 to May 2017, after obtaining the approval from the institutional ethical committee. This was a prospective, randomized, double blind controlled study.

Sixty adult patients between the age group of 18 to 60 years of either sex, weighing 40 to 60 kgs with ASA physical status I & II scheduled for upper limb surgeries were included in the study. Patients having evidence of contraindication to brachial plexus block like convulsive disorders ,bleeding abnormalities, pregnancy, neurological deficit, uncontrolled diabetes Mellitus, patients taking adrenoreceptar agonist or antagonist drugs and patients having hypersensitivity to local anesthetic agents were excluded from the study. Patients with morbid obesity and significant pulmonary, hepatic or cardio –vascular disease were also excluded from the study.

The patients were randomly divided into two groups, C-control group (n=30) and S-study group (n=30). The control group received 37 ml of 0.25% Bupivacaine with 3 ml of Normal Saline: while the study group received 37 ml of 0.25% Bupivacaine with 30 micrograms of Dexmeditomedine diluted in normal saline to make 3 ml of the total volume.

After proper pre-anesthetic check –up and routine investigations, patient was taken in the operation theatre; intravenous line was secured and monitoring started. Baseline Heart Rate (HR), Non invasive Blood Pressure (NIBP), Peripheral Oxygen Saturation (SPO_2)and Respiratory Rate (RR) were recorded.

After proper patient positioning, the area of the block to be performed was prepared by painting with Povidone Iodine and spirit and covered with drapes. About 2 cms above the mid-clavicular point just lateral to subclavian artery pulsations, a 22 Guage short beveled needle was introduced in a posterior, caudal and medial direction. After obtaining parasthesia in the forearm, 40 ml of the solution from a coded syringe (contents unknown to the performer) was injected slowly with frequent negative aspiration test for blood to avoid accidental intravascular injection. In case where parasthesia could not be elicited, the solution was injected after the first rib was hit. Patients with inadequate block were dropped from the study.

Sensory and motor block was evaluated every five minutes up to first thirty minutes of injection and then every thirty minutes even after surgery was complete till the block was resolved.

The Heart Rate (HR) Non Invasive blood pressure (NIBP) and Peripheral Oxygen Saturation (SpO_2) were the parameters recorded at every five minutes for the first thirty minutes, and thereafter at every ten minutes until the end of surgery. Post-operatively, the motor and sensory block and the vital parameters were recorded every half hourly. Data collection was done by the same anesthesiologist who was unaware of the group allocation.

A. The sensory block assessment was carried out as follows

Sensory Block Assessment (Three Point Scale)

Normal sensation	0
Loss of pinprick sensation	1
Loss of touch sensation	2

B .The Motor Block Assessment was Carried out as Follows

Motor Block Assesment (Bromage 3 Point Scale)

Normal motor function with full flexion &extension in all joints	1
Decreased motor strength Ability to move fingers only	2
Complete motor block Inability to move fingers	3

C .Visual Analog Scale

Post operative pain was assessed by Visual Analog Scale (VAS) from

0 - no pain to 10-worst pain.

D. The level of sedation was assessed with Modified Ramsey sedation score.

Modified Ramsey Sedation Score

Sedation Score	Clinical Response
0	Paralyzed, unable to Evaluate
1	Awake
2	Lightly sedated
3	Moderately sedated ,follows simple commands
4	Deeply sedated, responds to non painful stimuli
5	Deeply sedated, responds only to painful stimuli
6	Deeply sedated, unresponsive to painful stimuli

The end point of monitoring was the time for rescue analgesic dose request by the patient at VAS 4.

Results

The parameters were noted as, the time for onset of sensory block, onset of motor block, duration of sensory and motor block, duration of analgesia, sedation score and untoward side effects.

There was no significant difference in the demographic data between the two groups.

Onset of sensory block-The mean onset time for sensory block was 18.8±3.0 minutes in study group (S) and 19.5±2.6 minutes in control group (C), the difference being statistically insignificant (p value 0.3382).

Onset of motor block-The mean onset time of motor block was 15.8±5.4 minutes in group S, and 16.5±4.7 minutes in group C. However, this difference was not statistically significant (P value 0.5943).

Duration of sensory block –The mean duration of sensory block was noted as 490.35±36.60 minutes (S group) and 175.38±26.50 minutes (C group); which was statistically highly significant (p value 0.0001).

Duration of motor block-The values group observed were 460.39±64.68 minutes (S group) and 160.18±40.20 Minutes (C). The difference in the observations was highly significant (P value 0.0001).

Duration of analgesia-The mean duration of analgesia was 510.67± 58.40 minutes (S group) and 175.50±25.13 minutes (C group), the difference observed was statistically highly significant (p value 0.0001).

In the Control group, where dexmeditomedine was not used, the sedation scores were observed as 1 (24 cases) & 2 (6 cases); whereas in the Study group, the sedation scores were 1 (2 cases), 2 (14 cases), 3 (9 cases) & 4 (5 cases). The difference in the observations was highly significant for score1 (p value 0.0000), for score 3 (p value 0.0011) & for score 4 (p value 0.0192); whereas, the difference was

Table 1: Comparison of demographic data

Variable	Control group	Study group	P value
Age (years)	40.8± 10.2	40.2±10.4	0.8223 NS
Weight (kgs)	61.72	62.70	0.7443 NS
Sex (M/F ratio)	21/9	22/8	0.7744 NS
ASA Grade (I/II)	25/5	26/4	0.7176 NS

(S-significant, NS-not significant)

Table 2: Comparison of time profiles

Baseline Characteristics	Control Group (minutes)	Study Group (minutes)	p-Value
Onset of sensory block	19.5±2.6	18.8±3.0	0.3382 NS
Onset of motor block	16.5±4.7	15.8±5.4	0.5943 NS
Duration of sensory block	175.38±26.50	490.35±36.60	0.0001 HS
Duration of motor block	160 .18±40.20	460.39±64.68	0.0001 HS
Duration of Analgesia	175.50±25.13	510.67±58.40	0.0001 HS

Table 3: Comparison of Sedation Scores

Sedation Score	Control group (n=30)	Study group (n=30)	P value
0	_	_	-
1	24	2	0.0000 HS
2	6	14	0.0285 S
3	0	9	0.0011 HS
4	0	5	0.0192 HS
5	_	_	-
6	_	_	-

significant for score 2 (p value 0.0285). The level of sedation was never alarming; neither any need for artificial ventilation appeared. Instead, the patients who received dexmeditomedine were calm and quiet, with stable pulse rate and blood pressure, not requiring any additional sedation. Adverse effects- Effects like hypotension, bradycardia, nausea &vomiting were not observed in our study.

Discussion

Supraclavicular brachial plexus block is gaining popularity for upper limb surgeries and is one of the most commonly used nerve blocks. Its effectiveness in terms of cost, performance, margins of safty are the reasons behind, providing good post operative analgesia as well.

Bupivacaine alone provides analgesia for 4 to 6 hours. Various adjuvants like Clonidine, Tramadol and opiates have been used along with bupivacaine so as to improve perioperative analgesia , while minimizing systemic side effects [2,3,4,&7]. Yashitomi et el [8] demonstrated that dexmeditomedine as well as clonidine enhances the action of local anesthesia via peripheral adrenoreception. Studies have shown that clonidine prolongs the duration in brachial plexus block [9], but was associated with bradycardia, hypotension and respiratory depression as side effects.

Masuki et el [5] suggested that dexmeditomedine induced vasoconstriction via α_2 adrenoreceptar action in humans possibly, also discussing vasoconstriction around the site of injection, delaying the absorption of local anesthetic agent and thus prolonging its duration of action. Dexmeditomedine is a highly selective and specific α_2 agonist drug with α_2/ α_1 selectivity ratio 1620:1 as compared to 220:1 for clonidine, thus reducing the unwanted side effects of α_1 action .Hence dexmeditomedine was preferred over clonidine in this study. Transient hypotensive response with doses 1-4 micrograms/kg is attributed to stimulation of $\alpha_2\beta$ subtype of receptor in vascular smooth muscle. Bradycardia is a reflex as a result of this action; and it is persistant subsequently because of central sympathetic system inhibition.

The baroreceptar reflex and the heart rate response to pressor agent was well preserved with the use of dexmeditomedine .Thus hypotension and bradycardia were easily treatable. Being highly selective for α_2A receptors, dexmeditomedine has analgesic, anxiolytic and sedative properties; which encourages its use in Intensive Care Unit, as an operative sedation, and as an adjuvant to local anesthetic agents in spinal, epidural and caudal epidural blocks [11].

The volume of local anesthetic agent was taken as 40 ml because this volume was associated with a more complete spread in brachial plexus block [1].

Intrathecal dexmeditomedine in combination with bupivacaine has been studied in human beings without any post operative neurological deficit. So, a dose of 30 micrograms of dexmeditomedine was selected and 0.25% of bupivacaine was used to minimize total dose of the drug to avoid local anesthetic toxicity.

As the previous studies have reported higher incidence of side effects, mainly bradycardia and hypotension with higher doses (ie 100 micrograms) of dexmeditomedine [12].

The mean onset time for sensory block was 18.8 minutes in study group (S) and 19.5 minutes in control group (C) (approx.). In the study conducted by Rachana Gandhi et el [13], the onset of sensory block in plain bupivacaine group was significantly faster (18.4 minutes) as compared to the study group, ie bupivacaine with dexmeditomedine; similar to our observations. Esmagolu et el [12] have used 100 µg of dexmeditomedine which would explain faster onset of sensory block (9.03 minutes) in their study.

The mean onset time of motor block was 15.8 minutes in S group, and 16.5 minutes in group C (approx.). However, this difference was not statistically significant.The mean duration of motor block was 460 minutes in study group and 160 minutes in control group (approx.).

Esmagolu et el [12] and Agrawal et el [14] observed this duration of motor block as 773 minutes and 702 minutes respectively. The prolongation can be attributed to the higher doses of bupivacaine and dexmeditomedine they used. The mean duration of analgesia was observed as 510 minutes in group S and 175 minutes in the group C (approx.).

Esmagolu et el [12] observed the duration of analgesia as 1008.09 minutes; which can be explained on the basis of larger doses of Laevobupivacaine and dexmeditomedine (100µg). Also, the incidence of bradycardia and hypotension was higher in above study and other studies using 100 µg of dexmeditomedine. There was statistically significant difference in the level of sedation in both the groups (Table 3), which is similar to those observed by Rachana Gandhi et el [13].

Conclusion

Dexmeditomedine is a useful drug to combine with bupivacaine to use in brachial plexus block as the onset of sensory and motor block is faster as compared to Plain bupivacaine, but not significant. The duration of sensory and motor block is prolonged with addition of dexmeditomedine . The duration of analgesia is also prolonged which extends postoperatively, minimizing the complications associated with pain. The sedation scores and incidence of bradycardia and hypotension could be kept low when small doses of dexmeditomedine are used.

Acknowledgements

We express our deep sensation of gratitude to the management, JIIU trust and Dr. Amarnath B. Solepure, Dean, IIMSR Medical College, Badnapur, Jalna, Maharashtra. We also deeply acknowledge the help and support of Dr. Sudhir Bhope, Professor & Head, Dept. of Anesthesiology and Dr. A.M. Khadri, Medical Superintendent, Noor Hospital, Badnapur and our patients.

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