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Comparison Between Interscalene Block using 0.5% Ropivacaine with Low dose Dexmedetomidine and using 0.5% Ropivacaine Alone in Upper Arm Surgeries: An Observational Study

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Abstract

Background: Interscalene brachial plexuses block is one of the delicately done widely used blocks for upper humerus and shoulder surgeries. Ropivacaine, a newer Local Anaesthetic (LA), has been increasingly used nowadays in different concentrations for peripheral nerve blocks including brachial plexux block. Dexmedetomidine, a selective α2-receptor agonist has also been reported to improve the quality of intrathecal and epidural anesthesia when used along with LA as adjuvant. In this background, this study was undertaken to observe any alteration of the quality of brachial plexus block when dexmedetomidine used as an adjuvant along with ropivacaine in interscalene approach while performing upper arm surgeries. *Methods:* On obtaining Institutional Ethics Committee approval, sixty patients in total were studied when equally divided into two groups, R and RD. Thirty Patients for each group (either R or RD) were studied who fulfilled inclusion protocol and underwent surgery under brachial plexus block. Patients observed in group R received 30 ml of 0.5% ropivacaine and patients observed in group RD received 30 ml of 0.5% ropivacaine with 50 µg (0.5 ml) dexmedetomidine by electrical stimulations by using peripheral nerve stimulator (PNS) for brachial plexus block. All patients were primarily assessed for 24 hours for duration postoperative pain relief using VAS pain score (0-10centimeter). Secondarily onset and duration of sensory and motor blocks were assessed as well. Patient satisfaction scores (PSS) were also recorded by a specific scoring method for 24 h postoperatively where score 5=excellent, 4=very good, 3=good, 2=fair, and 1=poor. All patients were also monitored for hemodynamic parameters, oxygen saturation, respiratory parameters, sedation and any other adverse outcome for 24 hours. *Results:* The independent samples t test and Chi square test procedures were used to compare means and standard deviations for two groups of cases accordingly. Parametric and nonparametric data were assessed accordingly and p value < 0.05 was considered as significant. Patients observed in both groups were comparable with respect to baseline demographic characteristics. Total duration of analgesia in patients of group R was 540.21 ± 11.54 minutes and in group RD was 630.75 ± 10.67 min. The difference was statistically significant (p value <0.0001). Onset and duration of sensory and motor blockade were also found to be shortened and prolonged respectively in patients of group RD in comparison to group R. PSS were also found to be better in group RD. *Conclusion:* Dexmedetomidine when added in a relatively low dose as an adjuvant to bupivacaine for interscalene brachial plexus block, it was observed to shorten the onset time and prolongs the duration of both sensory and motor blocks with significant prolongation of duration of postoperative analgesia in patients undergoing upper humerus and shoulder surgery.

Keywords: Adjuvant; Low dose dexmedetomedine; Interscalene block; Duration of analgesia.

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Introduction

Regional anesthesia is a recommended technique for upper and lower limb surgeries with better postoperative profile.[1,2] Interscalene approach brachial plexuses block is one of the most widely used blocks for upper end of humerus and shoulder surgeries.

Research have been continuing in the recent years for an ideal local anaesthetic drug that should possess a fast sensory onset, differential offset, with an earlier offset of motor than sensory blockade, enabling early ambulation with prolonged analgesia. Ropivacaine, a newer Local Anaesthetic (LA), has been increasingly used nowadays in different concentration for peripheral nerve blocks. It has lesser cardiac toxicity and higher safety margin when compared to bupivacaine.[3,4] It produces differential neural blockade with less motor block, hence well tolerated for postoperative analgesia and reduced cardiovascular and neurological toxicity.[5,6] However, it has been found that onset time for ropivacaine used in major nerve or plexus block is typically 20-30 mins with an average duration of block is 360-720 mins.[M]

Many drugs such as clonidine[8] and fentanyl [9] have been used successfully as adjuvant with different LAs for the early onset of the block and for prolonging the duration of the block. Dexmedetomidine, an α2-receptor agonist, with α2/α1 selectivity 8 times more than that of clonidine has also been reported to improve the quality of intrathecal and epidural anesthesia[10,11] when used along with LA as adjuvant. Use of dexmedetomidine as an adjuvant to 0.5% ropivacaine in interscalene approach brachial plexus block had been provided with relatively lesser amount of concrete data so far. Consequently a suitable dose of dexmedetomidine for brachial plexus blocks had still not been established convincingly. Hence in this study an optimal dose of 50 µg dexmedetomidine had been chosen based on few of the earlier studies.[12,13,14,15]

This observational study was primarily aimed to know whether 50 µg dexmedetomidine as an adjuvant to 0.5% ropivacaine in interscalene approach brachial plexus block using peripheral nerve stimulator can alter the quality of the block.

Objectives

Primary outcome: To compare total duration of analgesia following successful interscalene approach brachial plexus block between two groups.

Secondary outcome: To compare onset and duration of motor and sensory anesthesia along with patient satisfaction between two groups and also to compare any adverse outcome like sedation, bradycardia, hypotension and voice change etc. between these two groups.

Study design: Longitudinal comparative observational study.

Study period: October 2017 to September 2018

At orthopaedic Operation Theatre, Burdwan Medical College, Burdwan.

Materials and Methods

On approval from the Institutional Ethics Committee, sixty patients were observed following interscalene brachial plexus block when they were equally divided into two groups, R and RD for study convenience. Preoperatively patients were counseled and familiarized with the use of visual analog scale (VAS) pain score for the assessment of perioperative pain. All the patients participating in the study were explained clearly about the purpose and nature of the study in their own understandable language and written informed consent was taken.

Inclusion criteria

- American society of Anesthesiologists (ASA) physical status I and II.
- Aged between 18 and 60 years.
- Scheduled for upper limb surgery mainly upper end of humerus and shoulder surgeries.

Exclusion criteria

- Patients on beta blockers.
- Pregnant.
- With coagulopathy.
- Morbid obesity.
- Severe cardio-pulmonary disease.
- Neurological deficits in the operative arm.

Pre anaesthetic assessment was done for every patient following which patients in Group R received 30 ml of 0.5% ropivacaine and patients in Group RD received 30 ml of 0.5% ropivacaine with 50 µg (0.5 ml) dexmedetomidine by electrical stimulation with PNS. Same anaesthesiologists prepared study drug solutions and administered the block and were designed to observe the quality and duration

of the block and the hemodynamics and respiration postoperatively for 24 hours for each patient of both the groups. These anaesthesiologists collected and analyzed the data and were also involved in management of the patients perioperatively.

Each patient observed in the study were premedicated with tablet alprazolam 0.5 mg and tablet ranitidine 150 mg orally at bedtime the and kept fasting for 10 hours overnight.

In the following morning on arrival of each patient for surgery, 18 gauge intravenous cannula was inserted with infusion of Ringer's lactate. Each patient was thoroughly monitored for heart rate (HR), noninvasive measurements of systolic blood pressure (SBP), diastolic BP (DBP), mean arterial pressure (MAP) and continuous ECG, respiratory rate (RR), and oxygen saturation (SpO_2). The baseline SBP, DBP, MAP, and HR were recorded.

After positioning of each patient on operating table with the head turned to opposite side, interscalene groove was identified by rolling the finger posterior to sternocleidomastoid muscle between the bellies of the anterior and middle scalene muscle at the level of cricoid cartilage. Skin over the insertion site was infiltrated with 2% lignocaine.

Interscalene block was performed in all patients with the peripheral nerve stimulator (Stimuplex, B Braun) connected to 5 cm, 22 gauge, short bevel insulated stimulating needle by modified Winnies approach. The intensity of stimulating current was initially set to deliver 1 mA with impulse duration of 0.1 ms. Thereafter, current was gradually decreased to 0.5 mA. The localization of the plexus was considered optimal when an output current of <0.5 mA caused the contraction of pectoralis muscle, deltoid, biceps or triceps. After eliciting motor response of any of these muscles, 30 ml of 0.5% ropivacaine alone was given in patients of group R and and 30 ml of 0.5% ropivacaine with 50 mcg (0.5 ml) of dexmedetomidine in patients group RD as per study protocol in increments of 5 ml after fixing the stimulating needle aspirating in between to avoid inadvertent intravascular injection.

Hemodynamic parameters such as HR, SBP, DBP as well as SpO_2, and RR were monitored at every 20 min interval till 1 hour of LA injection and then every 30 min till 2 hour and thereafter every hour till the end of surgery and postoperatively one hourly till first 24 hour. Adverse events such as hypotension (20% decrease in relation to the baseline value), bradycardia (HR < 45 bpm), hypoxemia ($SpO_2 \leq 90\%$), perioperative nausea and vomiting, and development of change of voice (if any) were recorded. Clinically relevant bradycardia (heart rate < 45 bpm) spells were treated with atropine (0.6 mg IV). Sedation was evaluated by using the University of Michigan Sedation Scale (UMSS)[12] of 0 to 4 [0 = awake and alert; 1 = minimally sedated/ sleepy, appropriate response to conversion and/or sound; 2 = moderately sedated, somnolent/sleepy, easily aroused with tactile stimulation and/or simple verbal command; 3 = deeply sedated/deep sleep, aroused only with significant stimulation and 4 = could not be aroused].

Patient's perception of pain was assessed using VAS (0–10).

Block was considered inadequate when sensory anesthesia was not achieved within 30 min following which general anesthesia was considered and patient was not included in the study.

The following parameters were assessed.

Onset of sensory block

Sensory block was assessed by loss of sensation to pinprick over the C5T1 dermatomes using a 3points scale which is as follows:

0 sharp pain, 1 dull pain (analgesia), 2 no pain (anesthesia).

Sensory onset time was defined as the time interval between the end of LA administration and establishment of score 2 on 3 point scale on all nerve territories.

Onset of motor block

Motor block was assessed using Bromage scale.

0 Normal motor functions with full flexion and extension of the elbow, wrist, and fingers

1 Decreased motor strength with the ability to move fingers only

2 Complete motor blockade with the inability to move fingers.

Motor block onset time was defined as the time interval between the end of LA administration and complete motor block (score 2).

Duration of sensory block

Duration of sensory block was defined as the time interval between the end of LA administration and the complete resolution of anesthesia (score 0 on a 3 point scale) on all nerves.

Duration of motor block

Duration of motor block was defined as the time interval between the end of LA administration and the recovery of complete motor function (Score 0 on Bromage scale).

Patient satisfaction

Patient satisfaction score (PSS) was recorded after 24 h postoperatively as 5 excellent, 4 very good, 3 good, 2 fair, and 1 – poor.

Patients were monitored for 24 h postoperatively to assess total duration of sensory and motor blockade and VAS pain score.

Postoperatively rescue analgesia in the form of nonsteroidal anti-inflammatory drugs (injection diclofenac sodium 75 mg) was given when patient complained of VAS ≥ 3.

The patients were continuously monitored for any perioperative complications and adverse reactions and examined on the 3rd post operative week for any weakness in the concerned arm.

Statistical analysis

A sample size of 26 patients were to be needed in each group to detect an intergroup difference of duration of analgesia of at least 30 minutes with a power of 0.80 and α error of 0.05 with a pooled standard deviation of 10 minutes. In order to make good for attrition rate, a total number of 30 patients in each group were included for the study. Chi-square test was applied for age, weight, sex and ASA grades and independent samples *t* test procedures was used to compare means of standard deviation for two groups of cases for demographic data, hemodynamic parameters, onset and duration of sensory/motor blockade and duration of analgesia and any adverse effects. SPSS for windows (version 21.0, SPSS Inc., Chicago, IL, USA) was employed for data analysis. $P < 0.05$ was considered as significant.

Results

Sixty patients belonging to ASA physical status 1 and II and fulfilling other criteria of the study undergoing shoulder and upper humerus surgeries under interscalene block were included in the study. As shown in Table 1, patients in both groups were comparable with respect to baseline demographic characteristics.

Table 1: Demographic and surgical variables

Variables	Group R	Group RD	P Value
Age (years)	45.67 ± 9.8	44.18 ± 10.04	0.563
Weight (Kg)	55.16 ± 8.46	56.08 ± 8.32	0.673
Sex (M/F)	18/12	20/10	0.884
ASA (I/II)	17/13	18/12	0.951
Duration of surgery (min)	90.33 ± 21.96	87.16 ± 26.66	0.539

As shown in Table 2, the mean time for the onset of sensory block in Group R was 15.6 ± 1.06 min and in Group RD was 12.96 ± 1.18 min. The difference was statistically significant with earlier onset of sensory block in Group RD ($p < 0.0001$).

The mean time for the onset of motor block in Group R was 18.3 ± 1.877 min and in Group RD was 16.4 ± 1.1 min. The difference was statistically significant with earlier onset of motor block in Group RD ($p= 0.0268$).

The mean duration of sensory block in Group R was 506.77 ± 10.77 min and in Group RD was 598.5 ± 10.98 min. The difference was statistically significant in ($p <0.0001$).

The mean duration of motor block in Group R was 413.45 ± 14.75 min and in Group RD was 424.6 ± 20.89 min. The difference was statistically significant ($p<0.02$).

Table 2: Characteristics of brachial plexus block

Column1	Group R	Group RD	*p* Value
Onset time of sensory block (minutes)	15.6 ± 1.06	12.96 ± 1.18	<0.0001
Onset time of motor block (minutes)	18.3 ± 1.877	16.4 ± 1.1	0.0268
Duration of sensory block (minutes)	506.77 ± 10.77	598.5 ± 10.98	<0.0001
Duration of motor block (minutes)	413.45 ± 10.75	424.6 ± 12.89	0.02

Total duration of analgesia in Group R was 540.21 ± 11.54 min and in Group RD was 630.75 ± 10.67 min as shown in table 3. The difference was statistically significant (p value <0.0001).

Table 3: Characteristics of analgesia

Column1	Group R	Group RD	*p* value
Time to get first rescue analgesic	540.21 ± 11.54	630.75 ± 10.67	<0.0001

Patients in both the groups had an equally good PSS.

PSS	Group R	Group RD	*p* Value
PSS 5	17	23	0.757
PSS 4	7	12	0.688

Table 4: Suspected adverse drug reaction profile in the two study groups

Suspected adverse reaction	Ropivacaine plus dexmedne (RD)	Ropivacaine alone (R)	*p* value
Bradycardia (HR <45 bpm)	1	0	1.000
Hypotension (fall in MAP > 20% of base line)	8	6	0.766
SpO2 < 90%	0	0	
Sedation score (mean ± standard deviation)	2.2 ± 0.75	1.7 ± 0.53	< 0.236
Postoperative arm weakness	1	0	1.000

Discussion

Dexmedetomidine so far had been shown promising outcome in intravenous conscious sedation in ICU patients. Different studies done in different set ups also had shown that dexmedetomidine's use could prolong analgesia when used with local anaesthetics for neuraxial blocks by virtue of its effects on spinal α_2 receptors.

Drugs such as clonidine and fentanyl had been in use as successful adjuvant with bupivacaine and/or ropivacaine for the early onset as well as for prolonging the duration of brachial block. Dexmedetomidine for being a relatively more selective α_2 agonist with α_2 adrenoreceptors located in the CNS and spinal cord level had been found to be responsible for the sympatholysis, sedation, and antinociception mediated by G-protein inhibition of L-type calcium channels thereby producing a complex pattern of analgesia by both spinal and supraspinal mechanism. Dexmedetomidine had also been shown to exert an anti hyperalgesic action in neuropathic pain states involving the peripheral nervous system and so had been increasingly found to be used as an adjuvant with various local anaesthetics in peripheral nerve blocks to decrease the time of onset and increase the duration of analgesia. Although clonidine added to bupivacaine prolonged the duration of anesthesia and analgesia in brachial plexus block, but was found to be associated with bradycardia, hypotension, and respiratory depression and over the past few years dexmedetomidine had gradually replaced clonidine as an adjuvant of choice. Ropivacaine, a newer LA with less cardiac and neural toxicity than bupivacaine, had been in use currently as an ideal agent for neural blockade. However it was found that ropivacaine could be less effective at times and larger volumes of drug might be required for getting adequate block. Some recent randomized, double-blind trials had shown that dexmedetomidine 1 microgram/Kg as an adjuvant to 0.5% levobupivacaine for axillary brachial plexus blockade shortened block onset time, prolonged duration of motor and sensory effects, extended postoperative analgesia and decrease in total analgesic use.[15] Ropivacaine being a newer LA had been in use in various concentrations of 0.25%, 0.5%, and 0.75% for nerve blocks producing greater sensory and motor differential blockade than bupivacaine, in a dose dependent manner, with higher concentrations (1%) causing greater degree of motor blockade than lower concentration (0.5% and 0.75%).[4] In the present study 0.5% ropivacaine had been chosen with an idea to achieve maximum possible sensory blockade with minimum effect on motor movements and to minimise unnecessary side effects of inadvertent high block. Dexmedetomidine dose had been chosen to be 50 microgram to avoid untoward bradycardia, hypotension and sedation yet to achieve adequate adjuvant effect for a desired quality of block during surgery and post operative period as well. Some of the previous studies had reported that 50 microgram dexmedetomedine could produce significant prolongation of analgesia when added to ropivacaine in brachial blocks.[8, 10, 15] It was clearly found in the present study that there was no significant difference between the two groups R and RD as far as the demographic data are concerned while it was also observed that mean total duration of analgesia in patients of group RD (630.75 ± 10.67 minutes) was significantly longer than the patients of group R (540.21 ± 11.54 minutes) till the receipt of first dose of rescue analgesic which was very much in corroboration with another study of Agarwal S, Aggarwal R, Gupta P *et al*. where they had shown the adjuvant effect of dexmedetomedine with bupivacaine in brachial plexus block.[16] Present study also had shown to improve the onset of motor and sensory block in patients of group RD due the adjuvant effect of dexmedetomedine which was similar to many other studies. Total duration of sensory and motor block were also found to be significantly prolonged in patients of group RD for the use of dexmedetomedine and these findings could well be compared to other recent works done with dexmedetomidine in brachial block. One of the possible causes of prolongation of effect of local anaesthetic could be the vasoconstriction caused by dexmedetomedine at the injection site by its alpha 2 adrenoceptor agonist effect resulting delayed absorption of local anaesthetic (AM AbdElmaksoud and his colleagues).[8] Moreover it was also found that that patient satisfaction was also better in patients of group RD which was assessed by a specified protocol based scoring system and though not significant as such but found to be almost comparable to a previous study that showed similar kind of patient satisfaction pattern for patients receiving dexmedetomedine as an adjuvant.[17] Many other studies had also emphasized on the role of dexmedetomedne for its adjuvant effect on pain relief thereby prolonging the effect of brachial block in post operative period and reducing the requirement of opioid rescue analgesics especially. Although this study was not designed to comment on this perspective but as per the observations it was quite clear that diclofenac sodium, the rescue analgesic used in this study was needed after a longer period of post

operative time in patients of group RD receiving dexmedetomedine as an adjuvant with respect to the patients of group R without dexmedetomedine.

There were limitations in this study of which non availability of ultrasography machine guided interscalene brachial plexus block was the foremost one which was more of a technical issue in this medical college. This medical college being a peripheral college certain logistic shortcomings such as lack of proper post operative care facilities made the postoperative assessment of pain of each patient a little more difficult and unassuming on the basis of VAS scoring for 24 hours post operative period which could have been better otherwise. Variations in observations by anaesthesiologists could be another method related problem which could not be addressed properly.

Conclusion

This observation based comparable study had substantial data to conclude that low dose dexmedetomedine when added as adjuvant to 0.5% ropivacaine in interscalene brachial plexus block produced significant prolongation of duration of analgesia in the operated arm without much clinically concerning side effects.

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