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Original Research Article

A comparative study of dexmedetomidine and dexamethasone as adjuvants to ropivacaine in supraclavicular brachial plexus block

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Abstract

Background: Enhancing the duration of sensory and motor blockade of regional anaesthesia is often desirable for prolonged surgeries and also provides pain relief in the immediate postoperative period. We performed a prospective, randomised, study to evaluate the effect of Dexmedetomidine and Dexamethasone as adjuvants to Ropivacaine in supraclavicular approach of brachial plexus block.

Study design: The study was a controlled, randomised, double-blinded, prospective study.

Methods: Sixty ASA physical status 1 and 2 patients undergoing elective hand, forearm and elbow surgeries under brachial plexus block were randomly divided to receive either 8 mg Dexamethasone + 30ml 0.5% Ropivacaine or 1 mcg/kg Dexmedetomidine + 30 ml 0.5% Ropivacaine. The block was performed using a nerve stimulator. Onset and duration of sensory and motor blockade and total duration of analgesia were measured. Vitals were recorded at 3, 5,10,15,30 and 45 minutes. Two sample 't' test of difference between two means was used to analyse the differences between various parameters that were used in the cases. Categorical data was assessed by Chi square test and Fishers exact test. P value of < 0.05 was considered significant.

Results: The onset of sensory block and onset of motor block both were found to be sooner with Dexmedetomidine than Dexamethasone. The duration of sensory block and motor blockade and duration of analgesia was longer with Dexmedetomidine than Dexamethasone.

Conclusion: Both Dexmedetomidine and Dexamethasone enhanced the onset and duration of blockade but, the effect was found to be more pronounced with Dexmedetomidine.

Keywords: Dexmedetomidine, supraclavicular block, dexamethasone, ropivacaine, brachial plexus block

1. Introduction

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Brachial plexus block is one of widely employed regional nerve block technique for perioperative anaesthesia and analgesia for surgery of upper extremity. Ropivacaine is a newer longer acting local anaesthetic belonging to aminoamide group of local anaesthetics. It is a pure S enantiomer developed to reduce potential toxicity and

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improve relative sensory and motor block profiles [1].
Dexmedetomidine, a newer α2-adrenoreceptor agonist is currently in focus for its sedative, anxiolytic and analgesic properties. It results in a dose-dependent increase in the duration of sensory and motor block [2]. Dexamethasone, a long-acting glucocorticoid (t 1/2 >36 h) has potent anti-inflammatory and analgesic effects. It is proved to be beneficial in peripheral nerve blocks. These drugs in various combinations with other adjuvants and local anesthetics were studied in the past few years, but very few studies have compared their efficacy in a single study with Ropivacaine against each other.

2. Methodology

This prospective study was conducted in 60 ASA 1 and ASA 2 patients posted for upper limb surgeries below shoulder joint under supraclavicular brachial plexus block in MAMATA MEDICAL COLLEGE AND GENERAL HOSPITAL for a period of 1 year. The study was a controlled, randomised, double-blinded, prospective study. The patients with ASA 1 and ASA 2 status, with age group of 15-60y of both sex and patients undergoing elective upper limb surgeries were included. The patients with ASA 3 and ASA 4 status, infection at site of injection, peripheral neuropathy, presence of 1^{st}, 2^{nd} and 3^{rd} degree heart block, pregnant patients, presence of coagulopathies and known allergy or hypersensitivity to local anaesthetic drugs were excluded.
Patients were randomly divided into two groups group DM and group DX with 30 patients each. In group DM the patients received 30ml Ropivacaine (0.5%) with (1 mcg/kg) Dexmedetomidine and in group DX-patients received 30ml Ropivacaine (0.5%) with 8 mg Dexamethasone. The total volume of drug injected into both the groups was constant. In each patient thorough history was elicited. Patient was clinically examined in detail and investigated with CBP, X-ray chest, Serum creatinine, Blood sugar, Electrocardiogram and if age >40 years standard monitoring with pulse oximetry, ECG and NIBP was recorded. An intravenous fluid was started before undertaking the procedure which continued throughout the length of surgery. Vital parameters were recorded throughout the length of the procedure and oxygen at the rate of 4L/min was administered through oxygen mask.
Technique of block: The brachial plexus block was carried out after thorough explanation of the procedure and emphasizing the need for patient cooperation.
The procedure was carried out by a single experienced anaesthesiologist in all the patients of both the groups. The classical approach to supraclavicular block using a single-injection, nerve stimulator technique was used in this study.
The patient was placed in the dorsal recumbent position without any pillow, arms at the sides and head turned to the opposite side to be blocked. Small pad was placed in the interscapular region. The patient was asked to lower his/her shoulder and flex the elbow, so that the forearm rests on the lap. The wrist was supinated such that the palm of the hand faced the patient's face. (This manoeuvre allowed for detection of any subtle finger movements produced by nerve stimulation).
Under strict aseptic conditions, the part of the neck was cleaned and draped. The anesthesiologist stood on the side to be blocked. The lateral border of the sternocleidomastoid (SCM) muscle was identified and followed distally to the point where it meets the clavicle the point of needle entrance was about 1 inch (2.5 cm) lateral to the insertion of the SCM in the clavicle 60 or one 'thumb breadth' lateral to the SCM. Palpation of the subclavian artery at this site confirms the landmark. The palpating index finger was placed at this site [3].
Local infiltration of 1 ml of 2% lidocaine was given at the proposed puncture site.
We used an insulated needle to perform this technique. The needle was connected to nerve locator by the electrodes and was properly grounded with the help of ECG lead. We started the stimulation with an intensity if 2.0 mA and a pulse width of 100 μs. Once the desired

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response was obtained-that is a muscle twitch of the fingers which is clearly visible - we started to decrease the current gradually to 0.4 mA. If we still obtained the desired response the drug solution of 32ml is injected after performing negative aspiration for blood before each incremental injection of 5ml.
If we did not get adequate response or if repositioning of the needle was necessary, the needle was withdrawn and the penetration angle was adjusted in the antero-posterior plane, either slightly more posterior or more anterior, but always parallel to the midline.
During the conduct of block, the patient was observed vigilantly for any complications of the block and for the toxicity of the drugs injected and thereafter monitored continuously. The various parameters collected for Sensory block were the onset measured from 3 minutes to 45 minutes post injection of drug using the spirit swab method with the time interval between end of anesthetic drug administration and complete resolution of sensory block on all nerves. And the motor block with onset measured from 3 minutes to 45 minutes post injection of drug using.

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 and/or wrist only.
3. Complete motor blockade with inability to move fingers.

And the duration of analgesia was calculated with the time interval between end of local anesthetic drug administration and recovery of complete motor function of hand and forearm. Postoperative analgesia measured by Visual Analogue Scale.
The precautions taken to prevent deleterious effects are repeated aspiration after every 5 ml of injecting the drug to prevent intravascular spread and test dose of the local anesthetic was given to look for hypersensitivity.
Statistical analysis was done using two sample ‘t’ test of difference between two means was used to analyse the differences between various parameters that were used in the cases. Categorical data was assessed by Chi square test and Fishers exact test. P value of < 0.05 was considered significant.

3. Results

Age, sex, ASA status, weight, type of surgery and duration of surgery showed the p value of >0.05. Hence the p value was insignificant and both the groups were comparable.
The time for onset of sensory block was 15.2 +/- 1.52 minutes in group DX and 10 +/- 1.43 minutes in group DM. The onset of block was faster in group DM compared to group DX. By calculating with t’ test of two independent means the p value was < 0.001 which is highly significant.

Onset of Sensory block (Minutes)	Study Groups				Total	
	DX (n=30)		DM(n=30)			
	No.	%	No.	%	No.	%
08-09	26	86.67%	0	0.00%	26	43.33%
10-15	4	13.33%	16	53.33%	20	33.33%
16-19	0	0.00%	14	46.67%	14	23.33%
Total	30	100.00%	30	100.00%	60	100.00%
Mean +/- SD	15.2 +/- 1.52		10 +/- 1.43			
t-statistic	13.62					
P Value	< 0.001					
Inference	Highly Significant					

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The time for onset of motor block was 13.13 +/- 1.38 minutes in group DX and 17.37 +/- 2.01 minutes in group DM. The onset of block was faster in group DM compared to group DX. By calculating with 't' test of two independent means the p value was < 0.001 which is highly significant.

Onset of Motor Blockade (Minutes)	Study Groups				Total	
	DX (n=30)		DM (n=30)			
	No.	%	No.	%	No.	%
10-13	0	0.00%	19	63.33%	19	31.67%
14-17	16	53.33%	11	36.67%	27	45.00%
18-22	14	46.67%	0	0.00%	14	23.33%
Total	30	100.00%	30	100.00%	60	100.00%
Mean +/- SD		17.37 +/- 2.01		13.13 +/- 1.38		
t-statistic	9.5					
P Value	<0.001					
Inference	Highly significant					

The duration of sensory block was 10.4+/-1.21 hours in group DX and 12.78+/-1.61 hours in group DM. The duration of block was longer in group DM compared to group DX. By calculating with 't' test of two independent means the p value was < 0.001 which is highly significant.

Duration of Sensory Blockade (hrs)	Study Groups				Total	
	DX (n=30)		DM (n=30)			
	No.	%	No.	%	No.	%
08-09	2	6.67%	18	60.00%	20	33.33%
10-14	19	63.33%	12	40.00%	31	51.67%
14-17	9	30.00%	0	0.00%	9	15.00%
Total	30	100.00%	30	100.00%	60	100.00%
Mean +/- SD	10.4+/-1.21		12.78+/-1.61			
t-statistic	6.45					
P Value	< 0.001					
Inference	Highly Significant					

The duration of motor block was 10.4+/-1.16 hours in group DX and 13.53+/-1.2 hours in group DM. The duration of block was longer in group DM compared to group DX. By calculating with 't' test of two independent means the p value was < 0.001 which is highly significant.

Duration of Motor Blockade (Hrs)	Study Groups				Total	
	DX (n=30)		DM (n=30)			
	No.	%	No.	%	No.	%
05-06	0	0.00%	1	3.33%	1	1.60%
07-13	6	20.00%	29	96.67%	35	58.40%
13-17	24	80.00%	0	0.00%	24	40.00%
Total	30	100.00%	30	100.00%	60	100.00%
Mean +/- SD	10.4+/-1.16		13.53+/-1.2			
t-statistic	11.17					
P Value	< 0.001					
Inference	Highly Significant					

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The duration of analgesia was 697.33 minutes in group DX and 892.7 minutes in group DM. The duration was longer in group DM compared to group DX. By calculating with 't' test of two independent means the p value was < 0.001 which is highly significant.

Total Duration of Analgesia (min)	DX	DM
Mean value	697.33	892.7
SD	44.6	43.76
T statistic	17.12767	
P value	<0.0001	
Inference	Highly significant	

Sedation was seen in all the patients in group DM with Dexmedetomidine. (Ramsay sedation score-2). This was statistically as well as clinically significant as it provided for a smoother experience for the patient.

4. Discussion

Inadequate pain relief in the period increases the patient morbidity and is often associated with poor surgical outcomes. Brachial plexus is one of most familiar and frequently performed blocks for upper limb surgeries. It consists of inj of LA s in the fascial spaces surrounding the nerve plexus, blocking autonomic, sensory and motor fibres [4].

Supraclavicular block was selected in this study because it provides rapid, Dense and predictable anaesthesia of entire upper extremity. It is carried at the division level of Brachial plexus nerves.

Post op pain relief must be safe, effective and feasible. Adjuvants improve analgesia, reduce systemic side effects, and reduce total dose of local anaesthetic required.

Local Anaesthetic used in this study is Ropivacaine. Due to additional advantages like cardiac stability, less cardiotoxicity, and pain relief with less motor blockade. The patients belonging to the age groups of 15-60 years were included in the study. They belonged to either sex. The demographic data in this study shows the mean age of 35.87 ± 10.6 yrs in group DX and 35.1 ± 8.6 years in group DM.

't' test of two independent means was performed which found the groups were comparable. This is in concurrence with the study done by Niranjan Kumar Verma and Ashutosh Ranjan where the mean age of patients in group DM was 32.19 ± 11.11 y and group DX was 32.88 ± 10.12 y [5].

The onset of sensory block was determined by using spirit swab method. The time of onset of block is 15.2 ± 1.52 minutes in group DX and 10 ± 1.43 minutes in group DM. The time of onset is faster with dexmedetomidine than with dexamethasone.

This corresponds to the study done by Sampathi Shiva Krishna *et al*. 8 mg of dexamethasone was administered with 28 ml of 0.5% Ropivacaine. The time of onset of sensory block was 15.333 ± 2.509 minutes vs 15.2 ± 1.52 minutes of the current study. HD Rashmi, HK Komala compared dexmedetomidine as an adjuvant to 0.75% ropivacaine in interscalene approach of brachial plexus block. The mean time for the onset of sensory block in Group R was 16 ± 1.93 min and in Group RD was 11.98 ± 2.01 min which is comparable to our Group DM [6].

The onset of motor block in this study was measured by Bromage three point score. It is 17.37 ± 2.01 minutes in group DX. In group DM the onset of motor block is 13.13 ± 1.38 minutes. The onset of motor blockade is faster with dexmedetomidine than with dexamethasone.

In a study done by Vivek S Palsule, Avani P Shah, Hitendra H Kanzariya dexmedetomidine with 0.25% bupivacaine was compared to plain bupivacaine. Onset time of motor block (min) was 17.33 ± 7.52 in group C and 11.83 ± 8.20 in group D vs 13.13 ± 1.38 minutes in group DM of the current study which is nearly comparable [7].

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In another study done by Niranjan Kumar Verma *et al*. time of onset of motor block (min) was 14.12 ± 1.6 min in group DM and 18.01 ± 4.51 min in group DX which is similar to the results our study.

In our study the duration of sensory block is 10.4 ± 1.21hrs in group DX and 12.78 ± 1.61hrs in Group DM. It is determined as the time interval between end of anesthetic drug administration and complete resolution of anaesthesia on all nerves. Both the drugs prolonged the duration of sensory blockade. The effect is more pronounced with dexmedetomidine than dexamethasone.

According to the results of study by Vivek S. Palsule, *et al*. duration of sensory block (min) in group C was 395.67 ± 211.72 min and 691.33 ± 310.28 in group D-with dexmedetomidine.

In the study done by Niranjan Kumar Verma and Ashutosh Ranjan the duration of sensory block was found to be 899.5 ± 61.7 minutes in group DM and 738 ± 24.4 minutes in group DX. Both the studies showed a prolonged duration similar to ours.

In this study the duration of motor block was found to be 10.4 ± 1.16 hrs in group DX and 13.53 ±1.2 hours in group DM. Both the adjuvants prolonged the duration of motor blockade. The prolongation is more pronounced with dexmedetomidine compared to dexamethasone.

In the study done by Niranjan Kumar Verma and Ashutosh Ranjan duration of motor block (min) in group DM was found to be 863.11 ± 54.2 minutes (14.3 hrs) and 692.2 ± 30.08 minutes (11.53 hrs) in group DX which is similar to the current study.

The total duration of analgesia was prolonged in both the groups. It was calculated from the time of onset of block to the time at which the patient received the first rescue analgesic on demand. The analgesia lasted for 697.33 minutes on an average in group DX and for 892.7 minutes in group DM.

In the study by Vivek S. Palsule, Avani P. Shah, Hitendra H. Kanzariya duration of analgesia (min) was 423.67 ± 213.11 minutes in group C and on group D was 735.67 ± 283.72 minutes-with dexmedetomidine which is comparable to 892.7 minutes achieved in our study.

Santosh Kumar, Urmila Palaria, Ajay K. Sinha, D.C. Punera and Vijita Pandey compared dexamethasone to ropivacaine in supraclavicular approach of brachial plexus block [8].

First rescue analgesia was required in group R earlier (557 ± 58.99 min) than Group D patients (1179.4 ± 108.60 min 19.65 hrs) and was statistically significant. Group R required higher doses of rescue analgesic when compared to Group D, which was statistically significant (p<0.001). Vandana Mangal, Tuhin Mistry, Gaurav Sharma, Md Kazim, Neelmani Ahuja, Amit Kulshrestha evaluated the effect of dexmedetomidine as adjuvant to ropivacaine in supraclavicular approach of brachial plexus block [9].

Duration of Sensory and motor block (S-613.34 ± 165.404 min and M-572.7 ± 145.709 min) was longer in group B than group A (543.7 ± 112.089 min and 503.26 ± 123.628 min; p<0.01).

Duration of analgesia was shorter in group A (593.19 ± 114.44 min) than group B (704.8 ± 178.414 min; p<0.001). Vitals signs-Heart rate, Blood Pressure with mean arterial pressure and saturation (SpO_2) were assessed. Heart rate was assessed at baseline-before start of procedure, at 3 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes and 45 minutes.

The results showed no significant change in heart rate between group DX and DM. Mean arterial pressure was also measured at same intervals. The results showed a significant change in MAP at intervals of 3 minutes, 5 minutes, 15 minutes, 30 minutes and 45 minutes. This is clinically not relevant. There was no significant change in saturation between both the groups at all the times.

No clinical or statistically significant adverse events were seen with Dexamethasone. Dexmedetomidine caused statistically significant sedation in group DM but it is not clinically significant.

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Conclusion

In conclusion addition of Dexamethasone (8mg) and Dexmedetomidine (1 mcg) to 30 ml) 0.5% Ropivacaine resulted in faster onset of sensory block with Dexmedetomidine, faster onset of motor block with Dexmedetomidine, prolonged duration of sensory block with Dexmedetomidine, prolonged duration of motor block with Dexmedetomidine and prolonged post-operative analgesia with Dexmedetomidine.

5. Source of funding: Nil.

6. Conflict of interest: There is no conflict of interest.

7. References

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