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A clinical comparison of Dexmedetomidine and Dexamethasone as adjuvant to Ropivacaine in Supraclavicular brachial plexus blocks for upper arm surgeries.

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Abstract

Background and objective: Adjuvants to local anaesthetic for Brachial Plexus Block enhances the quality and duration of analgesia. The purpose of this study was to compare an alpha-2 agonist Dexmedetomidine and a steroid Dexamethasone, when added as adjuvant to Ropivacaine in respect to onset, duration of sensory and motor block along with duration of analgesia. **Method:** After informed consent, 100 ASA I and II patients scheduled for elective upper limb surgeries under Supraclavicular brachial plexus block in JLN Medical College & Hospital, Bhagalpur from March 2015 to December 2015, were divided into two equal groups in a randomized double blind fashion. Group DM (n=50) received Ropivacaine (0.5%) 30 ml + Dexmedetomidine 1 ml (50 mcg) + 1 ml distilled water, making a total of 32 ml, and another group DX (n=50) received 30 ml of Ropivacaine (0.5%) + 2 ml of Dexamethasone (8 mg). Motor and sensory block onset times, block durations, quality of intraoperative analgesia and duration of analgesia were recorded. **Results:** Demographic data and surgical characteristics were similar in both groups. The sensory and motor block onset times was earlier in group DM as compared to group DX ($p<0.05$). Sensory and motor blockade duration were longer in group DM than in group DX ($p<0.001$). 24 hours visual analog scale was more in group DX as compared to group DM. The quality of anaesthesia was excellent in both the groups. Mean arterial blood pressure levels at 10, 15, 30, 45, 60, 90, 120 and 150 minutes were statistically insignificant between the two groups ($p>0.05$). The mean pulse rate at different time intervals were also statistically insignificant between the groups ($p>0.05$). **Conclusions:** Both Dexmedetomidine and Dexamethasone when mixed with Ropivacaine (0.5%) as adjuvants in Supraclavicular brachial plexus block for upper limb surgeries prolong the duration of block and the duration of postoperative analgesia but dexmedetomidine has earlier onset with longer duration of action in comparison to Dexamethasone.

Keywords: Ropivacaine, Dexmedetomidine, Dexamethasone, Supraclavicular Brachial Plexus Block, Peripheral nerve stimulator.

Introduction

Ropivacaine (0.5%) is lesser lipophilic than bupivacaine and that together with its stereo selective properties, it has higher threshold for cardiovascular and central nervous system toxicity than bupivacaine in animal and human volunteers **(1).**Dexmedetomidine is a highly selective α2 adrenergic agonist with an affinity of 8 times greater than clonidine **(2).**Various studies have shown that Dexmedetomidine prolongs the duration of sensory and motor block and provide a very good analgesia when used as an adjuvant to local anesthetics for nerve blocks **(3, 4, 5, and 6).** The anaesthetic and the analgesic requirement are reduced substantially because of its analgesic properties and augmentation of local anesthetic effects as they cause

hyperpolarization of nerve tissues by altering transmembrane potential and ion conductance at locus coereleus in brain stem **(7).** The stable haemodynamics and the decreased oxygen demand due to enhanced sympathoadrenal stability make it a very useful pharmacological agent for this purpose.

Steroids have powerful anti-inflammatory as well as analgesic property. Perineuraly injected steroids is reported to influence post-operative analgesia. Dexamethasone microspheres have been found to prolong the block duration in animal and human studies and adding methyl prednisolone to local anaesthetic increase the duration of brachial plexus block **(8-11).**

With these backgrounds, this study was carried out to compare the efficacy of Dexmedetomidine verses Dexamethasone as an adjuvant to Ropivacaine in Supraclavicular brachial plexus block. Our primary goal was the onset time, duration of motor and sensory blocks and the quality of intraoperative analgesia.

Materials and Methods

Study population: one hundred patients, scheduled for different upper limb surgeries were selected for study in the department of Anaesthesiology, JLN Medical College & Hospital, Bhagalpur. Patients were randomized into two groups. Group DM: (n=50) received Ropivacaine (0.5%) 30 ml + Dexmedetomidine 1 ml (50 mcg) + 1 ml distilled water and another group DX (n=50) received 30 ml of Ropivacaine (0.5%) + 2 ml of Dexamethasone (8 mg). The allocation sequence was generated by random number tables.

Inclusion criteria: After ethical committee approval and informed consent, 100 normotensive patients of ASA physical grade I –II of either sex, aged 20-50 years of either sex were included.

Exclusion criteria: Patients with hypertension, Hypotension, Bradycardia, presence of 1st, 2nd or 3rd degree heart block, hyperthyroidism, patients on adrenoreceptors agonist or antagonist therapy, with known hypersensitivity to local anaesthetic, pregnant women and preexisting peripheral neuropathy, were excluded from the study.

Method: After insertion of an 18 gauge IV cannula in the non-operated hand, a slow IV infusion of Ringer lactate was started. Base line measurements of heart rate (HR), non-invasive blood pressure, peripheral oxygen saturation (SpO2), and respiratory rate were recorded by attaching multipara cardiac monitor, before the blocks were performed. A continuous ECG monitoring was started. Three bottles (100 ml each) of 20% Intralipid was stacked nearby for fear of ant local anesthetic toxicity management, if needed. The study drug was prepared by an anaesthesiologist who was not involved in the study. Patients placed in supine position with a pillow under the scapular region extending and supporting the head also. Head was turned to the contralateral side so much that the chin came up to the midclavicular point making the skin over the part stretched. With a marker pen 1st line was drawn just over the clavicle. Patient was asked to lift head against resistance making prominent the lateral border of sternocleidomastoid muscle and the 2nd line was drawn over the lateral border of this muscle. A 3rd line was drawn at two finger breadth above and parallel to the first line. A 4th point was marked 1 cm lateral to the point of intersection of 2nd and 3rd line. This was the point of insertion of needle. Confirmation was made by asking the patient to sniff, which made the Interscalene groove more palpable by rolling the finger. The site was cleaned with povidone iodine solution. A very superficial skin wheel was made at the point with 0.5% lidocaine. A 5 cm insulated nerve stimulator needle was attached to a peripheral nerve stimulator, setting the nerve stimulator at 2.0 mA and a pulse width of 100 µs. Needle was inserted almost perpendicular with very slight inclination towards the contralateral nipple and desired response was obtained that was muscle twitch of the fingers which were clearly visible. This response was elicited after advancing the needle only about 1.0 to 1.5 cm from the skin surface. Deeper insertion was avoided. The current strength was reduced to 0.4 mA. If the desired response persisted at 0.4 mA, the drugs were injectedafter performing negative aspiration for blood before each incremental injection of 5 ml to a total volume of 30 ml of the drug.

Onset of sensory block was assessed by spirit swab method. Assessment of motor block was done using the Bromage three point score:

[0 =normal motor function with full flexion and extension of elbow, wrist and fingers,
1 =decreased motor strength with ability to move fingers and/or wrist only
2 =complete motor blockade with inability to move fingers**]**. It was done by the same observer each time till complete motor blockade after the drug injection. Sedation was assessed by the Ramsay sedation score **(12).**

Ramsay sedation score

score	Response
1	Anxious or restless or both
2	Cooperative, oriented and tranquil
3	Responding to commands
4	Brisk response to stimulus
5	Sluggish response to stimulus
6	No response to stimulus

Blood loss assessment was done and fluid was administered as par needed. Duration of surgery was noted. Side effects like nausea, vomiting, dryness of mouth and complications like pneumothorax, hematoma, local anaesthetic toxicity and post block neuropathy were monitored.

The duration of sensory block was defined as the time interval between the end of anaesthetic administration and the complete resolution of anaesthesia on all nerves. The duration of motor block was defined as the time interval between the end of local anaesthetic administration and the recovery of complete motor function of hand and forearm.

Statistical methods employed: Independent sample't' test (to measure difference between two groups) and Contingency table analysis (for association between the rows and columns) were employed. $P < 0.001$ was considered highly significant and $p < 0.05$ was considered as just significant.

Results

Table 1: Demographic data of the study subjects

	Group DM	Group DX	P value
Age in years(mean ±SD)	32.19 ±11.11	32.88±10.12	0.962
Weight in kg(mean ±SD)	59.35±4.26	62.23±7.22	0.54
Height in cm(mean ±SD)	168.88±1.66	164.33±2.10	0.42
Gender(M/F)	24/26	30/20	0.38

Table 1 shows the demographic data of the patients. There was no statistically significant difference between the two groups with respect to age, weight, height and sex.

Table 2: Type of fracture in the study

Type of fracture	Group DM	Group DX
Fracture lower end of humerus	20 (20%)	16 (16%)
Fracture olecranon	14(14%)	18(18%)
Fracture radius and ulna	16 (16%)	16 (16%)
Total	50 (50%)	50 (50%)

Table 2 shows that fracture lower end of humerus was most common with a total of 36 cases followed by olecranon fracture and Fracture radius ulna with 32 cases was less common.

Table 3: Characteristics of sensory and motor block in both groups

	Group DM	Group DX	P value
Onset time of sensory block (min)	12.59±1.4	14-65±3.31	0.0124
Onset time of motor block (min)	14.12±1.6	18.01±4.51	0.052
Duration of sensory block (min)	899.5±61.7	738±24.4	0.0001
Duration of motor block (min)	863.11±54.2	692.2±30.08	0.0001
Duration of analgesia (min)	908.5±14.2	786.35±69.74	0.0001

Sensory and motor block time was earlier in group DM as compared to group DX (table 3; $p<0.05$). Sensory and motor block duration were longer in DM group than DX group (table 3; $p<0.001$). Duration of analgesia was significantly longer in DM group than DX group (table 3; $p<0.001$). However, intraoperative analgesia was excellent and similar in both groups and statistically.

Table 4: Quality of analgesia in both groups

Quality of analgesia	Group DM	Group DX	P value
Excellent	48	46	>0.05
Good	2	2	
Fair	0	1	
Poor	0	0	
Time of 1st analgesia request (hr.)	16.69±0.	14.50±0.03	<0.0001
Postoperative analgesic consumption during the first 24 hours [n (%)]	16(32%)	21(42%)	0.0118

Insignificant between the two groups (table 4; $p>0.05$). From the 6th hour onwards, patients of group DM showed a significant lower VAS than the DX group. Mean arterial pressure, mean arterial pulse rate and SpO2 recorded at o,5,10,15,30,60,90,120 and 150 minutes showed no statistically significant changes ($p>0.05$). No side effects like nausea, vomiting, hypotension of hypoxia were noticed in either group.

Table 5: Comparison of pulse rate in both the groups

Duration	Group DM	Group DX	P value
Baseline	85	84	0.758
15 min.	83	81	0.663
30 min.	78	80	0.629
60 min	68	73	0.232
120 min	62	76	0.051
180 min	66	72	0.065

Table 5 shows the comparison of pulse rates in both the groups and were found comparable without any statistical significance. However pulse rates at 60, 120 and 180 minutes were slightly lower in DM group but it was never below 60 per minute.

Table 6: Comparison of mean arterial pressure in both the groups

Mean arterial pressure	Group DM	Group DX	P value
Baseline	89	88	0.788
15 min	87	85	0.625
30 min	84	80	0.112
60 min	80	77	0.231
120 min	78	75	0.089
180 min	78	73	0.063

Table 6 shows the comparison of mean arterial pressure which was comparable in both the groups without any statistical significance.

Discussion

In our study, we demonstrated that in patients undergoing Supraclavicular brachial plexus block for upper arm surgery, addition of Dexmedetomidine or Dexamethasone to Ropivacaine, shorten the sensory and motor block onset time and extends the duration of block time. Nowadays brachial plexus block is an easy, safe and the most commonly performed peripheral nerve blocks in routine anaesthesia practice. Ropivacaine itself provides analgesia for 4-7 hours but addition of adjuvants like alpha-2 agonist Dexmedetomidine or a steroid Dexamethasone, to Ropivacaine for Brachial Plexus Block further enhances the onset, quality and duration of analgesia **(15)**.

In this study drugs selected for Supraclavicular brachial plexus block were Ropivacaine, Dexmedetomidine and Dexamethasone. Ropivacaine is similar in structure to Bupivacaine but without the cardio-toxic effects of Bupivacaine due to its lower lipid solubility **(1, 13).**

Supraclavicular approach of brachial plexus block was preferred as the narrowest part of plexus is located there and anaesthesia will be rapid, dense and predictable for the entire upper limb **(6).**By using nerve stimulator, we avoided problems associated with the conventional technique, like discomfort, nerve injury and higher failure rates **(14).**

Dexmedetomidine is an a2 selective agonist, a pharmacologically active d-isomer of medetomidine and is a highly specific and selective a2 adrenoceptor agonist with a2:a1 binding selective ratio of 1620:1 as compared to 220:1 for clonidine, thus decreasing the unwanted side effects of a1 receptors. One of the highest densities of a2 receptors have been located in the locus coereleus. The hypnotic and sedative effects of a2 adrenoceptor activation have been attributed to this site in the CNS. It is also the site of origin of the descending medullospinal noradrenergic pathway, known to be an important modulator of nociceptive neurotransmission. In the region of the brain, a2-adrenergic and opioidergic system have common effector mechanisms, indicating that Dexmedetomidine has a supraspinaly site of action .presynaptic activation of a2 adrenoceptor in central nervous system inhibits the release of norepinephrine, terminating the propagation of pain signals and their postsynaptic activation inhibits sympathetic activity, thereby decreasing the heart rate and blood pressure in higher doses **(15).**

Addition of steroid to local anaesthetic effectively and significantly prolongs the duration of analgesia as well as producing earlier onset of action (16). Steroids are very potent anti-inflammatory and immunosuppressive agents. Perineuraly injection of steroid is reported to influence postoperative analgesia. Various steroids has been used for this purpose, but dexamethasone, a synthetic glucocorticoid derivative is preferred because of its highly potent anti-inflammatory property, about 25-30 times more potent than hydrocortisone and without any mineralocorticoid activity. Thus we found it to be safer and devoid of any potential side effect. Preoperative administration of dexamethasone has been shown to reduce overall pain scores and analgesia requirements in the postoperative period without any adverse effects **(17).**Dexamethasone is also known to reduce postoperative nausea and vomiting. The possible mechanism of analgesia and antiemetic actions are due to the anti-inflammatory property of dexamethasone **(11, 16).**

In our study we noticed significantly early onset of sensory and motor block in group DM compared to DX group ($p<0.05$). Postoperative analgesia was markedly prolonged in DM group (908.5±14.2 min), while it was only (786.35±69.74 min) in DX group, (p value <0.001). Patient in both the groups did not require sedation intraoperatively and they were comfortable throughout the surgery without unarousable sedative effects. The mean pulse rate and mean arterial pressure rate were comparable, although in the early stage of the block, the scores were low in group DM as compared to group DX, but were statistically insignificant. None of the patient in both the groups suffered marked hypotension or bradycardia. Nausea and vomiting were also negligible and comparable in both the groups.

Conclusion

Although both dexmedetomidine and dexamethasone are good adjuvants for Ropivacaine in peripheral nerve blocks but our present study of comparison between the two agents,suggests that Dexmedetomidine is a better choice for shortening the onset of motor and sensory block with enhancing the quality and duration of Supraclavicular brachial plexus block without any adverse side effect.

Ethical Clearance: No deviation from standard care of treatment.

Conflict of Interest: None

Source of Support: Nil.

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