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Original Research Paper

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COMPARATIVE STUDY OF DEXMEDETOMIDINE VERSUS DEXAMETHASONE AS AN ADJUVANT FOR SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK.

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ABSTRACT

Introduction: Brachial plexus block is the most preferred anaesthetic technique for upper limb surgeries. Adding adjuvant to local anaesthetics for brachial plexus block may enhance the duration and quality of analgesia and also to decrease the dose of postoperative opioid analgesic.

Aims and Objectives: The purpose of this study was to evaluate the effect of dexamethasone or dexmedetomidine when added as adjuvant during supraclavicular brachial plexus blocks (BPB) in respect to the onset and duration of sensory and motor block along with duration of analgesia.

Methods: Sixty ASA physical status I-II patients of age group between 20 to 60 years with elective forearm and hand surgery under brachial plexus blocks were randomly allocated into two equal groups in a randomised double blind fashion. Group DM (n = 30), to receive 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with Adr + 1 ml of Dexmedetomidine (50mcg) + 1ml distilled water, making a total of 32 ml and another Group DX (n = 25), to receive 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with Adr. + 2ml of Dexamethasone (8 mg). A nerve stimulation technique was used in all patients. The onset time and duration of sensory and motor blocks, quality of intraoperative analgesia and duration of analgesia were assessed.

Results: The time of onset of sensory and motor block was significantly less in group DM as compared to group DX ($P < 0.05$). The duration of the sensory and motor block as well as duration of post operative analgesia was significantly more in group DM as compared with group DX ($P<0.05$), but there was no statistically significant difference between both the groups with respect to the heart rate, mean arterial pressure and spo2.

Conclusions: Dexmedetomidine 50 g was more effective than dexamethasone 8 mg in extending the duration of supraclavicular brachial plexus block and prolonging the duration of post operative analgesia and it also significantly decreases the onset time of block.

KEYWORDS : Supraclavicular brachial plexus block, local anaesthetic, dexmedetomidine, dexamethasone.

INTRODUCTION:

Brachial plexus block is the most preferred and safe anaesthetic technique for upper limb surgeries. It has its own advantages by avoiding untoward effects of general anaesthetic drugs and upper airway instrumentation. Various approaches of brachial plexus blocks have been described, but the supraclavicular approach is the easiest and most consistent method for anaesthesia and perioperative pain management for surgeries below shoulder joint**(1).** Brachial plexus in supraclavicular region is at the level of nerve trunks and is compactly arranged so that block can be reliably achieved with rapid onset and high success rate for elbow, forearm and hand surgeries**(**2).

Adjuvant analgesic strategy to prolong the analgesic duration, to reduce the potential risk of side effects of local anaesthetics by decreasing the dose of local anaesthetics has been tried by many investigators. Many drugs like epinephrine, Butorphanol tartrate, dexamethasone, tramadol, Buprenorphine, verapamil, methylprednisolone, Clonidine, dexmedetomidine are commonly used as adjuvant along with local anesthetic.3 Out of these adjuvants dexamethasone, dexmedetomidine has shown promising results and is completely devoid of complications. Dexmedetomidine is a highly selective α2 adrenergic agonist **(3).**Various studies have shown that Dexmedetomidine prolongs the duration of sensory and motor block when used as an adjuvant to local anaesthetics for nerve blocks **(4, 5, 6, and 7).** The anaesthetic and the analgesic requirement are reduced substantially because of its analgesic properties and augmentation of local anaesthetic effects. It causes hyperpolarization of nerve tissues by altering trans membrane potential and ion conductance at locus ceruleus in brain stem **(8).** The stable haemodynamics and the decreased oxygen demand due to decreased sympathetic outflow 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 act locally on nociceptive C-fibers (via glucocorticoid receptors) to increase the activity of inhibitory potassium channels, thus decreasing their activity in dose depended manner. Dexamethasone may act by inhibition of phospholipase A2 as well as changes in cell function induced by glucocorticoid receptor activation. Steroids induce some degree of vasoconstriction, so one hypothesis is that it acts in a similar manner to epinephrine by reducing local anaesthetic absorption **(9, 10).**

MATERIALS AND METHODS:

After obtaining institutional ethical committee approval and informed consent the study was conducted on 60 normotensive patients of ASA physical grade 1 and 2of either sex between 20-60 years of age. All the patients were randomly divided into 2 groups:

Group DM (n = 30), received 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with Adr. + 1 ml of Dexmedetomidine (50mcg) + 1ml distilled water, making a total of 32 ml. While Group DX (n = 30), received 15 ml of 0.5% bupivacaine and 10 ml of 2% lignocaine with Adr. + 2ml of Dexamethasone (8 mg).

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 pre-existing peripheral neuropathy, were excluded from the study.

Method: In the pre-operative room, intravenous access was secured with 18-G cannula on the contralateral hand and baseline parameters such as heart rate mean arterial pressure, oxygen saturation was observed and recorded.

In the operation theatre, a slow IV infusion of Ringer lactate was started and monitors were connected (pulse oximetry, electrocardiography and non-invasive arterial blood pressure

monitoring). Oxygen was administered via a Hudson mask at a rate of 5 L/min. The brachial plexus block was carried out after thorough explanation of the procedure and emphasizing the need for patient cooperation. Supraclavicular brachial plexus block was performed under aseptic precautions with the patient in supine position, and head turned slightly to the opposite side. A small pillow was placed in between the shoulders. The arm to be anaesthetized is adducted and the hand extended along the side towards the ipsilateral knee as far as possible. We used a nerve stimulator with a 22-G, 5 cm insulated needle for precise localization of the brachial plexus. A skin wheal with local anaesthetic was raised in the 1.5-2 cm posterior to the midpoint of the clavicle. The subclavian artery is usually palpable at this site. The nerve stimulator frequency was set at 1 Hz, and the intensity of the stimulating current was initially set to deliver 2 mA. The insulated needle was inserted through the skin wheal in a posterior, caudal and medial direction until a distal motor response is elicited. The position of the needle was considered acceptable when an output current ≤0.4 mA still elicited a distal motor response. At this point, the local anaesthetic mixture of 32 ml was injected in increments after negative aspiration for blood and air.

Onset of sensory block was assessed by pin prick discrimination method. Assessment of sensory block was done at each minute after completion of drug injection. Complete sensory block was considered when there was complete loss of sensation to pin prick in the dermatomal areas corresponding to median nerve, radial nerve, ulnar nerve and musculocutaneous nerve.

Assessment of motor block was carried out by the same observer at each minute till complete motor blockade after drug injection. Onset of motor blockade was considered when there was Grade 1 motor blockade. Peak motor block was considered when there was Grade 2 motor blockade. Motor block was determined according to the modified Bromage three point score for upper extremity:

Grade 0 =normal motor function with full flexion and extension of elbow, wrist and fingers.
Grade 1=decreased motor strength with ability to move fingers and/or wrist only.
Grade 2=complete motor blockade with inability to move fingers**.**
The block was considered incomplete when any of the segments supplied by median, radial, ulnar and musculocutaneous nerve did not have analgesia even after 30 min of drug injection. It was considered a failed block. Hemodynamic variables such as heart rate and blood pressure were monitored at 15, 30, 60, 120, 180 min after the block intraoperatively. Duration of surgery was also noted.

The intra- and post-operative assessment was done by an anaesthesiologist who was unaware of the drug used. Patients were assessed for duration of analgesia as per a numeric rating scale of 0 to 10. The numeric rating scale was recorded post-operatively every 60 min till the score of 4. The rescue analgesia was given in the form of inj. diclofenac sodium (1.5 mg/kg) intramuscularly at the VAS ≥4 and the time of administration was noted. It was considered as duration of analgesia.

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 Analysis: 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

Patient Characteristics	*Group DM*	*Group DX*	*P value*
Age in years(mean ±SD)	34.19 ±11.11	34.68±10.12	0.859
Weight in kg(mean ±SD)	62.35±4.26	64.23±7.22	0.224
Height in cm(mean ±SD)	167.18±1.66	166.83±2.10	0.350
Gender(M/F)	14/16	13/17	0.38
Duration of surgery	58.94±10.66	60.12±11.44	1.180

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, sex and duration of surgery.

Table 2: Characteristics of sensory and motor block in both groups

Group DM	Group DM	Group DX	P value
Onset time of sensory block (min)	14.01±2.11	16.65±3.31	0.0005
Onset time of motor block (min)	16.12±2.1	18.91±3.41	0.0003
Duration of sensory block (min)	898.5±41.7	788±26.4	0.0001
Duration of motor block (min)	863.11±47.2	742.2±28.08	0.0001
Duration of analgesia (min)	908.5±24.2	836.35±39.74	0.0001

Sensory and motor block time was earlier in group DM as compared to group DX (table 2; p<0.05). Sensory and motor block duration were longer in DM group than DX group (table 2; p<0.001). Duration of analgesia was significantly longer in DM group than DX group (table 2; p<0.001). However, intraoperative analgesia was excellent and similar in both groups and statistically insignificant.

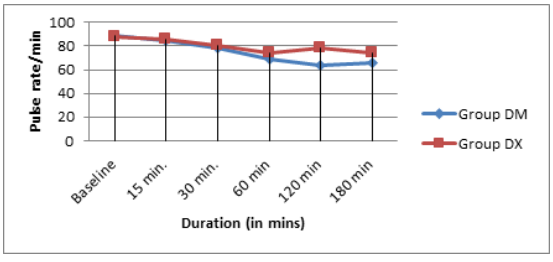

Figure 3: Comparison of pulse rate in both the groups

Figure 3 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.

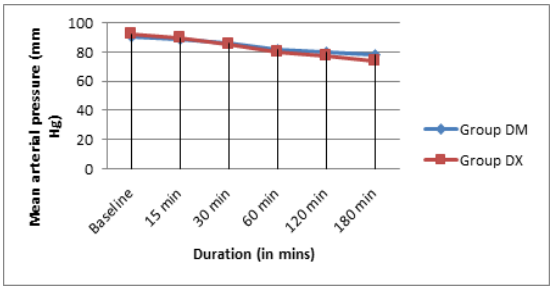

Figure 4: Comparison of mean arterial pressure in both the groups

Figure 4 shows the comparison of mean arterial pressure which was comparable in both the groups without any statistical significance.

DISCUSSION:

Addition of both the adjuvant to local anaesthetic caused early onset, prolonged sensory and motor block, delayed onset of postoperative pain, decreased requirement of opioid analgesic in post-op period and lower incidence of post operative nausea and vomiting.

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 **(7).**By using nerve stimulator, we avoided problems associated with the conventional technique, like discomfort, nerve injury and higher failure rates **(11)**.

Dexmedetomidine is d-isomer of medetomidine and is pharmacologically active 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. In CNS, locus coereleus has highest density of a2 receptors and its activation causes hypnotic and sedative effects. Descending medullospinal noradrenergic pathway, which is an important modulator of nociceptive neurotransmission also originates from this site. Dexmedetomidine also has supraspinal site of action as suggested by common effector mechanisms of a2-adrenergic and opioidergic system in brain. Decrease in heart rate and blood pressure in higher doses occurs due to activation of postsynaptic receptors which inhibits sympathetic activity. Whereas activation of presynaptic a2 adrenoceptor in central nervous system inhibits the release of norepinephrine, terminating the propagation of pain signals**(12)**.

Steroids when added to the local anaesthetic effectively and significantly prolongs the duration of analgesia as well as causes early onset of action as they have very potent anti-inflammatory and immunosuppressive effects**(13)**. Dexamethasone, a synthetic glucocorticoid derivative is preferred because of its 25-30 times more potent anti-inflammatory property than hydrocortisone and also it does not have any mineralocorticoid activity. Thus it avoids any potential side effects and becomes more safe to reduce overall pain scores and analgesia requirements in the postoperative period. In our study we found that addition of dexmedetomidine to the local anaesthetic mixture decreases the onset time for sensory and motor block and also increases the duration of sensory and motor block as well as duration of analgesia significantly when compared to dexamethasone in the patients undergoing supraclavicular brachial plexus block for arm and forearm surgeries

The fndings of our study were in concurrence with the studies done by **Niranjan kumar verma et al (14)** in respect to the onset and duration of sensory and motor block and duration of analgesia.

CONCLUSION:

Although both dexmedetomidine and dexamethasone are good adjuvants for supraclavicular brachial plexus block but our present study suggests that Dexmedetomidine is a better choice for earlier onset of motor and sensory block with enhancing the quality and duration of sensory and motor block as well as duration of post-operative analgesia 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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