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Original Research Article

EFFECT OF TWO DIFFERENT DOSES OF DEXAMETHASONE AS AN ADJUVANT TO 0.5% ROPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK - AN OBSERVATIONAL STUDY

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Abstract:
Background and Aims: The ideal dose of dexamethasone for brachial plexus block is not clear. This study was carried out to evaluate onset & duration of analgesic effect of 0.5% ropivacaine with two different doses of dexamethasone as an adjuvant.
Materials and Methods: Nerve stimulator guided supraclavicular brachial plexus block was given in 90 patients, randomly assigned to one of the two groups: (n= 45 in each group) Group RD2 and RD4 received 25 ml of 0.5% ropivacaine + 2 mg dexamethasone and 25 ml of 0.5% ropivacaine + 4 mg dexamethasone respectively. Different block characteristics were evaluated.
Result: Onset of sensory block and motor block was 16.8 ± 2.56and 23.4 ± 5.31 min, respectively, in Group RD2, while it was 11.25 ± 1.78 min and 16.23 ± 2.33 min, respectively, in Group RD4. The duration of analgesia was significantly prolonged in Group RD4 compared to Group RD2 (610.28 ± 108.56 vs 468.7 ± 80.41 min; $P < 0.001$).
Conclusion: Dexamethasone when added to ropivacaine fastens the onset of sensory & motor blockade. A dose of 4 mg of dexamethasone was more effective than 2 mg in prolonging the duration of sensory & motor blockade and duration of analgesia.

Keywords: ropivacaine, dexamethasone, brachial plexus block

Study Designed: Prospective observational study.

1. INTRODUCTION

Brachial plexus block is one of the most reliable and the most commonly performed techniques to control intra and postoperative pain. Bupivacaine and ropivacaine are the most commonly used local anaesthetic drug for the block. Bupivacaine is a well-established long-

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acting regional anesthetic, which like all amide anesthetics has been associated with cardiotoxicity when used in high concentration or when accidentally administered intravascularly. Ropivacaine is a long-acting regional anesthetic that is structurally related to bupivacaine. It is a S(−) enantiomer, unlike bupivacaine, which is a racemate, developed for the purpose of reducing potential toxicity & improving relative sensory & motor block profiles[1]. It blocks the peripheral afferents acting on voltage dependent sodium channels [2]. Apart from lower cardiotoxicity it is less toxic to central nervous system as compared to bupivacaine [3].

The analgesic effect of single‐shot injection of local anaesthetics is time limited. Various adjuvants have been studied to improve the quality and increase the duration of the local anaesthetic action in different regional blockade techniques. The analgesic effects of spinal and systemic corticosteroids in combination with local anaesthetics have been approved in human studies, whereas dexamethasone microspheres have increased blockade duration in both human and animal studies [4-7]. Furthermore, dexamethasone has been shown to possess an anti-inflammatory action [8]. The addition of dexamethasone to local anaesthetic administration in order to prolong analgesia duration has recently been explored. Most of the studies have used high dose of dexamethasone (8mg) but very few studies have tried to explore lower effective dose of dexamethasone for prolongation of block.

The present study was conducted to evaluate the duration of analgesia of two different doses of dexamethasone, 2 mg and 4 mg added to 0.5% Ropivacaine, in patients posted for upper-limb surgeries under supraclavicular brachial plexus block (SCBPB). Our study also sought to assess the onset and duration of sensorimotor blockade, hemodynamic variables, and adverse effects in both the groups

2. MATERIAL & METHOD

A prospective observational study was conducted in a tertiary care hospital. After obtaining institutional ethics committee approval and written informed consent, 90 patients of either gender, in the age group of 18–70 years, weight ranging between 50 and 80 kg belonging to ASA (American Society of Anaesthesiologists) Grade 1 and 2 posted for elective surgeries on upper extremity were enrolled for the study.

Patients who refused to give informed consent, ASA grade 3 or above, obese and short‐neck patients, patients with coagulopathy, neuropathy, or local infection at the site of block, and those with history of allergy to the study drug were excluded from the study. A detailed history, thorough physical examination, routine investigations, or any special investigations if required were done for the study.

For the purpose of the study, the patients were randomly allocated to one of the two groups. Group RD2 received 25 ml of 0.5% ropivacaine with 2 mg dexamethasone. Group RD4 received 25 ml of 0.5% ropivacaine with 4 mg dexamethasone. All blocks were performed by attending anesthesiologist skilled in performing SCBP blocks using peripheral nerve stimulator.

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Under all aseptic precautions 2 ml of 2% Lidocaine was infiltrated locally. A 22G 1.5-inch needle was introduced 2 cm above the midclavicular point directed just lateral to subclavian artery pulsation, caudal & medially until desired muscle twitch was elicited. The current intensity was set initially at 2 mA & stimulating frequency set at 1Hz then gradually decreased. The position of needle was considered to be acceptable when output current < 0.5 mA elicited a slight distal motor response in forearm & hand. After negative aspiration of blood, the study drug was injected. Sensory block was assessed by pinprick test using a 3-point scale [Table 1]. Motor block was evaluated by Modified Bromage Scale (MBS) [Table 2].

Table 1: Grade of Sensory Block: 3-point scale	
SCORE	EFFECT
2	Loss of sensation of touch (anesthesia)
1	Loss of sensation of pinprick (analgesia)
0	Normal sensation

Table 2: Modified Bromage Scale	
4	Full power in relevant muscle group
3	Reduced power but ability to move muscle group against resistance
2	Ability to move relevant muscle group against gravity but inability to move against resistance
1	Flicker of movement in relevant muscle group
0	No movement in relevant group

Sensory and motor blocks were evaluated every 3 min up to 30 min after injection, and then every 30 min after surgery, until they had resolved. Sensory onset time was defined as the time interval between the end of total local anesthetic administration and complete sensory block (Table 1; score 2). Duration of sensory block was defined as the time interval between the end of local anesthetic administration and the complete resolution of sensory block (Table 1; score 0). Onset of motor blockade was the interval between the end of injection and complete motor paralysis (Table 2; score 0). Duration of motor block was defined as the time interval between the end of local anesthetic administration and the recovery of full power in relevant muscle group (Table 2; score 4). Duration of analgesia was taken as the time interval between the end of local anesthetic administration and the first dose of rescue analgesic given to the patient.

Pain was assessed using the Visual Analogue Scale (VAS; 0-10) every 60 min during first 24 hour. Intramuscular (IM) diclofenac 75 mg was administered when the VAS > 4. Patients were observed for any incidence of hypotension, bradycardia, fall in peripheral SPO2, any

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discomfort, nausea, vomiting, shivering, pruritus, pain, or any other adverse effects and were managed according to clinical protocol.

Data were analyzed using SPSS version 22 for Windows (IBM Corp., Armonk, NY, USA). Quantitative data were represented as mean ± standard deviation, and for qualitative data, number and percentages were used. Student's t‑test was used for quantitative data. The Chi‑square test was used as test of significance for qualitative data. $P < 0.05$ was considered statistically significant.

3. RESULTS

A total of 90 patients (45 in each group) were included in the study. Patients of both groups were comparable with respect to the demographic profile for age, sex distribution, ASA physical status and the duration of surgery [Table 3]. There was no statistical significance found in baseline hemodynamic parameters.

Table 3: Demographic Data

Variables	Group RD2 (n=45)	Group RD4 (n=45)	P-Value
Age (years)	38.25±8.42	35±6.37	0.078
Gender (male/female)	28/17	30/15	0.65
Weight (kg)	56.54±6.78	59.20±9.38	0.24
Height (cm)	165.4±5.4	168.1±8.6	0.14
ASA (Ⅰ/Ⅱ)	38/7	36/9	0.58
Duration of surgery (min)	110.4±15.23	104.56±18.56	0.20

Data are represented as mean±SD. SD=Standard deviation,
ASA=American Society of Anesthesiologist

The onset of sensory block was significantly faster in Group RD4 than in Group RD2. The mean sensory onset time was 16.8±2.56 min in Group RD2 as compared to 11.25±1.78 min in Group RD4 ($P < 0.001$). The mean duration of sensory block was 330.5±45.91 min in Group RD2 as compared to 480.21±35.25 min in in Group RD4 ($P < 0.001$). Motor block onset was faster in Group RD4 which was statistically significant. The mean motor onset time was 23.4±5.31 min in Group RD2 as compared to 16.23±2.33 min in Group RD4 ($P < 0.001$). The mean duration of motor block was 289.6±40.63 min in Group RD2 as compared to 421.8±38.65 min in in Group RD4 ($P < 0.001$) [Table 4]. The duration of analgesia was significantly prolonged in Group RD4 (610.28±108.56 min) when compared with Group RD2 (468.7±80.41min) ($P < 0.001$) [Table 4].

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Table 4: Block Characteristics Comparison			
Variable	Group RD2 (n=45)	Group RD4 (n=45)	*P*
Onset of sensory block (min)	16.8±2.56	11.25±1.78	<0.001
Duration of sensory block (min)	330.5±45.91	480.21±35.25	<0.001
Onset of motor block (min)	23.4±5.31	16.23±2.33	<0.001
Duration of motor block (min)	289.6±40.63	421.8±38.65	<0.001
Duration of analgesia (min)	468.7±80.41	610.28±108.56	<0.001
Data are represented as mean±SD. SD=Standard deviation			

Perioperative hemodynamic parameters of blood pressure, HR, and ECG were stable. There was no complaint of difficulty in breathing or any clinical evidence of diaphragmatic palsy or pneumothorax in any patient. No side effects including nausea, vomiting, hypotension, and hypoxemia were reported in either group.

4. DISCUSSION

Our result showed significantly prolonged analgesia effect with 4 mg of dexamethasone as compared to 2 mg of dexamethasone added to 0.5% ropivacaine in supraclavicular brachial plexus block. The higher dose of dexamethasone also fastens the onset and prolongs the duration of sensory and motor block.

Dexamethasone is long‑acting glucocorticoid. Mechanism of prolonged regional anesthesia and analgesia produced by corticosteroids is not fully understood. Steroids induce vasoconstriction, thus reduce local anesthetic absorption. They also increase the activity of inhibitory potassium channels on nociceptive C‑fiber and inhibit synthesis and/or release of various inflammatory mediators. These mechanisms are known to increase duration of analgesia. This effect has been proposed to last up to 48 hours [9,10].

Many studies reported the prolonged duration of sensory and motor block when dexamethasone was used as an adjuvant with bupivacaine and ropivacaine in brachial plexus block, but they differed regarding the dose of dexamethasone [11-15].

Persec et al[16] used 4 mg of dexamethasone to levobupivacaine for block and found significant prolongation of sensory and motor block. Our results also suggest more prolongation of sensory and motor block with use of 4 mg of dexamethasone as compared to 2 mg. Feroz et al[17] in their study used 8 mg dexamethasone to ropivacaine for supraclavicular brachial plexus block and achieved total duration of motor block of 8.2±0.50 hour and sensory block of 12.3±0.40 hour. We observed near similar duration of analgesia with 4 mg of dexamethasone and lower dose of ropivacaine.

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Bindal et al[18] also used 8 mg of dexamethasone with ropivacaine and bupivacaine in supraclavicular brachial plexus block and found similar prolongation of sensory and motor block. A meta-analysis by Kirkham et al[19] suggested that 4 mg of dexamethasone represents a ceiling dose and prolongation of analgesia by a mean period of 6 to 8 hours and higher doses failed to provide additional analgesic duration.

Hemodynamic parameters were stable during the surgery and in postoperative period which gives an add on superiority over other adjuvants such as opioids which cause respiratory depression and α2 agonists which cause hypotension, bradycardia, and sedation.

Despite the concern surrounding the "off‑label" use of perineural adjuvants,[20] the safety profile of dexamethasone is promising. Animal studies show reduced blood flow to normal nerves for 4 h after topical application of intrafascicular injection of dexamethasone. This may produce harmful effects on nerve fibers, but there are no reports available regarding long ‑term effects on peripheral nerves.[21] No trial has reported neurotoxicity attributable to dexamethasone in human beings till date.

Our study was observational study with small sample size. Studies with more robust study design with good sample size are needed to support our study findings.

5. CONCLUSION

Dexamethasone 4mg when added to 0.5% ropivacaine fastens the onset of sensory & motor blockade and prolongs the duration of sensory & motor blockade as compared to 2mg of dexamethasone as an adjuvant.

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Conflicts of interest

There are no conflicts of interest

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