Original Research Article

Indian Journal of Anesthesia and Analgesia
2018; 5 (2): 181-185
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.5218.5

Effect of Dexamethasone as an Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgeries

Chandrashekarappa Kavi[1], Swetha Purohit[2], Rakesh P.S.[3]

[1]Professor [2,3]Assistant Professor, Dept. of Anaesthesiology, Subbaiah Institute of Medical Sciences, Shimoga, Karnataka 577222, India.

Abstract

Background: Brachial plexus block is widely employed regional nerve block technique for upper extremity surgeries. Supraclavicular approach is most preferred as it is easy and gives consistency in results with minimal side effects. Various adjuvants have been added to local anesthetics to Prolong the duration of anesthesia. In our study, Dexamethasone has been added to ropivacaine to evaluate its effect on duration of analgesia. *Aim:* Evaluating the effect of adding dexamethasone to ropivacaine in supraclavicular brachial plexus block compared with ropivacaine alone. *Materials and Methods:* A Randomised prospective and double blinded clinical study. Seventy patients of ASA I and II of either sex, aged 20-65 years, undergoing various elective upper limb surgeries were equally divided into two groups and given supraclavicular brachial plexus block. Group A patients ($n = 35$) received 30 ml of 0.5% ropivacaine with distilled water (2 ml)control group whereas Group B patients ($n = 35$) received 30 ml of 0.5% ropivacaine with 8 mg dexamethasone (2 ml) made study group. The primary outcome measures were the onset of sensory and motor block, duration of analgesia and pain scores. *Results:* The onset of sensory and motor block was seen to be faster in Group B than Group A. Patients in group A required first rescue analgesia earlier (410.28± 38.70 min) thanthose of Group Bpatients (996.60 ± 56.60 min), which was found statistically significant ($P < 0.002$). The total dose of rescue analgesia was higher in Group A as compared to Group B, which was statistically significant ($P < 0.00$). *Conclusion:* Addition of dexamethasone (8 mg) to ropivacaine in supraclavicular brachial plexus approach significantly and safely prolongs sensory, motor blockade and postoperative analgesia more than that produced by ropivacaine alone.

Keywords: Dexamethasone; Ropivacaine; Local Anesthetics; Peripheral Nerve Blocks; Supraclavicular Block.

Introduction

Brachial plexus block is a very popular and useful technique for both as a sole regional anesthetic technique as well as additive to general anesthesia. It is widely employed as it is easier to perform and provides superior quality of analgesia and avoids the common side effects associated with general anesthesia as it offers better pain relief and also reduces the number of days of stay in the hospital. Supraclavicular approach is considered to be easier and also gives consistent results for surgeries of upper limb [1]. Few complications reported in this technique are pneumothorax and hemothorax. Various local anesthetics alone or in combination with different adjuvants have been tried to prolong the duration of postoperative analgesia in the recent times. Bupivacaine, lignocaine, Ropivacaine have been used singly or in combinations.

Ropivacaine is a long acting local 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 cardio toxicity and improving relative sensory and motor block profiles [2]. Various adjuvants can be used with local anesthetics. Trials of mixinglocal anesthetic with adjuvant drugs like epinephrine, clonidine [3,4], opioids [5], midazolam

Corresponding Author: Swetha Purohit, Assistant Professor, Dept. of Anaesthesiology, Subbaiah Institute of Medical Sciences, Purle, Shimoga, Karnataka 577222, India.
E-mail: swethapurohit@yahoo.com

Received on 29.11.2017, **Accepted on** 11.01.2018

[6] have been done and have met with limited success. Corticosteroids have all been studied previously in an attempt to prolong th eduration of analgesia after peripheral nerve blockade with varying degrees of success [7].

It is widely believed that dexamethasone improves the quality and duration of peripheral nerve blockade [8]. They produce analgesia by blocking transmission of nociceptive myelinated c-fibers and suppressing ectopic neuronal discharge. More recent studies indicate that 8 mgdexamethasone added to perineural local anesthetic injections augment the duration of analgesia in peripheral nerve block [9]. Dexamethasone is very potent and highly selective glucocorticoid, its potency is about 40 times that of hydrocortisone [10].

In this study, we evaluated the onset of sensory and motor blockade, duration and quality of postoperative analgesia of Dexamethasone 8 mg added to Ropivacaine 0.5%compared to plain Ropivacaine 0.5% for brachial plexus block by supraclavicular approach.

Materials and Methods

After obtaining Institutional ethical committee clearance, a randomized prospective double blind study was conducted in our medical college hospital between February 2016 to January 2017. Inclusion criteria were 70 patients of either sex aged between 20 to 65 years undergoing various upper limb surgeries under supraclavicular brachial plexus block. Exclusion criteria were Patient refusal for the block, ASA grade 3, 4 and 5 , infection at the site of injection, bleeding disorders, peripheral neuropathies, co-existing systemic diseases and hypersensitivity to study drugs were excluded from the study. An informed and written consent was obtained from all the patients. These patients were randomly divided into 2 groups.

Group A(n=35):Patients received 30ml of Ropivacaine 0.5% and 2ml Distilled water (control group). Group B(n=35): Patients received 30ml of Ropivacaine 0.5% and 2ml Dexamethasone (8 mg). A detailed pre-anaesthetic evaluation and appropriate baseline investigations were carried out prior to the surgery.

Patients were blinded to the study by random allocation by computer generated number table. On the day of surgery preoperative heart rate, SpO2, noninvasive blood pressure, respiratory rate readings were recorded. On the operation table I.V.access secured with 18G I.V. cannula and ringer lactate 500ml infusion was started. Basic non-invasive monitoring with Pulseoximeter , Blood pressure and electrocardiography connected.

Supraclavicular block was performed using nerve stimulation technique in the supine position with head turned 45^0 to the opposite side and arm placed by the side of chest. Under asepsis a peripheral nerve locator (Fisher and Paykel, Newzealand) connected to a 22 G, 50-mm-long stimulating needle (Stimuplex, Braun, Germany) was inserted almost perpendicularly to the skin in a caudal and posterior-lateral direction, 1-1.5cm above the midclavicular point and subclavian artery pulsation. After proper location of the brachial plexus which was appreciated by desired motor response at 0.6 Ma current, 32ml prepared coded drug solutions were injected with intermittent negative aspiration.

The Following Parameters were Studied

- Onset of sensory block was defined asthe time from injection to onset of analgesia in each of the major peripheral nerve distributions (ulnar, radial, medial and musculocutaneous). Sensory block was assessed by pinprick using the blunt end of a 27-gauge needle at 5 min intervals up to 30 min. Sensory block was graded according to the following scale:

  0 = no block (normal sensation)

  1 = partial block (decreased sensation)

  2 = complete block (no sensation).

- Onset of motor block defined as the time from injection to the inability of the patient to move his/her fingers or raise their hand. Motor block was measured at 10 min intervals for 30 min by assessing the following motor functions: flexion at the elbow (musculocutaneous nerve), extension of the elbow and the wrist (radial nerve), opposition of the thumb and index finger (median nerve), and opposition of the thumb and small finger (ulnar nerve). Motor block was graded according to the following scale: 0 = no block (full muscle activity), 1 = partial block (decreased muscle activity), and 2 = complete block (no muscle activity).

Post operative follow up was carried out in the recovery room and post operative ward. The duration of analgesia was noted using visual analogue score (VAS) which is numeric scale of 0-10 for pain at every half an hour for first 10 hours and then hourly till 24 hours. When the patients began to experience the worst pain (VAS >8), it

wasconsidered that analgesic action of the drugs was terminated and rescue analgesic (IM Diclofenac 1-1.5mg/kg) given.

Total duration of motor block postoperatively was assessed every hourly by asking the patients to move their fingers and to see whether they are able raise the hand or not and time was recorded.

Any side effects like drowsiness, pruritus, nausea, vomiting, Horner's syndrome, phrenic nerve palsy, pneumothorax, respiratory depression and sign and symptoms for local anaesthetic toxicity if any were looked for and noted. The above assessments were carried out by the principal investigator who was blinded to the drugs administered in the plexus block.

Statistical Analysis

Assuming Alpha-error of 0.05 and power (1-ß) of 90%, the effective sample sizeon the basis of duration of analgesia came out to be 34 so it was rounded off to 35 to increase the power of the study. The duration of analgesia was analysed by unpaired Student *t*- test. Categorical data were presented as mean and standard deviation. The results were considered significant if *P* value is <0.05 and highly significant if *P* value is < 0.001.All the statistical analysis was done with SPSS version 21.

Results

Seventy patients were enrolled and participated in the study. Demographic characteristics and duration of surgery were comparable in both the study groups [Table 1]. The mean duration of onset of sensory and motor block and the mean duration of peak of sensory and peak of motor blockade were comparable in both the groups [Table 2]. Duration of analgesia was taken as time from the onset of sensory blockade to the reappearance of pain. The mean duration of analgesia (sensory block) was longer in Group B as compared to group A (990.89±98.69 min versus 409.55±34.88 min), which was highly statistically significant (*P* = 0.002) [Figure 1].

VAS scoring was zero in both the study groups in the immediate postoperative period and remained as such up to 7 hours of postoperative period and had no statistical significance.

In Group A, patients required first rescue analgesia at 7 hr 23 min (410.28 ± 38.70 min) while in Group B, patients required first rescue analgesia at 16 hr 39 min (996.60± 56.60 min), which was found statistically significant in Group (*P* = 0.000) [Figure 2]. The amount of rescue analgesic was more in Group A versus Group B (98.75 mg versus 43.75 mg) which was again statistically significant.

Table 1: Demographic data

	Group A	Group B
Age (Years)	43.45± 5.67	40.90±3.89
Gender (M:F)	16:19	20:15
Weight (Kgs)	58.90±3.88	60.77±1.67
ASA I/II	14/21	18/17

Table 2: Block characteristics

	Group A	Group B	P Value
Onset of sensory Block(min)	3.45±0.66	3.22±0.24	<0.05
Onset of Motor Block(min)	5.66±0.87	4.56±0.97	<0.05
Duration of Sensory block(min)/Duration of analgesia(min)	409.55±34.88	990.89±98.69	<0.05
Duration of motor block(min)	318.65±50.45	825.60±70.65	<0.05
Time of first resue Analgesia(min)	410.28±38.70	996.60±56.60	<0.05

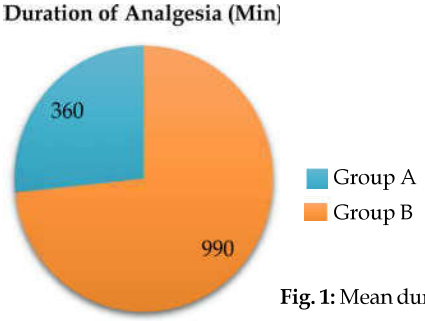

Fig. 1: Mean duration of Analgesia

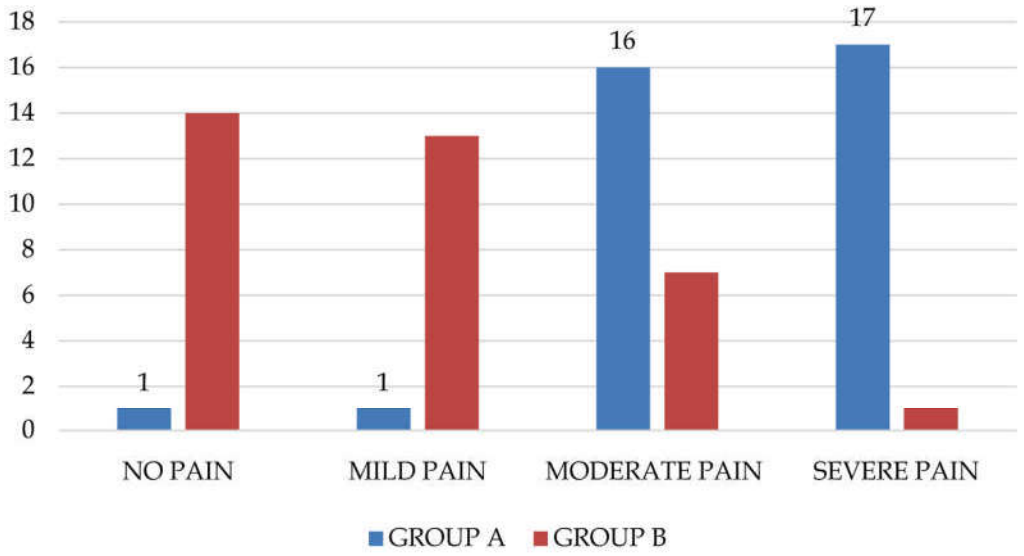

Fig. 2: Comparision of VAS Scores

Discussion

Brachial plexus block has emerged as a popular technique for upper limb surgeries. Peripheral nerve blocks not only provide intraoperative anaesthesia but also provide post operative analgesia. Several adjuvants like epinephrine, opioids, alpha2 agonists, dexamethasone etc. have been added to local anaesthetics to prolong the duration of action. Many studies have successfully proved the usefulness of dexamethasone as an effective adjuvant in peripheral nerve blocks [10]. The mechanism of action of corticosteroids in prolonging peripheral neural blockade may be secondary to a local action on nociceptive C-fibers mediated via glucocorticoid receptors and the up-regulation of function of potassium channels in excitable cells.

In our study the onset times of sensory and motor blockade was seen to be faster in the group with dexamethasone which is in support with one study by Shrestha BR et al [10] where onset of action was 10-30 minutes in local anesthetic group (mean 18.15±4.25) and 10-20 minutes (mean 14.5±2.10) in the local anesthetic plus steroid group. They found statistically significant difference between two groups.

However another study by Ali et al [11] found that the onset time of sensory and motor blockade was similar in both the groups. Our study showed prolonged duration of analgesia in Dexamethasone group when compared to plain Ropivacaine group. Kathrine Holte et al [12] found that addition of small amounts of dexamethasone to bupivacaine incorporated in microcapsules prolonged local analgesia compared with microcapsules with plain bupivacaine after subcutaneous administration in humans.

In another study by Droger C etal [13], it was found that incorporation of dexamethasone into bupivacaine microspheres significantly prolonged intercostal nerve block in sheep and the reason was believed to be due to a causative relationship between the suppression of inflammation and the remarkably longer duration of effect. The mechanism of the analgesia induced by corticosteroids is suspected to be mediated by their anti-inflammatory or immune-suppressive effects [14].

Few studies believe that the block prolonging effect of dexamethasone is due to its local action and not a systemic one [13]. They found that steroids produce analgesia by blocking transmission in nociceptive c-fibres and suppressing ectopic neuronal discharge. Local application of methylprednisolone has been found to block transmission in c-fibres but not in α and β fibres [15]. The effect was reversible, suggesting a direct membrane action of steroids. There are others who believe that analgesic properties of corticosteroids are the result of their systemic effect [16].

The safety of dexamethasone use in a nerve sheath may raise some concerns. Nerve injury is a rare complication of dexamethasone injection, and it usually occurs in the context of needle trauma.

Various doses of dexamethasone (4-16mg) as an adjuvant to local anaesthetics for peripheral nerve block have been used by various studies.We used a

dose of 8 mg because administration of this dose seems to be safe in adults and also used in many previous studies. Adverse effects with a single dose of dexamethasone are probably extremely rare and minor in nature, and previous studies have demonstrated that short-term (< 24 hours) use of dexamethasone was safe [17].

The main limitation of our study was that we could not use ultrasound guidance for the block procedure though it is recommended as gold standard due to non availability in our institution.

Conclusion

Our study concludes that addition of dexamethasone to ropivacaine as an adjuvant in supraclavicular brachial plexus significantly shortens the onset of sensory and motor blockade and prolongs the duration of postoperative analgesia in patients undergoing upper limb surgeries when compared to Ropivacaine alone. It was found to be well tolerated and cost effective method without the occurrence of remarkable adverse effects. Future scope of study is to evaluate the mechanism of action as well as the optimal dose before its routine use as a perineural adjunct that can be advocated to prolong block characteristics and also to study the side effects if any in late post-operative period.

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