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A study of Dexamethasone as an adjuvant with Bupivacaine for Supraclavicular Brachial Plexus Block

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Abstract:
Background*: Brachial plexus block with Bupivacaine provides effective intraoperative anesthesia and analgesia. Studies have found that the addition of Dexamethasone as an adjunct to Bupivacaine prolonged the duration of anesthesia and analgesia when compared to bupivacaine alone.*
Objective*: to compare the onset and duration of sensory and motor blockade following administration of either bupivacaine alone or in combination with dexamethasone in supraclavicular brachial plexus block using peripheral nerve stimulator.*
Material and Methods*: 100 ASA I and II patients, aged between 18 and 60 years, who underwent elective upper limb surgeries were randomly allocated into two equal groups. Group A received 28 ml of 0.5% Bupivacaine and 2 ml of normal saline whereas Group B recieved 28 ml of 0.5% Bupivacaine with 2ml (8mg) of Dexamethasone for supraclavicular brachial plexus block. The onset and duration of sensory and motor blockade were observed between the two groups.*
Results*: The onset of sensory blockade was faster in Group B (7.96 min) when compared to Group A(9.08)(p<0.0001). The duration of sensory(364 min vs 1089min) and motor blockade (314min vs 1030 min) was longer in Group B (p<0.0001). There were no significant complications in the study group.*
Conclusion*: Dexamethasone, when added to Bupivacaine in the supraclavicular brachial plexus block, shortens the onset time and prolongs the duration of sensory and motor blockade without any systemic side effects.*
Keywords: *brachial plexus block; regional anesthesia; bupivicane; dexamithasone; sensory block; motor block*

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I. Introduction

Regional block after a single dose of local anesthetic is of limited duration and efficacy. Hence, the co-administration of adjuvants with local anesthetics may be helpful for the potentiation of the analgesic effect.(1) Drugs like fentanyl, clonidine, and midazolam are used to prolong the postoperative analgesic effect of Supraclavicular Block (SCB) for the forearm and hand surgeries. However, the usage of these adjuvants is not conclusive or free from side effects. Furthermore, these adjuvants have found to yield unsatisfactory motor and short sensory block, sedation, hypotension and bradycardia.(2-4)

Recently several studies have observed early-onset and prolong duration of analgesia with the use of Dexamethasone, a long-acting glucocorticoid in Supraclavicular Block. It is commonly used to reduce postoperative nausea, vomiting, pain and to improve the quality of recovery after surgery. (5) The mechanism to show such effects may be by attenuating the release of inflammatory mediators, reducing ectopic neuronal discharge and inhibiting potassium channel-mediated discharge of nociceptive C-fibres .(6) (7)However, many studies have shown variable time to onset and duration of analgesia. (8-10)

This study was aimed to compare the effect of local anesthetic with or without Dexamethasone in Supraclavicular brachial plexus block in respect of onset and duration of sensory and motor block and duration of postoperative analgesia.

II. Material And Methods

This is a prospective randomized comparative study done at UCMS over a period of 2 years from April 2015 to March 2017 after taking Institutional ethical clearance and informed written consent

from the participants. 100 adult patients of either sex, aged 18 to 60 years with American Society of Anesthesiologists (ASA) physical status I and II posted for elective orthopedic surgeries of the elbow, forearm, wrist and hand under Supraclavicular brachial plexus block were enrolled in this study. Patients were equally allocated in a randomized manner by a sealed envelope technique into two groups. Sample size was calculated as follows:

$n=z^2pq/e^2$ =99.9936
where z=1.96 at 95% Confident Interval
p(prevalence) =percentage of cases done under supraclavicular brachial plexus block anaesthesia among the cases undergoing all kind of anaesthesia at UCMS= 7%
q= (1-p)
e= permissiable error of 5 %

Patients in Group A received 28 mL 0.25% bupivacaine and 2 mL 0.9% normal saline whereas patients in Group B received 28 mL 0.25% bupivacaine and 2 mL dexamethasone (8 mg). Exclusion criteria included in this study were patients' refusal, ASA physical status III and more,patients with a history of peptic ulcer disease, uncontrolled diabetes mellitus and hypertension, cardiorespiratory disease, hepatic or renal failure, pregnancy, coagulopathy, significant neurological and psychiatric disease, patient on psychotropic drugs or chronic analgesic therapy, known hypersensitivity to the study drugs, adequate block not obtained within 30 minutes of injection, any perioperative complication related to the block and duration of surgery more than 2 hours.

All patients were advised for nil per oral after midnight before the surgery day. On the day of surgery, the procedure for the block was explained and monitors were attached. Brachial plexus block was done with the help of nerve stimulator (StimuplexKanuleA50, B Braun, Melsungen, Germany). The 22-gauge 5 cm, an insulated needle was used and the position of the needle was considered to be acceptable when an output current < 0.5 mA still elicited a slight distal motor response in forearm and hand. The intensity of pain was assessed by 1-10cm Pain Visual Analog Scale (1- no pain and 10- worst imaginable pain).Heart rate, peripheral oxygen saturation, respiratory rate, and blood pressure was measured before the block (baseline), then 5, 10, 15, 30, 60, 90, 120,150, 180,240,300 minutes after the block.

Comparison of time of onset and duration of the sensory blockade between two groups was our primary outcome measures whereas the comparison of time of onset and duration of motor blockade between the groups was our secondary outcome measures.

Onset time of sensory block was defined as the time interval between the end of local anesthetic injection and loss of sensation to pinprick in all of the nerve distributions. Onset time of motor blockade was defined as the time interval between the end of local anesthetic injection and paresis in all of the nerve distributions. The duration of sensory block was defined as the time interval between the onset of sensory block and the first postoperative pain(VAS $\geq$ 4cm). The duration of motor block was defined as the time interval between the onset of motor block and complete recovery of motor functions.

The duration of Surgery was considered from the starting of skin incision up to the end of skin closure. Sensory and motor blockade of radial, median, musculocutaneous, medial cutaneous nerve of arm and forearm, and ulnar nerves were assessed every 2 minutes after completion of injection till 30 minutes and then every 30 min after the end of surgery till first 12 hours, thereafter hourly until the block had completely worn off. After 30 minutes, if the block was considered to be adequate, surgery commenced. If inadequate block, supplemental rescue nerve block will be performed and those patients were excluded from data analysis.

Injection Ketorolac 30 mg IV was given as rescue analgesia when VAS$\geq$4 cm in the postoperative period. The number of injection Ketorolac given to each patient during the first 24 hours of the postoperative period was recorded. Any side effects, after the injection of drugs till 24 hours postoperatively was recorded. Two sample t-test was applied using STATA version 15 for data calculation.

III. Results

Demographic characteristics and duration of surgery were comparable in both the groups and the difference was not statistically significant (p>0.05), (Table 1).

Table 1: demographic charecteristics

Variables	Group A		Group B		
	Mean	SD	Group B	SD	P-Value
Age(in years)	33.80	9.92	34.75	7.52	0.735
Weight(in Kg)	59.8	8.55	58.25	6.67	0.052

Duration of surgery (in min)	103.8	41.45	96.5	46	0.6825

The onset of sensory occurs earlier in group B as compared to group A. The difference in onset of sensory blocks between the two groups was statistically highly significant ($p<0.05$). The onset of the motor was slightly earlier in group B however was not significant statically (Table 2)

Table 2: Showing Onset of Block

Onset of blockade (in min)	Group A		Group B		
	Mean	SD	Mean	SD	P-Value
Sensory	9.08	+/-1.46	7.96	+/-1.56	0.0004
Motor	13.8	+/-2.66	12.94	+/-2.52	0.0572

Duration of sensory and motor blockade was longer in group B and shorter in group A. The difference in duration of sensory and motor blocks were statistically significant in both groups. (Table 3)

Table3. Showing Duration of Blocks

	Group A		Group B		
Duration of Block (in min)	Mean	SD	Mean	SD	P-Value
Sensory	364.52	110.62	1089	180.04	<0.0001
Motor	314.38	108.94	1030.52	197.93	<0.0001

Pulse rate, blood pressure, oxygen saturation were monitored throughout the surgery and also postoperatively. All values were within the normal range. There was no statistically significant difference between the mean preoperative, intra-operative and postoperative values. The vitals were well maintained in all the patients.

The timing of the first rescue analgesia was significantly late and the total consumption of analgesia was significantly less in the first 24 hours in dexamethasone group as shown in Table 4.

Table 4. Timing and amount of analgesia

Variables	Group A		Group B		
	Mean	SD	Mean	SD	P-Value
Timing of 1st rescue analgesia (in Min)	364.52	±110.62	1089	±180.04	<0.0001
Total amount of Analgesia (in mg)	79.8	±14.35	34.2	±10.51	<0.001

IV. Discussion

Moderate to severe pain after orthopedic surgeries can be reduced by regional neural blockade with local anesthetics.(11) Interventions that increase the duration of local anesthetics action could prolong postoperative pain control.(12)We use dexamethasone as an adjunct to bupivacaine for the supraclavicular block.

The major finding of our study was that the duration of sensory and motor blocks gets significantly prolonged with the addition of dexamethasone in bupivacaine. These results show a similar finding as in many previous studies using dexamethasone with bupivacaine for brachial plexus block.(8, 13, 14) This prolongation of analgesia may be explained by corticosteroid's local action on nociceptive C-fibers and upregulation of the function of potassium channels in excitable cells. However, most of these studies have demonstrated variation in the duration of analgesia.(14-16)

Choi S et al.collected data from nine trials which include 801 patients with patients receiving either local anesthetic alone or in combination with perineural dexamethasone (4-10mg).(8) They conclude that dexamethasone significantly prolonged the analgesic duration of bupivacaine from 730min to 1306min (mean difference 576minutes). In our study, the duration of analgesia was increased by 3 fold in the dexamethasone group. The difference in study methodology may have accounted for this variation in the duration of analgesia among various studies like the use of the larger volume of injectate, variation in dexamethasone dose and use of adjuncts such as epinephrine or bicarbonate. Also, the mean onset of sensory block was significantly earlier in Group dexamethasone as shown in our study result. This could be due to the synergistic action of local anesthetics and dexamethasone.

Although many studies reported the prolonged duration of sensory and motor block when dexamethasone was used as an adjuvant with bupivacaine in brachial plexus block, they show variable results regarding the onset of sensory and motor block.(17) In his study, Vieira *et al* performed a brachial plexus block in 88 patients scheduled for shoulder arthroscopy using 20 ml of the local anesthetic mixture with dexamethasone adjuvant. There was no significant reduction in the onset of sensory and motor blockade in the

dexamethasone group compared to the control group. (13) This discrepancy could be due to the difference in the local anesthetic volume and technique of block.

The hemodynamic parameters such as heart rate, systolic BP, and diastolic BP were stable in both groups in our study.

In our study first, rescue analgesia was delayed and eventually total consumption of analgesia was significantly less in the dexamethasone group in the first 24 hours.

There are some limitations to this study. Firstly, post-operative blood glucose levels and long-term neurological sequelae were not analyzed. Secondly, we did not evaluate the interaction between the dosage of dexamethasone and block duration.

V. Conclusion

Dexamethasone shortens the onset and prolongs the duration of sensory and motor blockade effectively and enhances the quality of blockade when used as an adjuvant to bupivacaine in the supraclavicular block, with minimal hemodynamic changes, thus making dexamethasone a potential adjuvant for peripheral blocks

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