

Original Research Article

Effect of dexamethasone as an adjuvant to 0.5% levobupivacaine in supraclavicular brachial plexus block for upper extremity surgeries

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ABSTRACT

Background: The supraclavicular brachial plexus block has proven to be an important, safer and effective alternative to general anaesthesia in surgeries of upper extremity. Primary aim is to study the effect of addition of dexamethasone to levobupivacaine on postoperative analgesia and secondary objectives are to study onset, peak effect and duration of sensory and motor block in brachial plexus blockade in adult patients posted for upper limb surgeries

Methods: This prospective randomized clinical study was conducted on 60 patients of age 18 to 60 years posted for upper limb surgeries. They were randomly allocated into two groups of 30. In Control group LS (n=30) received Inj. Levobupivacaine 30ml and Inj. Normal saline 2ml. In Study group LD (n=30) received Inj. Levobupivacaine 30ml and Inj. Dexamethasone 2ml (8mg).

Results: Both the groups were demographically comparable. Onset of sensory block and motor block in group LD and in group LS were similar ($p>0.05$). Mean duration of sensory and motor block in group LD was higher than in group LS (<0.001). Duration of postoperative analgesia was 21.20 ± 3.23 hours in group LD and 10.24 ± 1.57 hours in group LS ($p<0.001$).

Conclusions: Dexamethasone added to levobupivacaine for brachial plexus block prolonged the duration of sensory, motor blockade and postoperative analgesia but did not alter the onset time, peak effect time of sensory and motor blockade.

Keywords: Dexamethasone, Levobupivacaine, Postoperative analgesia, Supraclavicular brachial plexus block, Upper extremity surgery

INTRODUCTION

Supraclavicular approach for brachial plexus block is the most commonly used regional anaesthetic technique to provide surgical anaesthesia for upper extremity surgeries.¹ The supraclavicular brachial plexus block provides ideal conditions for surgery, maintains stable intraoperative hemodynamics and extends analgesia in the postoperative period, hence proven to be an important, safer and effective when compared to general anaesthesia in surgeries of upper extremity. It includes

blocking of the brachial plexus where it is most compactly arranged, with relatively less requirement of the anaesthetic solution and rapid onset of action.²

Peripheral nerve blocks with local anaesthetics provide excellent operating conditions, facilitate early mobilization and reduce the stay in post anaesthesia care unit (PACU), but the duration of analgesia is rarely maintained for more than 4-8 hours even with the longest acting local anaesthetics. To improve block characteristics and prolong the duration of postoperative

analgesia, many adjuvants are added to local anaesthetics in peripheral nerve blocks. Adjuvants can be opioids like morphine, fentanyl, butorphanol and non-opioids like clonidine, dexmedetomidine etc have been used but these have side effects like heavy sedation, respiratory depression and psychomimetic effects.³

Various steroids have been used for this purpose but dexamethasone a synthetic glucocorticoid, relieves pain by blocking transmission in nociceptive C-fibers, by suppressing ectopic neural discharge and reducing inflammation.⁴ It has highly potent anti-inflammatory property without mineralocorticoid activity, no significant neurotoxicity and elevation of blood glucose concentrations.

Levobupivacaine is recently introduced in Indian market and not many studies for its usage in brachial plexus block are available. It has a potentially reduced toxic profile compared to bupivacaine.⁵ Various pharmacokinetic, animal and clinical studies not only confirm the cardiac toxicity of racemic bupivacaine but experimental studies with levobupivacaine also indicate lower cardiovascular depressant effect and central nervous system toxicity.^{6,7}

The aim of this study was to know the effect of dexamethasone when added to levobupivacaine in supraclavicular brachial plexus block using peripheral nerve stimulator (PNS) on the duration of postoperative analgesia.

METHODS

The present study was carried out in a tertiary hospital during the period of January 2015 to July 2016. It was a prospective randomized double blind clinical study of 60 patients undergoing upper extremity surgery. The study was conducted after taking the approval of institutional ethical committee and written informed consent from the patients before including any patient in the study.

Patients were randomly allocated using shuffled sealed opaque envelope technique into one of the following two groups depending upon the drugs, they were to receive for brachial plexus block. The study drugs were prepared by an anaesthesiologist who was involved in randomization of the patient and not involved further in the study. Thus the observer and the patient were blinded to the study drug. Group LD (n=30) patients received Inj. Levobupivacaine Hydrochloride 0.5% 30 ml with Inj. Dexamethasone 8mg 2ml; Group LS: (n=30) patients received Inj. Levobupivacaine Hydrochloride 0.5% 30ml with Inj. Normal Saline 2ml.

Patients between 18 to 60 years of age of either gender and of American society of anaesthesiologists (ASA) physical status Class I and II posted for both elective and emergency surgeries and with normal sensory and motor function in affected limb were selected. Patients with

known hypersensitivity to local anaesthetic drug, bleeding disorder/ patients on anticoagulants, pregnant, lactating mothers, anatomical abnormality of the neck, Body mass index (BMI) >30 kg/m² are excluded from the study.

All the patients underwent a thorough pre-anaesthetic checkup. Patients were kept nil by mouth for a minimum of 6 hours for solids and 2 hours for clear liquids before taking them for surgery. On the morning of the surgery, anaesthesia machine checked and after wheeling in the patient into the operation theatre, pulse oximetry, electrocardiograph and noninvasive blood pressure monitors were attached and the baseline pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, ECG (lead II) and oxygen saturation were noted down. A wide bore IV cannula was secured and an infusion of Ringer lactate(RL) was started. Premedicated with Inj. Ondansetron 0.1mg/kg IV, Inj. Midazolam 0.01mg/kg IV.

Patient was placed in supine position without a pillow, arms at the side and head turned slightly to the opposite side. The anaesthetist stood at the head end of the patient and the area was aseptically prepared and draped. The subclavian artery pulsation was felt 1 cm above the midpoint of the clavicle.

An intradermal wheal was raised just above the palpating finger with a 26G needle. A 2 inch 24G short bevel nerve stimplex needle was inserted through the skin wheal just 1cm above subclavian artery pulsations in between anterior and middle scalenei. The following setting was used in nerve locator - Begin at 1.5 mA current strength – A clear motor twitch of all fingers was taken as end motor response. As soon as we observed the twitch the current strength was decreased to 0.5mA with continued observation of twitch. Even at 0.5 mA current when we got a satisfactory twitch of all fingers, the simulator was turned off, and the drug injected with repeated negative aspiration for blood and air. Sensory block was assessed by pin prick method using 24G hypodermic needle, every minute till peak effect occurs. Patient was asked to answer questions and grading of sensory effect was done as follows-

Grade-0: Normal sensation (Sharp pain felt); Grade-1: Blunted sensation (Dull sensation or slight heaviness); Grade-2: No pain perception (State of anaesthesia)

Assessment of sensory block was done along the distribution of median nerve, radial nerve, ulnar nerve and musculocutaneous nerve. Following time intervals were noted: Time to sensory onset was considered as the time duration between injection of drug to time for blunted sensation over any one of the nerve territories. Time to peak sensory effect was considered from the time of injection of study drug till when there was complete loss of sensation to pin prick along all the above-mentioned nerve territories. Duration of sensory block

was taken as the time from the time of injection of study drug till the patient developed grade 0 sensory block over all the areas supplied by 4 nerves.

Motor block was assessed by using following grading scale as described by Bromage.

Grade 0: Normal muscle tone with full flexion and extension of elbow, wrist and fingers; Grade 1: Decreased muscle strength (with weak grip) i.e. Paresis; Grade 2: Complete motor block with inability to move the fingers.

Motor block was assessed by 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). Following times were noted: Onset of motor block was taken as the time elapsed between injection of drug and attainment of grade 1 block. Peak motor block was considered as the time elapsed between injection of drug and complete loss of motor power or grade 2 motor block. Duration of motor block was taken as the time from injection of drug till return of grade 0 motor block of all the muscles supplied by the 4 nerves. Pulse rate, Blood pressure, Respiratory rate and oxygen saturation (SpO₂) were monitored regularly before giving the block, 5 minutes after the block then every 5 minutes till 15 minutes and then every 15 minutes till the end of surgery and the same parameters again recorded immediately post-operatively before shifting the patients. These were again checked when we visited the patients at regular intervals for noting VAS score. Postoperative analgesia was measured from the time of injection of anaesthetic drug to the first demand of rescue analgesic. In the postoperative period, patients were visited first at 30 and 60 minutes, then

every 1 hourly till 6 hours then every 2 hourly till 12 hours then at 18 and 24 hours. The post-operative analgesia was assessed using 10-point visual analogue scale (VAS) which is the most commonly used method of assessing intensity of acute pain and its relief. All the patients were observed for any side effects and complications like hypotension, bradycardia, respiratory depression, nausea, vomiting, allergic reactions, pneumothorax, local hematoma formation and any neurological sequel in the intra and post-operative period.

Statistical analysis

A pilot study with 10 patients was first conducted to define the population and decide on the criteria for patient selection. Statistical power was calculated to be 99.9% for motor block period as 0.05, 0.001 and was calculated to be 99.9% for sensory block period as 0.05, 0.001. From the results obtained in the Pilot study, a target population of 30 subjects in each group was decided. Data obtained in the above-mentioned fashion were properly tabulated. All the qualitative data were analyzed using chi square test. The quantitative data were analyzed using unpaired t-test. Results were expressed as Mean \pm SD. P values <0.05 were taken as statistically significant and values <0.001 were taken as highly significant. All analyses were done using SPSS version 20 statistical software. All values were rounded off to a maximum of two decimals.

RESULTS

Demographic characteristics and duration of surgery were comparable in both the study groups (Table 1). The mean duration of sensory block in group LD was 10.17 \pm 1.13 hours and in group LS was 6.5 \pm 0.6 hours and was statistically significant (P <0.001).

Table 1: Demographic data.

Parameter	Group LD	Group LS	P value
Number of patients	30	30	
Age (in years, Mean \pm SD)	33.43 \pm 12.55	35.4 \pm 11.33	>0.05
Sex (Male: Female)	20:10	23:7	>0.05
Weight (in kg, Mean \pm SD)	61.0 \pm 7.22	60.06 \pm 4.7	>0.05

Table 2: Onset time, peak effect time and total duration of sensory, motor blockade.

Parameter	Group LD	Group LS	P value
Onset time of sensory block (in mins)	4.3 \pm 1.53	4.57 \pm 1.41	>0.05
Onset time of motor block (in mins)	6.66 \pm 1.26	6.88 \pm 0.84	>0.05
Peak effect time of sensory block (in mins)	9.3 \pm 2.2	9.07 \pm 1.07	>0.05
Peak effect time of motor block (in mins)	12.9 \pm 1.4	13.1 \pm 1.52	>0.05
Total duration of sensory block (in hrs)	10.17 \pm 1.13	6.5 \pm 0.6	<0.001
Total duration of motor block (in hrs)	8.35 \pm 0.81	7.42 \pm 0.78	<0.001
Total duration of analgesia (in hrs)	21.2 \pm 3.23	10.24 \pm 1.57	<0.001

The mean duration of motor block was 8.35 ± 0.81 hours in group LD and 7.42 ± 0.78 hours in Group LS and was statistically significant ($p < 0.001$). The total duration of postoperative analgesia was 21.2 ± 3.23 hours in group LD and 10.24 ± 1.57 hours in Group LS ($p < 0.001$) (Table 2).

Rescue analgesia started from 6th hour postoperatively in group LS and at the end of 12th hour all patients in group LS had received their rescue analgesia with Inj diclofenac 75mg intramuscular. While in group LD, rescue analgesia started from 18th hour postoperatively and even at the end of 24 hours only 20 patients required rescue analgesia. The rest 10 patients did not require any rescue analgesic in the first 24 hours postoperatively. Thus, requirement of rescue analgesia was much earlier in group LS as compared to group LD ($p < 0.001$: highly significant) (Figure 1).

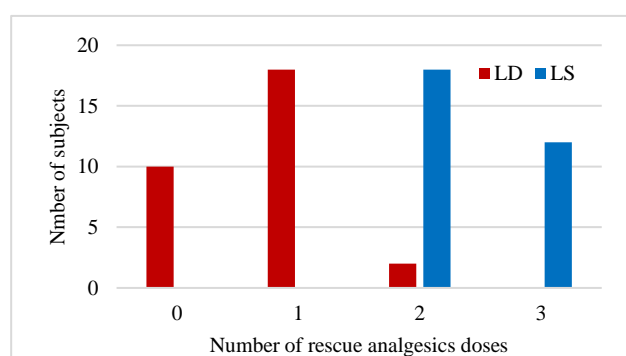


Figure 1: Rescue analgesic requirements in 24 hours.

There was no significant difference in heart rate, blood pressures, respiratory rate, and oxygen saturation when preoperative values were compared with intra-operative and postoperative values. Patients were observed for complications like nausea, vomiting, pneumothorax, haematoma, post block neuropathy, local anaesthetic toxicity. None of the patients had any complications.

DISCUSSION

Supraclavicular brachial plexus block is an effective, time tested regional anaesthetic technique for surgeries of upper extremities. It is not only an excellent alternative, but also offers several perioperative advantages over general anaesthesia like reduced stress response, less blood loss, provides superior surgical conditions, optimal postoperative analgesia, reduces the incidence of postoperative nausea, vomiting, providing early ambulation and reduced length of hospital stay, leading to satisfactory patient acceptance and improved clinical outcome.

Levobupivacaine has got a relatively longer duration of action when compared with lignocaine. It has less cardiotoxicity when compared to bupivacaine, therefore levobupivacaine, a relatively cardiostable local anaesthetic is chosen and observed its properties in terms of sensory, motor blockade and postoperative analgesia when used

alone and in comparison, with dexamethasone added as adjuvant. In this randomized double blind study, we demonstrated that addition of dexamethasone 8mg to levobupivacaine 0.5% prolonged the duration of sensory and motor block and also mainly the postoperative analgesia, but it has no effect on the onset and peak effect time of sensory and motor block. Movafegh A et al evaluated the effect of dexamethasone added to lidocaine on the onset and duration of axillary brachial plexus block and concluded that addition of dexamethasone prolonged the duration of sensory and motor blockade.⁸ Pathak RG et al has compared supraclavicular brachial plexus block with and without dexamethasone using a mixture of 1.5% adrenalized xylocaine (20ml) and 0.5% Bupivacaine (16ml) and concluded that addition of dexamethasone to mixture of local anaesthetic drugs in the brachial plexus block through supraclavicular approach has significantly prolonged motor blockade and duration of postoperative analgesia.³

Biradar et al added dexamethasone to lidocaine in supraclavicular brachial plexus block and concluded that addition of Dexamethasone to 1.5% Lidocaine with Adrenaline in supraclavicular brachial plexus block reduced the onset time of sensory and motor blockade and prolonged the duration of postoperative analgesia and motor blockade.³ The onset time of sensory and motor block is reduced in this study due to the usage of lignocaine with adrenaline whereas levobupivacaine without adrenaline is used in our study.

Persec et al had done randomized controlled study, assessed 70 patients undergoing upper-extremity surgeries using ultrasound-guided single-shot supraclavicular blockade and investigated the analgesic effect of low dose dexamethasone added to levobupivacaine.¹⁰ They concluded that using single-shot low-dose dexamethasone in a mixture with levobupivacaine resulted in prolonged analgesia duration and less analgesic use compared with levobupivacaine alone. When compared to our study, in group LD rescue analgesia started from 18th hour postoperatively and even at the end of 24 hours only 20 patients required rescue analgesia. The rest of the 10 patients did not require any rescue analgesic in the first 24 hours postoperatively.

This study compares with Movafegh A et al and Pathak et al where there was no significant difference in the onset time of the sensory and motor blockade between groups.^{3,8} This study also shows similar results as Movafegh A et al, Pathak et al, Biradar et al, Persec et al studies, who concluded that duration of sensory and motor blockade was significantly longer in the dexamethasone group.^{3,8-10} Shrestha BR et al, Youn Jin Kim et al, Persec et al reported significantly prolonged duration of postoperative analgesia and decreased requirement of rescue analgesics in the first 24 hours postoperative period in dexamethasone group.¹⁰⁻¹² The analgesic mechanism of corticosteroids is not yet fully understood, it has been reported that (1) Steroids induce a

degree of vasoconstriction, which results in reducing LA absorption, and they attach to the intracellular receptor to modulate nuclear transcription. (2) Stan et al reported that steroids suppress the synthesis and secretion of various inflammatory mediators, which prolongs the period of analgesia up to 48 hours and (3) Attardi et al showed that dexamethasone act on glucocorticoid receptors, which increase the activity of inhibitory potassium channels on nociceptive C-fibres, but more research on the influence of steroids on peripheral nerve fibres and its mechanisms is necessary.^{13,14}

Fredrickson, Rahangdale concluded that there were no clinical differences in duration of analgesia between IV dexamethasone and perineural dexamethasone.^{15,16} Based on these results, it is possible there is some degree of systemic absorption of dexamethasone that contributes to the extended duration of analgesia. It is important to note that mechanism of action is not clearly understood. Therefore, more research is needed to elucidate the mechanism by which dexamethasone administered systemically or perineurally prolongs duration of analgesia. A possible limitation of our study was that ultrasound guided supraclavicular brachial plexus block along with nerve stimulator would have been ideal, but our department received ultrasound machine only in May 2016, by which 90% of the present case study was finished.

CONCLUSION

We conclude from present study that, levobupivacaine 0.5% with dexamethasone (8mg) when compared to levobupivacaine 0.5% alone in supraclavicular brachial plexus block showed prolonged duration of postoperative analgesia, prolonged duration of sensory and motor block, no difference in onset and peak effect time of both sensory and motor block between the groups.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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