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Research Article

EFFECT OF PERINEURAL AND INTRAVENOUS DEXAMETHASONE AS AN ADJUVANT TO BUPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK FOR POSTOPERATIVE ANALGESIA AFTER UPPER LIMB SURGERY

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A B S T R A C T

Brachial Plexus block is an excellent alternative to general anaesthesia for a wide variety of upper limb procedures and is a useful analgesic component for major elective and emergency surgeries. It provides a superior quality of analgesia and avoids the common side effects associated with general anaesthesia such as postoperative nausea and vomiting **Aim**: To compare the efficacy of perineural dexamethasone with intravenous dexamethasone as an adjuvant to bupivacaine in Supraclavicular brachial plexus block. **Setting**: Randomized controlled single blind study. **Methods**: Group I (Control) received bupivacaine 0.375% 30ml. Group II received bupivacaine 0.375% 30ml and 8mg dexamethasone intravenously**.** Group III received bupivacaine 0.375% 30ml and 8mg dexamethasone perineurally. **Statistics**: Chi square is used to compare categorical values. One way ANOVA is used to determine whether there are any statistically significant differences between the means of more than two independent (unrelated) groups. **Results:** With respect to mean time for first rescue analgesic need, its duration was maximum in perineural Dexamethasonegroup (7.84±0.37 hrs) as compared to intravenous Dexamethasone (6.28±0.46hrs) and Control group (4.72±0.47 hrs). Statistically, this difference was significant. In 24hrs, total number of Rescue analgesia used was minimum for group III with mean 2.76±0.44 and maximum for group I with mean 3.20±0.41. The difference in amount of rescue analgesia used among the three groups was found to be highly significant (**p<0.001**). **Conclusion:** Perineural dexamethasone as an adjuvant to bupivacaine in Supraclavicular Brachial Plexus Block delayed the rescue analgesic need by several hours in comparison to intravenous bupivacaine.

INTRODUCTION

Postoperative pain is associated with various significant psychological and physiological changes and if it is not treated adequately it may increase risk of postoperative pulmonary and cardiac complications. So effective management of this postoperative pain is very essential to reduce these complications and to promote earlier mobilization of patient, reduce cost of care and increasepatient satisfaction.[1].

Supraclavicular Brachial Plexus block is an excellent alternative to general anaesthesia for a wide variety of upper limb surgeries involving the arm and forearm, from the lower humerus down to hand. It also provides extended analgesia in postoperative period and avoids the common side effects associated with general anaesthesia such as postoperative nausea and vomiting.

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It can be used as a single shot injection or as a continuous infusion for analgesia[1]. Different drugs have been used as adjuvants with local anaesthetics in Brachial Plexus block to achieve quick, dense and prolonged block with a single shot technique.[2,3]Steroids particularly Dexamethasone have been studied as an adjuvant to local anesthetics in various peripheral nerve blocks for prolonging the duration of analgesia. Dexamethasone significantly prolongs the duration of analgesia via blocking the nociceptive impulse transmission along the myelinated C-fibres. It has been observed by various authors that Dexamethasone when added to local anaesthetics in Supraclavicular brachial plexus block significantly prolongs the duration of analgesia.[4,5] Recently there has been interest towards intravenous use of dexamethasone as an adjuvant to peripheral nerve blocks for prolonging the duration of analgesia and it has been observed that intravenous dexamethasone prolongs the duration of analgesia as well[6].Various studies have been done to compare intravenous

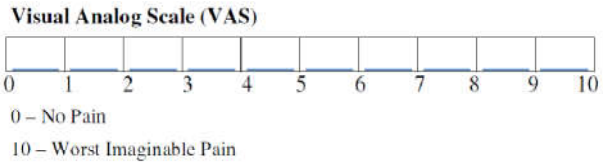
dexamethasone with perineural dexamethasone but there are conflicting results[7,8,9]. So this randomized controlled study was planned tocompare the efficacy of perineural dexamethasone with intravenous dexamethasone as an adjuvant to bupivacaine in Supraclavicular brachial plexus block. The primary objective of this study was to compare duration of analgesia (time to first rescue analgesia after administration of block). The secondary objectives were to compare postoperative VAS score, duration of sensory and motor blockade, and total consumption of rescue analgesia in first postoperative 24 hours and hemodynamic variables (HR, BP, O2 saturation).

MATERIAL AND METHODS

This single blind randomized controlled study was carried out at our hospital to compare the effect of intravenous and perineural Dexamethasone as an adjuvant to bupivacaine for postoperative analgesia in Supraclavicular brachial plexus block after upper limb surgery. The period of study was one year. After obtaining clearance from Institutional Ethical Committee, patients aged between 18-65years, in ASA grade I or II scheduled for elective Orthopaedic surgeries of elbow, forearm and hand under Supraclavicular Brachial Plexus block after taking written informed consent were included in the study. All patients were informed regarding the procedure and drugs being used in the study and were allowed to raise questions regarding the same. Consent from each patient was obtained before including them in the study. Patients with prior diagnosis of depression, corticosteroid treatment (in any form) within the previous last 4 months, other associated injuries, coagulopathy and known hypersensitivity, patients with polytrauma, loss of consciousness, renal dysfunction and sepsis, local infection at site and patchy or inadequate anaesthesia, requiring conversion to general anaesthesia were excluded from the study. All patients were randomly divided into three groups of 25 each according to Computer-Generated randomization and all patients were given Supraclavicular brachial plexus block. Patients were not aware which study drug has been given to them. Group I (Control) received bupivacaine 0.375% 30ml. Group II received bupivacaine 0.375% 30ml and 8mg dexamethasone intravenously. Group III received bupivacaine 0.375% 30ml and 8mg dexamethasone perineurally. Pre anesthetic checkup was done before surgery. Procedure was explained to the patient. Intravenous line was secured and crystalloid started. Pulse, NIBP, SpO_2 were recorded before block and at regular intervals thereafter. Premedication with inj. Midazolam 0.02 mg/kg body weight was administered before the procedure. 30 ml drug solution for 'single shot' Supraclavicular Brachial Plexus block was prepared. The patient was placed in a supine position, with the head turned away from the side to be blocked. The arm to be anaesthetized was adducted, and the hand was extended along the side towards theipsilateral knee as far as possible. The midpoint of the clavicle was identified and marked. After aseptic preparation of the area, posterior border of Sternocleidomastoid was palpated by asking the patient to raise the head slightly. The palpating fingers were then rolled over the belly of the Anterior Scalene muscle into the Interscalene groove, approximately 1.5 to 2.0 cm posterior to the midpoint of the clavicle. Palpation of Subclavian artery at this point confirmed the landmark. A skin wheal was raised with local anaesthetic cephalo posterior to the pulsations. A 22 gauge, 1.5 inches short beveled needle was then introduced through the same point, parallel to head and neck, in a caudal, slightly medial and posterior direction, until either paraesthesia was elicited or first rib was encountered. If the rib was encountered, the needle was moved over the first rib until paraesthesia was elicited in the arm or hand. After eliciting paraesthesia and negative aspiration of blood, keeping the needle in the same position the study drug was injected slowly ruling out intravascular injection intermittently. Sensory and motor block were evaluated upon administration of drug as baseline and every 5 minutes thereafter for 30 minutes or until onset of blockade noted and thereafter every 60 minutes. Sensory block was evaluated by pin prick method with a 23 Ghypodermic needle. Assessment of sensory block was done in the dermatomal areas corresponding to Median nerve, Radial nerve, Ulnarnerve, and Musculocutaneous nerve till complete sensory blockade was achieved.

Sensory block is graded as:
Grade 0 : Sharp pin felt
Grade 1 : Analgesia, dull sensation felt
Grade 2 : Anaesthesia, no sensation felt
Block was considered to have failed when sensory anaesthesia was not achieved within 30 minutes. General anaesthesia, was given subsequently to these patients and they were excluded from the study.

The duration of effective analgesia was measured from the administration of block until the first use of rescue analgesic. Pain was assessed using a10 point Visual Analogue Scale (VAS) in which a score of "0" indicates "no pain" and a score of "10" "worst pain imaginable".



The rescue analgesia in the form of inj. Diclofenac sodium (1.5 mg/kg) intravenous was administered at the Visual Analogue Scale score of ≥4.

Duration of sensory block was determined by noting the time when there was return of dull sensation to pin prick and duration of motor block was determined by noting the time the patients could first move their fingers.Side effects and complications were also noted

Sample Size

Sample size was calculated on the basis of variation in duration of analgesia in the two groups using the formula :

$$n = \frac{\left(z_\alpha + z_\beta\right)^2 \left(\sigma_1{}^2 + \sigma_2{}^2\right)}{d^2}$$

Where $\sigma_1 = 13.4$, $\sigma_2 = 11.3$ The SD's of duration of analgesia in the two groups studied in the reference paper Rebeiro KS *et al*[10]

d =min(σ_1,σ_2) the minimum mean difference consider to be medically significant

type I error α = 5% corresponding to 95% confidence level
type II error β = 20% for detecting results with 80% power of study

So the required sample size was calculated to be 25 in each group.

RESULTS

Demographic profiles were comparable between three groups.(Table I). The motor duration was minimum for group I with mean 271.20± 71.67 min and maximum for group III with mean 366.80±19.73 min. The difference in motor duration among the three groups was found to be highly significant (p<0.001). The sensory duration was minimum for group I with mean 274.40 ± 37.65 min and maximum for group III with mean 426.40±22.52 min. The difference in sensory duration among the three groups was found to be highly significant (p<0.001).

Time to 1st Rescue analgesia used was minimum for group I with mean 4.72±0.46 hrs and maximum for group III with mean 7.84±0.37 hrs. The difference in amount of rescue analgesia used among the three groups was found to be highly significant (p<0.001).In 24hrs, total number of Rescue analgesia used was minimum for group III with mean 2.76±0.44 and maximum for group I with mean 3.20±0.41. The difference in amount of rescue analgesia used among the three groups was found to be highly significant (p<0.001).The amount of Diclofenac used was minimum in group III with mean 126.00±35.71 mg and maximum in group I with mean 207.00±32.69 mg .The difference in amount of Diclofenac used among the three groups was found to be highly significant (p<0.001).

The mean VAS score in Group-I at T2hr was 0.0±0.0 which after minor fluctuations goes to the maximum value 4.00±0.58 at T5hr and then reduced again to finally have the value 0.0±0.0 at T12hr.The mean VAS score in Group-II at T2hr was 0.0±0.0 which after minor fluctuations goes to the maximum value 3.00±2.12 at T8hr and then reduced again to finally have the value 0.08±0.28 at T12hr.The mean VAS score in Group-III at T2hr was 0.0±0.0 which after minor fluctuations goes to the maximum value 4.12±1.39 at T8hr and then reduced again to finally have the value 0.00±0.00 at T12hr.

No significant differences in HR were observed at all the time point of study. (Fig:I) Significant differences in SBP were observed at 0 min, 5min and 20 min (p<0.05) and significant differences in DBP were observed at 5min, 15 min and 240 min (p<0.05) but these differences were not clinically relevant.(Fig 2&3).

Table 1 Anthropometric Distribution of Subjects

Variable	Group I(n=25)	Group II (n=25)	Group III(n=25)	p-value
	Mean±SD	Mean± SD	Mean± SD	
Age(in years)	35.80±10.87	36.40±12.39	39.24±11.53	0.5383#
Weight (in Kg)	54.08±7.10	54.76±6.73	54.76±7.60	0.928#
Sex(Female:Male)	8:17	7:18	6:19	0.820#
ASA GradeI:II	7:18	6:19	6:19	0.932#

#p value > .05 non significant,*p value< .05 significant

Table 2 Intergroup Comparison of various parameters

Parameters	Group I(n=25)		Group II(n=25)		Group III(n=25)		F-value	p-value
	Mean	SD	Mean	SD	Mean	SD		
Motor Duration(in min)	271.20	71.67	298.40	26.72	366.80	19.73	29.17	<0.001*
Sensory Duration(in min)	274.40	37.65	336.00	38.62	426.40	22.52	128.32	<.001*
Time to first rescue analgesia(in hr)	4.72	0.46	6.28	0.46	7.84	0.37	325.93	<.001*
No. of rescue analgesia in first 24 hr	2.76	0.44	2.36	0.49	3.20	0.41	22.19	<.001*
Diclofenac(Amount in mg)	207.00	32.69	177.00	36.74	126.00	35.71	34.05	<.001*

#p value > .05 non significant,*p value< .05 significant

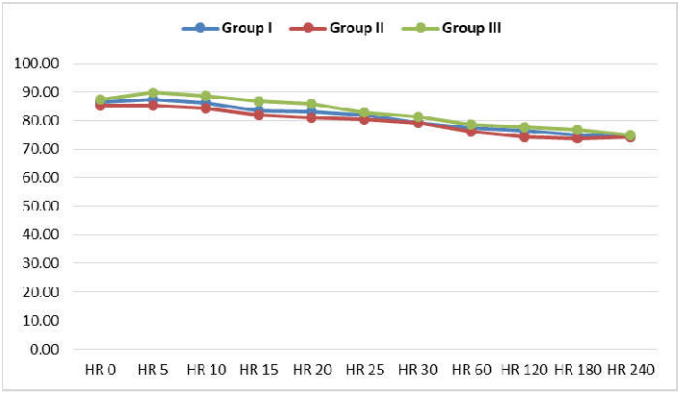


Figure 1 Intergroup comparison of heart rate (beats per minute) at various intervals (in minutes)

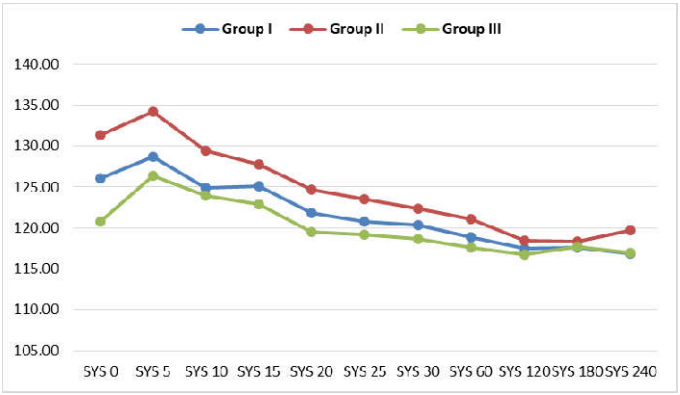


Figure 2 Intergroup comparison of systolic blood pressure (mm of Hg) at various intervals (in minutes)

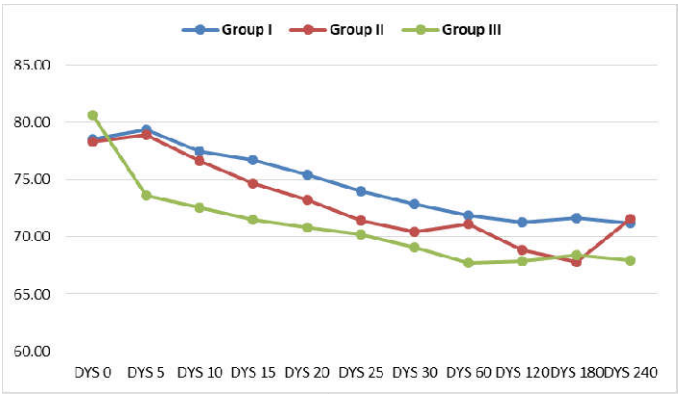


Figure 3 Intergroup comparison of DBP (mm Hg) at various time intervls(in minutes)

DISCUSSION

In our study we have compared intravenous dexamethasone and perineural dexamethasone as an adjuvant to bupivacaine in Supraclavicular brachial plexus block. The primary objective of our study was to compare duration of analgesia between the three groups and we observed that duration was maximum in perineural Dexamethasonegroup as compared to intravenous Dexamethasone and Control group. Statistically, this difference was significant. We also observed that duration of sensory and motor blockade was significantly higher in perineural group in comparison to other groups. In our study requirement of rescue analgesia(Diclofenac) in 24 hrs after surgery was minimum for perineural dexamethasone group with mean (126.00± 35.7 mg) followed by intravenous dexamethasone group with mean (177.00±36.74 mg) and maximum in control group with mean (207.00±32.69 mg) Diclofenace respectively. The difference in amount of rescue

analgesia used in 24 hrs among the three groups was found to be statistically significant.

Similarly to our study Bindal D *et al*.[11,]Patil TS *et al*.[5]and Gobinath S *et al*.[4]also found that dexamethasone as an adjuvant tobupivacaine and ropivacaine in supraclavicular brachial plexus block prolonged time for first rescue analgesia and reduced the requirement of rescue analgesics in comparison to bupivacaine and ropivacaine alone. Godbole MR *et al*.[9]conducted a study to evaluate the analgesic efficacy of perineural dexamethasone as an adjuvant to Supraclavicular block against systemic dexamethasone after supraclavicular block. They observed that dexamethasone, when used in supraclavicular block significantly prolongs the duration of analgesia and reduces the requirement of postoperative rescue analgesiain comparison to intravenous dexamethasone after supraclavicular block which is similar to our study. In their study they observed duration of analgesia was significantly higher in perineural group(15.8hr) vs intravenous group(10.3 hr). In their study they used 10ml lignocaine 1% and 10ml bupivacaine .5% with dexamethasone(.05mg/kg).

Similarly Aliste J *et al*[7] also observed that patients in perineural dexamethasone in comparison to intravenous dexamethasone had prolonged duration of analgesia, sensory block duration and mean motor block duration, after axillary block. Similarly Leurcharusme P *et al*[12] also observed in a multicentric randomized study that perineural dexamethasone prolongs duration of analgesia, sensory block duration and mean motor block duration in comparison to intravenous dexamethasone after infraclavicular block.

In a study conducted by Sakae TM *et al*,[13] they also observed that perineural dexamethasone prolongs duration of analgesia, sensory block duration and mean motor block duration in comparison to intravenous dexamethasone after interscalene block.

Contrary to our study Abdallah FW*et al*[6], DesmetM *et al*[14] and Mathew *et al*.[8] observed that the effectiveness of intravenous dexamethasone in prolonging the duration of analgesia was similar to perineural dexamethasone. Abdallah FW *et al*[6] observed that patients in intravenous group had longest duration of motor block and in both perineural group and intravenous group patients had reduced pain scores and opioid consumption in comparison to control group.

Rosenfeld DM *et al*[15]and Mc Hardy PG *et al*[16] observed that in intravenous group duration of analgesia was more in comparison to perineural group. But Rosenfeld DM et al15also observed that perineural dexamethasone group had reduced requirement of post-operative rescue analgesia in comparison to intravenous dexamethasone group which is similar to our study. Mc Hardy PG *et al*[16] did not observe any significant difference in consumption of opioids and postoperative analgesic between intravenous and perineural dexamethasone group.

With respect to VAS score, the present study found VAS score to be significantly higher in control group as compared to both the study groups till 5 hours. The mean VAS scores reached to 4 in Control group at 5 hours itself whereas in intravenous dexamethasone group they reached to 4 at 7 hours and in perineural dexamethasone group they reached to 4 at 8 hr.In Control group, all the patients had received rescue analgesic by 4.72±0.47 hrs. Thus perineural dexamethasone group presented with lower level of pain score(VAS) as compared to intravenous dexamethasone and control group. Similar to our study Sakae TM *et al*.[13] also found that perineural dexamethasone group had lower levels of VAS as compared with the intravenous and control groups.

In the present study, haemodynamically, all the three groups remained stable and comparable throughout the study period. The limitation of our study was that the study drugs (bupivacaine and dexamethasone) were not used as per kg weightbut drug doses were under the recommended safe limits. Secondly block was performed using landmark technique but it has not affected the result of our study as patients who were having failed block and required supplementation or general anaesthesia were excluded from the study.

To be concluded in our study we have observed that both perineural and intravenous dexamethasone prolong the duration of analgesia and reduce the requirement of rescue analgesia in postoperative period in Supraclavicular brachial plexus block. But, of the two combinations, perineural dexamethasoneas an adjuvant to bupivacaine significantly prolongs the time to rescue analgesia, reduces the requirement of rescue analgesia, enhances the duration of both motor and sensory blocksin comparison to intravenous dexamethasone.

Conflict of interest: Nil
Financial Support: Nil

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