

Dexamethasone as an adjuvant to Bupivacaine: Lignocaine in supraclavicular brachial plexus block for patients undergoing upper limb surgery: A comparative study

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Abstract

Introduction: Use of adjuvant prolongs the brachial plexus block. Local anesthetics with various adjuvants are used to increase the duration of postoperative analgesia in supraclavicular brachial plexus block. Perineural injection of steroid is known to influence postoperative analgesia.

Aim: Aim is to compare the onset and duration of analgesia of local anaesthetics with and without dexamethasone in supraclavicular brachial plexus block.

Materials and Methods: Fifty adult patients undergoing below elbow surgeries of upper limb under nerve stimulator guided supraclavicular brachial plexus block were selected and randomly divided into two groups of 25 each. Group-I (Dexamethasone) patients received 36 ml of mixture of 2% lignocaine plus adrenaline (20ml), 0.5% bupivacaine (15ml) with dexamethasone 4mg (1ml). Group-II (saline) patients received 36 ml of mixture of 2% lignocaine plus adrenaline (20ml), 0.5% bupivacaine (15ml) with saline (1 ml). The onset of sensory block and duration of analgesia in two groups were compared and development of complications were observed. Study Design: Randomized Double Blind controlled study.

Results: The two groups were comparable in demographic data. There was significantly faster onset of sensory blockade and prolonged duration of analgesia in the dexamethasone group than the saline group. There were no significant side effects.

Conclusion: Addition of dexamethasone as an adjuvant to local anesthetics in brachial plexus block provides in significantly early-onset and markedly prolonged duration of analgesia without hemodynamic disturbances.

Keywords: analgesia, dexamethasone, local anaesthetics, nerve stimulator, supraclavicular block

1. Introduction

Brachial plexus block is good alternative to general anesthesia for upper limb surgery. This avoids the unwanted effect of anesthetic drugs used during general anesthesia and the stress of upper airway instrumentation [1]. Brachial plexus block consists of injecting local anaesthetic drugs in the fascial spaces surrounding the nerve plexus, thereby blocking the autonomic, sensory and motor fibers supplying the upper extremity. Among various techniques, supraclavicular approach is a preferred one being simple, safe, preserve consciousness, avoids airway instrumentation, provides rapid recovery and good postoperative analgesia. It should always be considered to the patients where general condition is poor or not adequately prepared [2].

Various additives such as opioids, clonidine, and verapamil were added to local anesthetics to achieve quick, dense, and prolonged block, but the results are either inconclusive or associated with side effects [3, 4, 5].

Steroids have powerful anti-inflammatory as well as analgesic property. They relieve pain by reducing inflammation and blocking transmission of nociceptive C-fibers and by suppressing ectopic neural discharge [6].

In our study we use dexamethasone as an adjuvant to mixture of local anesthetics in supraclavicular brachial plexus block in patients undergoing upper limb surgery. The duration of postoperative analgesia, onset as well as duration of sensory and motor block, perioperative hemodynamic changes and any side effect were recorded.

2. Materials and Methods

This study was conducted in H.N.B. Base Teaching Hospital

Srinagar (Garhwal) Uttarakhand. After taking approval of the hospital research ethics committee and written informed consent from the patients. 50 adult patients ASA physical status I and II aged between 20 -60 years undergoing below elbow surgery of upper limb under nerve stimulator guided supraclavicular brachial plexus block were selected and randomly divided into two groups of 25 each. Group-I (Dexamethasone) patients received 36 ml of mixture of 2% lignocaine plus adrenaline (20ml), 0.5% bupivacaine (15ml) with dexamethasone 4mg (1ml). Group-II (saline) patients received 36 ml of mixture of 2% lignocaine plus adrenaline (20ml), 0.5% bupivacaine (15ml) with saline (1 ml).

Exclusion Criteria

1. Patients having hypertension, diabetes mellitus, neuropathy, peripheral nerve injury.
2. Geriatric, paediatric, pregnant patients.
3. Uncooperative patients & refuse to give consent.

It was a randomized, double blind controlled study based on previous studies of Movafegh *et al* and Bazin JE *et al*. [7, 8] A sample size of 21 in each group was determined with alpha error of 0.05 and power of 0.95 though the study was conducted on 25 patients in each group. By computer generated randomization, patients were divided into two groups of 25 patients each and received either dexamethasone 4mg (Group-I) or normal saline (Group- II) for supraclavicular brachial plexus block in upper limb surgeries. One day prior to surgery, Preanaesthetic checkup was conducted and a detailed history with complete physical and systemic examination including investigation reports were

assessed for fitness of anaesthesia and surgery. Each patient was instructed to take table A1 prazolam 0.5 mg, tablet Ranitidine 300 mg orally at bed time and nil per oral for 10 hours. On the day of surgery intravenous canulation with 20G to all the patients in the non-operative hand were established for drug and continuous fluid administration.

In the operation room after establishing 18 gauge intravenous (IV) access in the contralateral hand, the baseline parameters were observed and recorded, which included heart rate, noninvasive blood pressure, electrocardiogram, and pulse oximetry.

Fifteen minutes before administration of brachial plexus block, patients were premedicated with injection ranitidine 50 mg and injection ondansetron 4 mg intravenously while preloading with Ringer’s Lactate at 15ml/kg. A 36 ml mixture of 2% lignocaine with adrenaline (1:2, 00, 000) 20 ml plus either 1ml dexamethasone 4mg or 1ml 0.9% normal saline along with 15ml bupivacaine 0.5% was aspirated into a sterile bowl. Patient was placed supine with a pillow under the shoulder and head slightly turned towards the opposite side with the arms by the side. The block was performed under all aseptic precautions. The interscalene groove was identified and the finger moved towards the clavicle to palpate the subclavian artery. The stimulating insulated needle was connected to the nerve locator by electrodes and properly grounded with the help of ECG lead at the course of nerve to be blocked. The needle was inserted just above the palpating finger and advanced in a direction directly caudal and running parallel to the sagittal axis until an isolated muscle twitch was elicited in all fingers either in flexion or extension. Initially a current of 1mA, frequency of 2Hz was used to elicit the desired motor response then gradually reduced to obtain the best possible motor response at a current of 0.3mA. Either of the drug solution was injected after obtaining the best response at 0.3 - 0.4mA and confirming negative aspiration for blood. Following injection the area was massaged so as to help the solution track along the plexus. Antiseptic dressing was applied to seal the site of injection. During the conduct of the block and thereafter the patient was observed vigilantly for any signs of complications. The surgery was allowed after 15-20 minutes of injection.

Following injection of drug, sensory block of radial nerve, median nerve, musculocutaneous and ulnar nerves were recorded at 0, 2, 5, 10 and 20 minutes by pin prick method and compared with the same stimulation on the contralateral hand. Sensory block was graded according to the following scale:

- 0 = no block (normal sensation)
- 1 = partial block (decreased sensation)
- 2 = complete block/ anaesthesia (no sensation)

Duration of analgesia was recorded for 24 hours. Rescue analgesia was provided by injection tramadol hydrochloride 100 mg intravenous. Observation of hypotension, bradycardia, arterial puncture, pneumothorax, Horner’s syndrome, haematoma, local anaesthesia toxicity etc. were noted during the course. Hypotension was defined as systolic blood pressure (SBP) falling more than 20% below the baseline and bradycardia was defined as heart rate (HR) less than 60 beat per minute.

Patients who complained of pain or discomfort during surgery were converted into general anaesthesia and excluded from the study.

Statistical Analysis

Statistical analysis was performed with the software SPSS for windows version 20. Numerical/continuous variables were reported as Mean ± SD (standard deviation) and forqualitative/categorical variables were again described as number of cases and percentages.

The two group means were compared by Independent Sample Test (t-test) while more than two means, by ANOVA (F-test) and χ^2 -test was applied for categorical variables. Tables and figures were made by using MS word and Excel for windows. All comparisons were two-sided and the P values of < 0.05 and < 0.01 are treated as the cut off values for significance and highly significance respectively.

3. Results

The patients in the two study groups were comparable for age, sex, weight, height, ASA physical status which were statistically not significant (P>0.05) as shown in Table-1. Observation of various haemodynamic parameters were comparable and had shown almost same in both the groups. The difference was statistically not significant (P>0.05) as shown in Table -2. The difference in onset time in minutes between two groups were comparable and much faster in group-I (09:52.4 + 04:01.4) compared to group-II (12:55.9 + 04:52.7) and was statistically significant (P<0.05) Table-3. However comparison of sensory grade between two study groups at different intervals was statistically insignificant (P>0.05) as shown in Table-3. The difference in duration of sensory block in hours was much higher in group-I (10:14 +05:05) compared to group-II (03:50 + 00:39) and was statistically highly significant (P<0.01) Table-3.

One patient in group-I had developed hypotension and bradycardia which was treated with ephedrine 6 mg intravenous bolus & atropine 0.6 mg intravenously. The difference in distribution of side effects between two groups was statistically not significant with P>0.05 Table-4.

Table 1: Demographic profile of the two study groups

Parameters	Group-I (n=25) Mean+SD	Group-II (n=25) Mean+SD	P value
Age (yrs)	37.84 ± 3.19	37.20 ± 15.57	0.876
Sex (M:F)	15:10	15:10	1.000
Weight (kg)	53.04 ±9.821	55.96 ± 5.863	0.208
Height (Ft)	5.544 ±0.158	5.456 ± 0.145	0.046
ASA (I:II)	19:6	18:7	0.747

SD=Standard deviation

Table 2: Haemodynamic parameters

Parameters	Group-I (n=25) Mean+SD	Group-II (n=25) Mean+SD	P value
*HR	83.76 ± 8.171	84.20 ± 7.136	0.840
*SBP	120.2 ± 10.68	123.2 ± 12.58	0.362
*DBP	78.00 ± 6.658	80.36 ± 8.808	0.291

Between two study groups

*HR=Heart rate, SBP=Systolic blood pressure, DBP=Diastolic blood pressure

Table 3: Comparison of onset time, sensory grade and duration of analgesia between two study groups

Parameters	Group-I (n=25) Mean+SD			Group-II (n=25) Mean+SD			P value
Onset time (min)	09:52.4+04:01.4			12:55.9+04:52.7			*0.019
Sensory Grade	Grade-0	Grade-1	Grade-2	Grade-0	Grade-1	Grade-2	-
0 minute	25(100%)	0 (0%)	0 (0%)	25(100%)	0 (0%)	0 (0%)	-
2 minute;	14(56%)	11(44%)	0(0%)	17(68%)	8(32%)	0(0%)	0.382
5 minute:	2(8%)	19(76%)	4(16%)	4(16%)	18(72%)	3(12%)	0.54
10 minute	0(0%)	9(36%)	16(64%)	0(0%)	13(52%)	12(48%)	0.254
20 minute	0(0%)	0(0%)	25(100%)	0(0%)	0(0%)	25(100%)	
Sensory block (hr)	10:14+01:05			03:50+00:39			**0.000

*significant, **highly significant

Table 4: Comparison of side effect between two study groups

Side effects	Group-I	Group-II	P value use
No	24 (96%)	25 (100%)	0.999
Yes	1 (4%)	0 (0%)	

4. Discussion

Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries. A combination of lignocaine and bupivacaine provided good operating conditions but the duration of analgesia is rarely maintained for more than 3-4 hours [10].

Dexamethasone, a synthetic adrenocorticosteroid with the properties of anti-inflammatory and analgesic effects is known to be useful as an adjuvant to local anaesthetic for prolongation of analgesia [9, 10].

In most of the previous studies, the dose of the dexamethasone used was 8 mg whereas in our study we used 4 mg to see the effectiveness with the lower dose on the onset and duration of sensory block. All the findings and observations made during the study were tabulated, graphically depicted, statistically analyzed and inference drawn to evaluate whether addition of dexamethasone 4 mg to lignocaine and bupivacaine had any effect on the onset of sensory block and duration of analgesia.

In our study we observed that the onset of sensory block was significantly faster in dexamethasone group (09:52.4±04:01.4) compared to saline group (12:55.9±04:52.7) P=0.019. The duration of analgesia was also found significantly longer in dexamethasone group (10:14±01:05) compared to saline group (03:50±00:39) P<0.001 Table-3.

Observations of our study were comparable to the study conducted by Shrestha BR *et al.* [9] in which the onset time of sensory block was delayed (18.15±4.25) in control group and early (14.5±2.10) in dexamethasone group with P=0.05 whereas in our study the onset of sensory block was faster in both the groups (09:52.4±04:01.4) and (12:55.9±04:52.7) respectively. This may be because of nerve stimulator we used to identify the nerve and allowed to deposit the drug very close to the nerve to be blocked causing to an earlier onset of sensory blockade. They concluded that the addition of dexamethasone 8mg for brachial plexus block provides early onset and prolonged duration of analgesia without any side effects which correlates with our study however we achieved with higher sample size (25 patients each group) and lower dose of dexamethasone 4 mg.

Observations of the study were also comparable with the studies conducted by Golwala MP *et al.* [10] and Islam SM *et al.* [11] which claimed that the addition of dexamethasone 8 mg to the local anaesthetics for supraclavicular brachial plexus block results in significantly early onset of sensory block and markedly prolonged duration of analgesia which

correlates our study but again we achieved with lower dose of dexamethasone.

The observation of our study was in contrast to the study done by Movafegh A *et al.* [7] where the onset time of sensory block was similar in both the study groups which may be because of the different local anaesthetics used and their lower concentration. However duration of sensory block was significantly longer in dexamethasone group compared to control group (P<0.01) which correlates with our study.

In the study conducted by Shaikh MR *et al.* [12] the duration of sensory block was prolonged which correlates to our study but on contrary there was no effect on the onset time of sensory block that could be because of the lower concentration of bupivacaine used in their study.

Choi *et al.* [13] in their systematic review of 9 studies and 801 patients demonstrate that perineural administration of dexamethasone with local anesthetic prolongs brachial plexus block effects with no observed adverse events. The effect of systemic administration of dexamethasone on brachial plexus block must be investigated.

In comparison with epinephrine and midazolam addition of dexamethasone to bupivacaine had rapid onset of block and longer time to first analgesic request with fewer side effects. [14]

Arish *et al.* [15] concluded that when dexamethasone used as an adjuvant along with local anesthetic in brachial plexus block, it effectively prolongs the duration of both sensory (mean 1075.20 ± 144.831 min) and motor blockade (mean 475.20 ± 114.787 min) with no side effects.

Fourteen studies consisting of a total of 1022 patients in systematic review done by Knezevic *et al.* [16] have identified a significant beneficial postoperative effect of adding perineural dexamethasone to local anesthetics for brachial plexus block in several regards: duration of analgesia, pain scores, and opioid consumption. Both low (4–5 mg) and high doses (8–10 mg) of dexamethasone used in perineural adjunctive application comparably prolonged the duration of brachial plexus analgesia, regardless of different local anesthetic types and brachial plexus approaches.

5. Conclusion

The addition of 4 mg of dexamethasone as an adjuvant to mixture of local anesthetics in supraclavicular brachial plexus block effectively and safety shortens the onset of sensory and motor block, increases the duration of sensory and motor block and markedly prolonged duration of postoperative analgesia without hemodynamic disturbances.

6. References

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