

Evaluation of Post Operative Analgesia on Adding Dexamethasone with Ropivacaine in Interscalene Brachial Plexus Block for Shoulder Surgery

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Abstract : Background and Objectives: Dexamethasone as an adjuvant to ropivacaine for interscalene brachial plexus (ISBP) block prolongs duration of analgesia. However, this study was conducted to further substantiate analgesic efficacy of dexamethasone as an adjuvant to ropivacaine in ISBP block for shoulder surgeries. **Methods :** After taking hospital ethical clearance and written informed consent from patients, nerve stimulator guided ISBP block was given to 100 patients, randomly assigned to one of two groups: (N=50 in each group). Group R (ropivacaine) received 30 ml (0.5%) ropivacaine + 2 ml saline and group RD (ropivacaine – dexamethasone) received 30 ml (0.5%) ropivacaine + dexamethasone 8 mg. Duration of analgesia, onset of sensory and motor block, VAS score, 24 hour analgesic requirement were recorded and compared. Computer software SPSS version- 16 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis. Chi-square test and Student's t-test were used and $P < 0.05$ was considered as significant. **Results:** The mean duration of analgesia in Group RD was 1211.83 ± 32.86 min and in Group R it was 283.17 ± 7.71 min ($P = 0.0001$). Onset of sensory block in Group RD was 9.27 ± 0.980 min and in Group R was 16.00 ± 1.438 min ($p < 0.001$) Onset of motor block in Group RD was 14.07 ± 1.929 min and in Group R was 20.27 ± 1.799 min ($P = 0.2244$). **Conclusion:** Dexamethasone, when added as an adjuvant to ropivacaine during ISBP block, significantly prolonged duration of analgesia and shortened the onset of sensory and motor block. It provided prolonged post-operative pain relief and hence reduced the number of rescue analgesics required in first 24 hours.

Keywords: Bupivacaine, Dexamethasone, Interscalene brachial plexus block, Ropivacaine.

Date of Submission: 02-09-2018

Date of acceptance: 18-09-2018

I. Introduction

Pain after orthopedic surgery is intense and unbearable^[1]. Managing such pain is challenging. Particularly, in shoulder procedures, where early mobilization is integral part for success of surgery^[2], perfect plan for intra and post-operative pain management should be ready. In our institution, regional anesthesia in the form of an interscalene approach to the brachial plexus is often used for such procedures. But, we found, the analgesic effect of single shot ISBP block with local anesthetics (LA) alone is short-lived and lasted only till early post-operative period. Various adjuvants are added to LA to prolong post-operative analgesia. Dexamethasone a corticosteroid, is one such adjuvant, when added to LA solution, improves post-operative analgesia. It has highly potent anti-inflammatory property without mineralocorticoid activity and is also found to be safer and devoid of potential side effects. Studies have proved analgesic efficacy of dexamethasone with many LA's like lignocaine, bupivacaine, mepivacaine but only a handful studies have been done using ropivacaine. So, we conducted a randomized controlled trial to study analgesic efficacy of dexamethasone with ropivacaine in ISBP block. The primary aim of the present study was to determine whether dexamethasone (8 mg) as adjuvant to ropivacaine in ISBP would prolong duration of analgesia. Secondary outcome measures were onset of sensory and motor block, median pain scores by using visual analogue scale score (VAS), analgesic consumption in 24 h and blood sugar levels and hemodynamic parameters.

II. Subjects And Methods

A randomized prospective study was conducted in a tertiary care hospital from January 2018 to June 2018. Institutional ethics committee approval and written informed consent was obtained. 112 patients of either gender, in the age group of 18–70 years, weight ranging between 50 and 70 kg belonging to American Society of Anesthesiologists Grade 1 and 2 posted for elective surgeries on elbow, forearm, and hand were enrolled for the study. Patients who refused to give informed consent, obese and short-neck patients, patients with

coagulopathy, neuropathy, or local infection at the site of block, and those with history of allergy to the study drug or drug abuse were excluded from the study. A detailed history, thorough physical examination, routine investigations, or any special investigations if required were done for the study. Sample size was calculated assuming 20% increase in duration of analgesia after addition of dexamethasone; 50 patients per group were required with $\alpha = 0.05$, 80% power and 95% confidence limit. We required 50 patients in each group (100 total) and considering 10% drop outs (due to change in technique or cancellation on table), 112 patients were enrolled for the study. For the purpose of the study, the patients were randomly allocated using computer-generated random number tables into two groups of 56 patients each. Randomization assignments were stored in sealed, sequentially numbered opaque envelopes. The anesthesiologist, who was not involved in the study, opened the envelope in Operation Theater and prepared the drug accordingly. Observations were done by the anesthesiologist who was blinded to the drug. All blocks were performed by attending anesthesiologist skilled in performing ISBP blocks using peripheral nerve stimulator. The patient was placed supine on the operation table. Before starting the procedure, all the monitoring equipments (noninvasive blood pressure cuff, pulse oximetry probe, and electrocardiography) were attached to the patient and baseline values of blood pressure, heart rate, oxygen saturation, and respiratory rate were recorded. An intravenous cannula 18G was inserted. No premedication was given. Brachial plexus block was applied using interscalene approach and peripheral nerve stimulator. Evoked motor response of deltoid muscle was obtained at 0.2–0.4 mA. Once the desirable evoked motor response was obtained, the needle was stabilized and total volume of drug mixture as allocated to two groups was injected slowly after repeated aspiration in divided portions. Group R (56) received 30 mL (0.5%) ropivacaine + 2 mL (0.9%) saline, and Group RD (56) received 30 mL (0.5%) ropivacaine + dexamethasone 8 mg (2 mL). Time of administration of drug was noted. Patients were evaluated every 5 min after the completion of local anesthetic injection till complete sensory and motor blockade takes place. Sensory block was assessed by loss of sensation to pinprick over the deltoid muscle (C5, C6 dermatome) and evaluated using a three-point scale: 2 = normal sensation, 1 = loss of sensation to pinprick, and 0 = loss of sensation to light touch. Motor block was assessed by Modified Bromage Scale (4 = Full power in arm and shoulder muscles, 3 = Reduced power but ability to move arm and shoulder against resistance, 2 = Ability to move arm and shoulder against gravity but inability to move against resistance, 1 = Flicker of movement in arm and shoulder muscles, 0 = No movement in arm and shoulder muscles). The anesthesiologist who assessed all study parameters was blinded to group allocation and drug used. Overall quality of block was assessed on a three-point scale: 0 = complete failure, 1 = inadequate block, 2 = successful block. At the end of 30 min if there were no signs of motor and sensory block, it was considered failed block and patients were excluded. However, if any patient had incomplete block or complained of discomfort/pain intraoperatively they were managed with supplemental analgesia with IV ketamine (1–1.5 mg/kg) and propofol (1–2 mg/kg) and block was considered as inadequate block. Pain intensity was evaluated using 10 cm visual analog scale (VAS) where 0 represents no pain and 10 represents worst possible pain. Rescue analgesia with intramuscular diclofenac injection 75 mg was given if VAS score was ≥ 4 . VAS score was recorded postoperatively at 0, 5, 6, 12, 20, and 24 h. The time for the first rescue analgesic and 24-h analgesic consumption was noted. Duration of analgesia was defined as the time interval between the onsets of complete sensory block to the postoperative VAS score ≥ 4 /time for request for first rescue analgesic. Blood sugar levels were noted 2 h after injection of drug solution. Throughout the procedure, blood pressure, respiratory rate, and pulse rate were monitored continuously. Vitals signs were recorded at 0, 10, 20, 30, 60 min, 2, 4, 6, 12, and 24 h. Intraoperative vital parameters (HR/NIBP/rhythm/ SpO₂) were monitored every 5 min throughout the study. The data were analyzed statistically by using statistical software SPSS version- 16® (SPSS Inc., Chicago, Illinois, USA). All continuous data were expressed as mean and standard deviation and compared using independent sample t-test. All descriptive variables were compared using Chi-square test. The level of significance was set at $P < 0.05$, and 95% confidence intervals were calculated for the main outcome measures.

III. Results

Total 112 patients were enrolled in the study. Six patients in each group, were excluded from the study because of inadequate block, failed block or change of surgical plan. A total of 100 patients were included in statistical analysis (Group R n = 50, Group RD n = 50). Demographic data and surgical duration were found to be comparable [Table 1]

Table 1: Patient’s characteristics and surgical duration

GROUP	R	RD
Age (yrs)	33years8months±22years 5months	38years6months±16years6m onths
Sex (M/F)	25/25	23/27
Weight (kg)	57.2±7.29	59±9.07
Duration of surgery	105 min38 sec±30min 25 sec	117min 11 sec±39min 24 sec

(min)		
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Values are expressed as mean ± SD. M = male. F = female. Group R = 30 ml 0.5% ropivacaine + 2 ml normal saline. Group RD = 30 ml 0.5% ropivacaine + 2ml dexamethasone.

Onset of sensory block in Group RD was 9.27±0.980 min and in Group R was 16.00±1.438 min (p <0. 001) Onset of motor block in Group RD was 14.07±1.929 min and in Group R was 20.27±1.799min (P = 0.2244). The duration of analgesia was significantly prolonged in the Group RD 1211.83 ± 32.86 min compared to Group R 283.17 ± 7.71min (P = 0.0001) [Table 2].

Table no 2: Onset of sensory , motor block ,duration of analgesia

GROUPS	R	RD
Onset of sensory block (mins)	16.00±1.438	9.27±0.980
Onset of motor block (mins)	20.27±1.799	14.07±1.929
Duration of analgesia (mins)	283.17±7.71	1211.83±32.86
Median first 24 hour analgesic consumption (no. of diclofenac inj.)	3(3-4)	0(0-1)

Values are expressed as mean ± SD.. Group R = 30 ml 0.5% ropivacaine + 2 ml normal saline. Group RD = 30 ml 0.5% ropivacaine + 2ml dexamethasone

VAS scores in the first 4 h were comparable (P > 0.05). The median VAS score of group RD were statistically lower than median VAS score of group R at 5th, 6th, 20th, and 24th h postoperatively (P < 0.0001). At 5 h, median VAS score of group R was 4 and required analgesic. At 20 h, median VAS score of Group RD was >4 and required first dose of analgesic. Patients in Group RD showed excellent pain control up to 20 hours. Dexamethasone significantly lowered the median analgesic consumption for first 24 h in Group RD (0 [IQR 0–1]) than in Groups R (3 [IQR 3–4]) (p < 0.0001). (Table no. 3)

Table no.3

NO. OF ANALGESICS REQUIRED	GROUP R	GROUP RD
1	9%	70%
2	63%	28%
3	36%	2%

No significant difference in mean blood sugar level is seen in any of the groups (P > 0.05). Mean BP in mmHg, mean pulse rate and mean respiratory rate in all the four groups was comparable (P > 0.05).

IV. Discussion

Our study demonstrated that dexamethasone significantly prolonged the duration of analgesia of ropivacaine in ISBP block. This finding was in corroboration with many studies done in past [3-6]. We observed 2.0- fold prolongation of analgesia in RD Group in comparison to Group R almost similar to Cummings et al [4] who observed a 1.9- fold increase in the duration of ISB when dexamethasone was mixed with local anesthetic. We, also noticed significant early onset of sensory and motor block when dexamethasone was added to ropivacaine. Our finding was further substantiated by Dar et al. [5], who even postulated interaction between ropivacaine and dexamethasone which led to early onset of action. Dexamethasone is very potent and highly selective and long-acting glucocorticoid; its potency is about 40 times that of hydrocortisone. The mechanism of prolonged regional anesthesia and analgesia produced by corticosteroids is not fully understood. Steroids induce vasoconstriction, thus reduce local anesthetic absorption. Furthermore, they increase the activity of inhibitory potassium channels on nociceptive C-fiber and inhibit synthesis and/or release of various inflammatory mediators. These three mechanisms are known to prolong analgesia. This effect has been proposed to last up to 48 h [7-8]. We observed that median VAS score and 24 hour analgesic consumption was significantly less when dexamethasone was mixed with ropivacaine. A recent systematic review has shown that dexamethasone significantly reduces the VAS score and analgesic consumption when used along with local anesthetic however, the duration of significant relief is variable [9]. In our study, the mean blood sugar levels 2 h after injection of perineural dexamethasone showed no change, which proved that manifold prolongation of analgesia caused by dexamethasone is not due to systemic absorption but local action.

Hemodynamic parameters were stable throughout the surgery which gives an added superiority over other adjuvants such as opioids which cause respiratory depression and α2 agonists which cause hypotension, bradycardia, and sedation.

V. Conclusion

Dexamethasone (8 mg) significantly prolonged the duration of analgesia when used with 0.5% ropivacaine during ISBP block for arthroscopic surgery of shoulder. Early onset of sensory and motor block was also found by addition of dexamethasone. Dexamethasone also improved the quality of pain relief in the first 24 h post- operatively and hence reduced the rescue analgesic requirement without affecting blood sugar levels and hemodynamic parameters.

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Deeksha Bindal" Evaluation of Post Operative Analgesia On Adding Dexamethasone With Ropivacaine In Interscalene Brachial Plexus Block For Shoulder Surgery ."IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 9, 2018, pp 41-44.