IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 6 Ser.19 (June. 2020), PP 36-41
www.iosrjournals.org

Effect of Dexamethasone as an Adjuvant To Ropivacaine And Bupivacaine In Brachial Plexus Block For Prolongation Of Analgesia: An Observational Study

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Abstract

Background and objectives: *Supraclavicular brachial plexus block provides most complete and reliable anesthesia for upper limb surgery. Local anaesthetics like bupivacaine and ropivacaine are used frequently for block. To enhance the duration of analgesia different additives have been used. Recently dexamethasone has been studied as an adjuvant to local anesthetic in peripheral nerve block. We observed the effect of addition of dexamethasone to bupivacaine and ropivacaine in USG guided supraclavicular brachial plexus block. The primary objective was the duration of analgesia and secondary objectiveswere onset and duration of sensory and motor block and side effects and complications, if any.*

Material and method: *After institutional ethics committee approval,eighty patients of age group 18-60 years, ASA I-II, undergoing upper limb surgery under supraclavicular block were divided into two groups. Group BD (n=40) received inj. bupivacaine 0.5%, 28 ml + dexamethasone 8 mg and group RD received inj. ropivacaine 0.5%, 28 ml + dexamethasone 8 mg. Onset and duration of sensory and motor block, duration of analgesia and side effects and complications were recorded.*

Results: *Demographic data and duration of surgery were comparable in both groups. Onset time of sensory and motor block was earlier in group RD as compared to group BD ($p<0.05$). Duration of sensory and motor block was prolonged in group RD as compared to group BD ($p<0.05$). Duration of analgesia was prolonged in group RD than in group BD ($p<0.0001$). The difference in HR, SBP, DBP, MBP, mean RR and mean SpO_2 were statistically insignificant in both the groups at all time interval. ($p>0.05$).*

Conclusion: *Dexamethasone as an adjuvant to ropivacaine significantly prolongs the duration of analgesia as compared to bupivacaine. It also provides faster onset of sensory and motor block and prolongs the duration of sensory and motor block with minimal adverse effects.*

Key words: *Dexamethasone, ropivacaine, bupivacaine, supraclavicular brachial plexus block.*

Date of Submission: 17-06-2020 Date of Acceptance: 03-07-2020

I. Introduction

Supraclavicular brachial plexus block being a versatile technique provides an easiest and consistent method of anaesthesia for surgeries below shoulder joint.It provides good muscle relaxation, haemodynamic stability, superior quality of analgesia and avoids common side effects associated with general anaesthesia. It is also beneficial in patients for ambulatory surgeries and with significant comorbidities.[1,2]

Anatomical compactness at the distal trunk/ proximal division level is responsible for short latency, complete and reliable anesthesia for upper extremity surgery. Another advantage is that it can be performed with the patient's arm in any position and provides excellent anaesthesia for elbow, forearm and hand surgery.[3]

Local anaesthetics like bupivacaine and ropivacaine are used frequently for supraclavicular nerve block. They provide analgesia for 3-4 hours. To enhance the duration of analgesia different additives have been used epinephrine, morphine, pethidine, butorphanol, ketamine, midazolam, clonidine, neostigmine, dexmedetomidine, dexamethasone etc.Dexamethasone, a high-potency, long-acting glucocorticoid, has been shown to prolong peripheral nerve blockade. It decreases nociceptive C-fiber activity via a direct effect on glucocorticoid receptors and inhibitory potassium channels.

The present study was conducted to evaluate the effect of dexamethasone (8 mg) as an adjuvant to bupivacaine and ropivacaine in ultrasound guided supraclavicular brachial plexus block for upper limb orthopaedic surgery. The primary objective was duration of analgesia and secondary objectives were onset and duration of sensory and motor block and side effects and complications, if any.

II. Material And Method

The present observational study was conducted in the Department of Anaesthesiology and Critical Care, Pt. J. N. M. Medical College, Raipur(C.G.) from April 2018 to July 2019 after institutional Ethics Committee approval. Eighty patients of ASA grades I-II of either sex, aged 18-60 years posted for upper limb surgeries under supraclavicular brachial plexus block were included in this study. Patients with any bleeding disorder, on anticoagulants, severe respiratory disease, neurological deficit involving brachial plexus, local infection at injection site, allergy to study drugs, history of peptic ulcer disease, diabetes mellitus, hepatic or renal failure (contraindication to steroids) and pregnant women were excluded from study. Patients were equally divided into two group, group BD (n=40) received 0.5% bupivacaine 28 ml and dexamethasone 8 mg (2 ml) and group RD received 0.5% ropivacaine 28 ml and dexamethasone 8 mg (2 ml). All patients had thorough pre-anaesthetic evaluation, which comprised of a detailed history, clinical examination, height, weight, BMI and relevant investigations (Hb, TLC, Urine examination, BT, CT, Platelet count, Blood sugar, Blood urea, Serum creatinine and electrolytes, X- ray chest, ECG).

After written informed consent, patients were shifted to Operation Theater and multipara monitor was attached and baseline vital parameters (heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure, respiratory rate, arterial oxygen saturation) were recorded. Lignocaine sensitivity test was performed on all patients. After insertion of 18 G intravenous cannula over dorsum of contralateral limb, intravenous fluid was started. All patients were premedicated with i.v. ranitidine 50 mg and i.v. ondansetron 4 mg. Patients were placed in supine position with the head turned laterally away from the site of the block and arms were placed along the side of the body. After explaining the patient about the procedure, under aseptic precaution brachial plexus was approached through supraclavicular route lateral to the subclavian artery with help of USG machine Mindray M7. 30ml of the study drug was given once the plexus was identified by its characteristic honeycomb appearance. Sensory block was assessed by pin prick test using 3-point scale: score 0 = normal sensation, 1= loss of sensation of pin prick (analgesia) and score 2 = loss of sensation of touch (anesthesia). Motor block was evaluated by Modified Bromage scale on 3-point scale: Grade 0 = Normal motor function with full flexion and extension of elbow, wrist and fingers, Grade 1 = Decreased motor strength with ability to move the fingers only and Grade 2 = Complete motor block with inability to move the fingers. Sensory and motor block were evaluated every 3 min up to 30 min after injection and then every 30 min until the block was resolved. Onset of sensory block was defined as time interval between the end of local anesthetic administration and complete sensory block (score 2). Onset of motor block was defined as time interval between total local anesthetic administration and complete motor block (grade 2). Duration of sensory block was defined as a time interval between complete sensory block and complete resolution of anesthesia on all nerves (score 0). Duration of motor block was defined as a time interval from complete motor block to complete recovery of motor function of hand and forearm (grade 0). Duration of analgesia was defined as time between the onset of sensory block and onset of pain, was the time when patient requested first dose of analgesic.

HR, SBP, DBP, MBP, RR and SpO_2 were recorded after administration of drug at every 5 minute interval up to 30 minute, then at every 15 minute interval up to 60 minute then at 120, 180, 240, 480, 720, 960, 1200 and 1440 minute.

Adverse effects like CNS toxicity (restlessness, anxiety, blurred vision, tremors, drowsiness and convulsion) CVS toxicity (hypotension, bradycardia (HR <50 beats/min) hypertension, tachycardia, arrhythmias like extrasystoles, atrial fibrillation, ST segment changes), nausea, vomiting, allergic reactions, dyspnoea, Horner's syndrome and recurrent laryngeal nerve block were observed and recorded and managed accordingly.

For sample size calculation we used study ofModak S et al (2016)[4]. They found mean duration of analgesia (time interval for requirement of first rescue analgesic) was 14.40±2.13 hours in ropivacaine 0.5% with epinephrine group and 11.60±1.81 hours in bupivacaine 0.5% with epinephrine group. Taking this into consideration we calculate difference between these two means with confidence level 99%, α- error 1% power 99% with varience 6, minimum 74 samples are required (as calculated by Epitools software). Hence, we included 40 patients in each group.

Data were recorded and analyzed with the help of Statics Kingdom Calculator in stat software and Medcalc's statistical calculator. p-Value <0.05 was considered as significant and p-Value >0.05 was considered as not significant.

III. Results

There was no statistically significant difference in demographic data and duration of surgery between both the groups (Table 1).Mean onset time of sensory and motor block was significantly faster in group RD as compared to group BD [Table2] ($p<0.05$). Duration of sensory and motor block and duration of analgesia was prolonged in group RD as compared with group BDand this difference was statistically highly significant [Table 2] ($p<0.0001$). Mean heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure, respiratory rate and SpO_2 were statistically insignificant ($p>0.05$) in both groups at all time point intervals. Only one case(2.5%) of nausea and one case(2.5%) of vomiting was observed in group BD and RD respectively (Table 3).

Table 1: Demographic profile and duration of surgery

Parameters	Group BD (n=40)	Group RD (n=40)	p Value
Age (years)	38.40±10.84	41.15±13.42	0.3165
Sex (M:F)	28:12	27:13	0.8106
Weight (kg)	58.68±7.18	60.08±10.83	0.4976
Height (cm)	164±7.42	161.85±9.65	0.2674
Mean BMI (kg/m^2)	21.82±2.40	22.77±2.46	0.0844
Duration of surgery (min)	116.88±35.26	117.75±31.02	0.9070

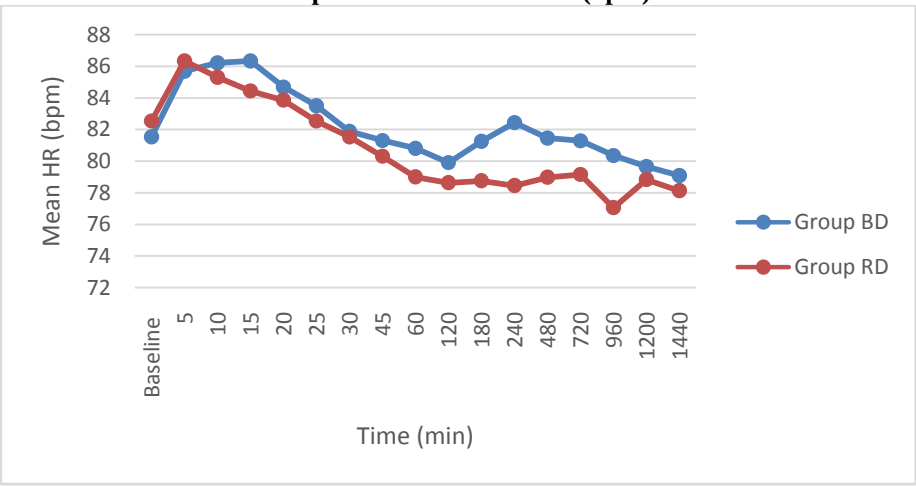
Table 2: Side Effects and Complications

Side effects	Group BD n (%)	Group RD n (%)
Nausea	1(2.5%)	0
Vomiting	0	1(2.5%)
Hypotension	0	0
Bradycardia	0	0
Others	0	0

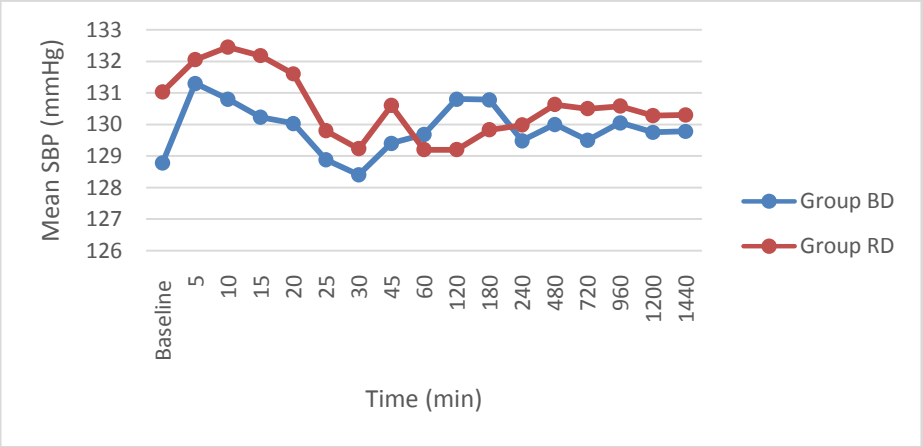
Table 3: Characteristics of Block

Parameters (min)	Group BD (Mean±SD)	Group RD (Mean±SD)	p Value
Onset of sensory block	11.15±3.05	9.40±2.75	0.0086
Onset of motor block	16.15±3.14	13.60±2.86	0.0003
Duration of sensory block	603±122.74	795.25±143.44	<0.0001
Duration of motor block	554±135.48	680.25±147.49	0.0001
Duration of analgesia	795.50±76.47	932.25±71.75	<0.0001

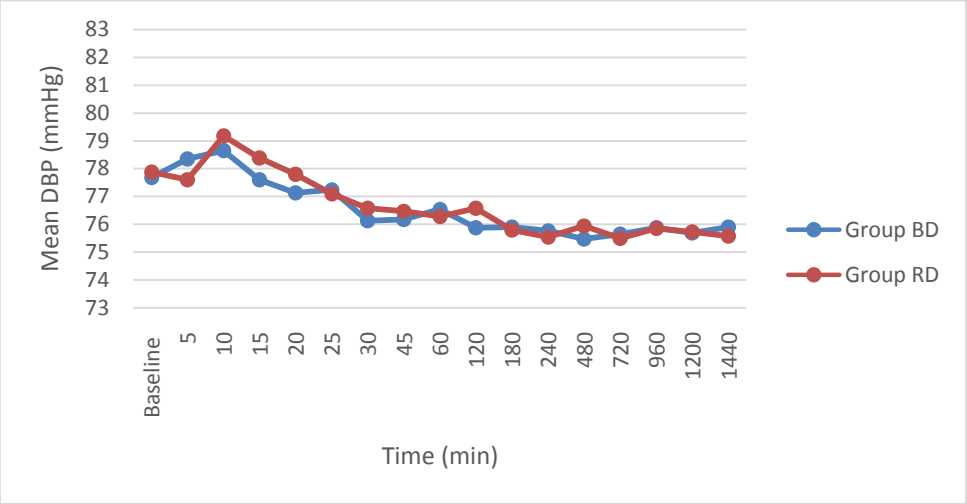
Graph 1: Mean Heart Rate (bpm)



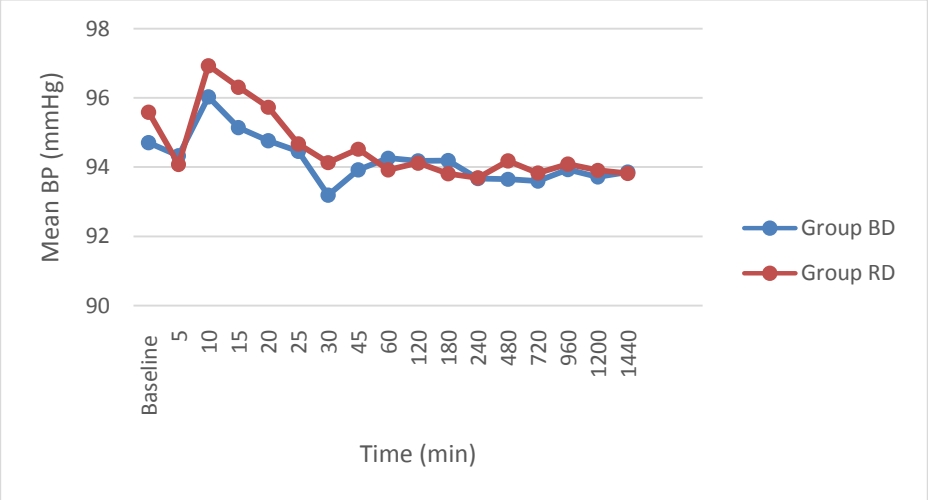
Graph 2: Mean Systolic Blood Pressure (mmHg)



Graph 3: Mean Diastolic Blood Pressure (mmHg)



Graph 4: Mean Blood Pressure (mmHg)



IV. Discussion

Supraclavicular brachial plexus block with local anaesthetics provide better anaesthesia for upper limb surgeries and also provide postoperative analgesia. It significantly reduces pain, allows faster discharge from hospital and avoids complications associated with general anaesthesia. Recently dexamethasone has been studied as an adjuvant to local anesthetic in peripheral nerve block[5].Perineural injection of dexamethasone prolongs postoperative analgesia. It relieves pain by reducing inflammation and blocking transmission of nociceptive C fibers and by suppressing ectopic neural discharge. Steroids also induce vasoconstriction and decrease the systemic absorption of local anaesthetic**.**

Gonuguntla S B et al[3]observed comparatively earlier onset of sensory and motor block with bupivacaine and dexamethasone as compared to our study, as high volume of drug was used and assessment of block was done at every one minute in their study while every three minute in our study.Relatively earlier onset of sensory and motor block in our study in RD group as compared to Krishna S S et al[6] was due to use of USG resulting in more precise localization of brachial plexus and deposition of drug. Higher concentration of bupivacaine(0.5%) and the use of ultrasound in our study as compared to the studies of Shaikh M R et al[7] (0.25%) and Nigam et al[8] (0.375%) might have resulted in earlier onset of sensory and motor block in our study.

Despite the use of same concentration of drug by Dar F A et al[9] (0.5% ropivacaine), use of ultrasound in our study could have resulted in earlier onset and prolonged duration of sensory and motor block.Mean duration of sensory and motor block was prolonged in our study as compared to the study of Nigam et al[7]due to the use of higher concentration of drug(0.5%) in our study. Alarasan A K et al[10]also observed shorter duration of sensory and motor block with bupivacaine and dexamethasone which is explained by use of high volume of study drug in our study(30 ml) as compared to their study(20 ml).

Mean duration of analgesia was prolonged in our study as compared to study of Modak S et al which could be due to use of dexamethasone with ropivacaine and bupivacaine as an adjuvant in our study instead of epinephrine which was used in their study. Mean duration of analgesia was prolonged with bupivacaine and dexamethasone in the study of Shrestha B R et al[11]as compared to our study. This can be explained by the use of large volume of drug in their study (0.5% bupivacaine 2mg/kg dilutedin 15 ml distill water and dexamethasone 8 mg) and analgesic was given when patients began to experience worst pain (VAS= 8-10) which was considered as duration of analgesia. Whereas first request of analgesic by the patient was considered as duration of analgesia in our study.In our study we observed prolonged duration of analgesia as compared to the studies of Kumar S et al[12]and Islam S M et al[13] which can be explained by USG guided block resulting in more precise deposition of drug.Comparatively longer duration of analgesia with bupivacaine and dexamethasone was found in the study of Pathak R G et al[13] as analgesicwas given when patients experienced worst pain (VAS= 8-10), while we considered first request of analgesic as duration of analgesia in our study.Mean duration of analgesia in bupivacaine dexamethasone group was prolongedin the study of El-Baradey G F[15] et al as compared to our study which could be due to difference in assessment technique of pain. Pain was assessed by VAS at 1, 3, 5, 10, 15, 20, 30 and 45 min then hourly up to 6 hours, 2 hourly up to 16 hours and 4 hourly until 24 hours. Postoperative rescue analgesic was considered if VAS 4 – 6, while first request of analgesic was considered as duration of analgesia in our study. Solanki N M et[16] al observed prolonged duration of analgesia as compared to our study because VAS was recorded 2 hourly and analgesic was given at VAS >4.

Higher incidences of side effects and complications in the study of Islam S M et al[13] and Pathak R G et al[14] could be due to the use of blind technique in their study whereas we used USG for brachial plexus localization.

Our study had some limitations like it was observational study. It did not exclude systemic action of steroid following absorption from the injection site, follow up for nerve injury was not done beyond 24 hours.

V. Conclusion

Addition of dexamethasone as an adjuvant with ropivacaine significantly prolongs the duration of analgesia as compared to bupivacaine. It also provides faster onset of sensory and motor block and prolongs the duration of sensory and motor block with minimal adverse effects.

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