Original Article

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Effect of Intravenous Dexamethasone in Prolonging the Duration of Supraclavicular Brachial Plexus Block with 0.5% Ropivacaine: A Prospective, Randomized, Placebo Controlled Study

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Abstract

Background: Supraclavicular brachial plexus block provides excellent, but time limited analgesia. In this study, we evaluated the effect of intravenous (IV) dexamethasone on the duration of the supraclavicular brachial plexus block with ropivacaine. The primary end points were onset and total duration of sensory and motor block, quality of analgesia and duration of analgesia.

Materials and Methods: After obtaining Institutional Ethical Committee's approval and getting informed consent from the patients, 80 patients were divided into two groups RD and R comprising of 40 each in a randomized, double blinded fashion. Group RD received 30 ml of 0.5% ropivacaine with IV dexamethasone 10 mg (2.5 ml). Group R received 30 ml of ropivacaine with IV 2.5 ml of normal saline. Motor and sensory block onset times, block duration, quality and duration of analgesia were recorded.

Results: Demographic and surgical characteristics were similar in both the groups. The mean duration of analgesia in Group RD was 934 ± 68 min (15.56 h), whereas in Group R, it was 342 ± 48.7 min (5.7 h) ($P < 0.0001$). The mean duration of motor block in Group RD and Group R were 425 ± 38.2 min (11.12 h) and 226 ± 36.4 min (6.2 h), respectively ($P < 0.0001$). Both these data were highly significant statistically.

Conclusion: IV dexamethasone significantly prolongs the analgesic duration of single-shot supraclavicular brachial plexus block with ropivacaine. As dexamethsone is not licensed for perineural use, clinicians should consider IV administration of dexamethasone to achieve increased duration of analgesia.

Key words: Dexamethasone, Ropivacaine, Supraclavicular brachial plexus block

INTRODUCTION

Regional block technique, like brachial plexus block is a popular and widely employed block for peri-operative anesthesia and as analgesia for surgeries of the upper extremity.[1] Now-a-days various drugs have been used with local anesthetics to achieve quick results, dense and prolonged block.[2] Unwanted effects of the anesthetic drugs which are used during general anesthesia, stress of laryngoscopy and tracheal intubation with the use of regional nerve block are avoided.[3] Along with this other local anesthetics drugs like morphine, epinephrine, clonidine, pethidine, midazolam are used.[4] However, these may lead to certain side-effects such as sedation, psychomimetic effects, respiratory depression, pruritis, etc.[5] Drugs having minimal side-effects and prolonged duration of analgesia are always looked for. In literature various studies have proved the efficacy like steroids such as Dexamethasone, which prolongs effects on the duration of regional nerve blocks.[6] It is very potent and selective glucocorticoid. Usually, this drug is used for anti-inflammatory and immunosuppressant action.[7] Clinical uses of dexamethasone are also used to treat patients suffering from neuropathic pain and complex regional pain

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syndromes.[8,9] The systemic anti-inflammatory properties are probably responsible for prolonged analgesia after single shot supraclavicular block. Our aim is to evaluate the efficacy of intravenous (IV) dexamethasone with ropivacaine in prolonging the duration of supraclavicular block compared with ropivacaine with normal saline.

MATERIALS AND METHODS

The present study was conducted from May 2014 to August 2014 in Government General Hospital, Rangaraya Medical College, Kakinada. Ethical clearance was obtained from Ethical Committee approval and informed consent was taken from patient those who were included in study. A total of 80 patients aged between 20 and 45 years posted for elective orthopedic surgeries of upper limb under supraclavicular brachial plexus block, belonging to American Society of Anesthesiologists (ASA) grading I and II of either sexes, weighing 40-75 kg were taken up for this study.

Exclusion Criteria

- Patient whose refused to participate in study
- Patients belonging to ASA III and IV
- Patients having history of allergy to local anesthetics or corticosteroids like dexamethasone
- Coagulopathy, diabetes mellitus
- Local infection at the site of proposed puncture for supraclavicular block
- Systemic use of corticosteroids within 6 months before surgery
- Pre-existing neuropathy involving the surgical limb.

Patients were randomly divided by simple random sampling into two groups, such as RD and R with 40 of them in each group.

In the operation theatre, IV fluid was started and IV access was secured with 18G cannula on the opposite limb. Baseline parameters were recorded by attaching all the basic monitoring devices like oxygen saturation (SpO_2), electrocardiogram (ECG), noninvasive blood pressure (NIBP).

Premedication was given to patient with tablet rantac - 150 mg night before surgery and injection midazolam 0.05 mg/kg intra-muscular (IM) 1 h prior to surgery.

Then later in supine position with head turned 45° to the opposite side and arm placed by the side of chest supraclavicular block was performed using nerve stimulation technique. Then needle insertion site was prepared with by use of antiseptic solution. About 1-1.5 cm above the midclavicular point subclavian artery pulsations were felt, 50 mm long insulated needle was inserted in caudad, backward and medial direction. When muscle contractions were seen at stimulating current between 0.2 mA and 0.5 mA at 2 Hz frequency with pulse width of 0.1 ms, drugs were injected with intermittent negative aspiration. Group RD received 30 ml of 0.5% ropivacaine with 10 mg (2.5 ml) dexamethasone IV. Group R received 30 ml of ropivacaine with 2.5 ml of IV normal saline.

After institution of the blockade following parameters were assessed:

- Sensory blockade was tested using pin prick method along the distribution of the four nerves (median nerve, radial nerve, ulnar nerve and musculocutaneous nerve)
- The duration of analgesia is defined as the time interval between the end of local anesthetic administration to the time when patient had visual analog scale score of ≥4
- Onset of sensory blockade is considered as the time interval between the end of local anesthetic administration and loss of sensation to pin prick
- Motor blockade assessment was done using the modified Bromage scale for upper extremities on a three point scale.

Modified Bromage Scale (Three Point Scale)

- Grade 0 = Normal motor function with full flexion/extension of elbow, wrist and fingers
- Grade 1= Decreased motor strength with ability to move fingers and/or wrist only
- Grade 2= Complete motor blockade with inability to move fingers.
    - Onset of motor blockade is considered as the time interval between the end of local anesthetic administration and inability to move fingers
    - The duration of motor blockade is defined as the time interval between the end of local anesthetic administration and the recovery of complete motor function of the hand and forearm
    - Surgery was allowed to proceed when complete anesthesia was achieved. Intra-operatively heart rate, ECG, NIBP, SPO_2 were monitored
    - The quality of intra operative analgesia was judged by the investigator at the end of surgery.

As excellent (no discomfort or pain) good (mild pain or discomfort, no need for additional analgesics) fair (pain that required additional analgesics) or poor (moderate or severe pain that needed more than 100 μg of fentanyl or general anesthesia.

Post operatively, motor blockade and verbal rating scale score were assessed every hourly. Injection diclofenac 75 mg IM was administered as rescue analgesic.

Statistical Analysis

Data were compiled systematically and Student's *t*-test, Chi-square test were use to analyzed the data. $P < 0.05$ was considered as significant and $P < 0.0001$ as highly significant.

RESULTS

The study was conducted on eighty patients.

In both the groups, patient's demographic profiles were comparable with regards to age, sex, weight, ASA status and mean duration of surgery (Table 1).

The mean time to onset of sensory block in minutes was 16.92 ± 4.63 in Group RD and 18.46 ± 3.55 in Group R ($P = 0.19$). Statistically not significant.

The mean time to onset of motor block in minutes in Group RD and Group R was 21.82 ± 3.61 and 23.43 ± 3.89 respectively ($P = 0.1359$). Statistically not significant.

Mean time to onset of sensory and motor blockade were earlier in dexamethasone group compared to the control group, but it is not statistically significant ($P > 0.05$).

Duration of motor block and duration of analgesia were prolonged in dexamethasone group compared to the control group. It is statistically very significant as $P < 0.0001$ (Figure 1).

In our study, the mean duration of analgesia in Group RD was 934 ± 68 min (15.56 h) whereas in Group R it was 342 ± 48.7 min (5.7 h) ($P < 0.0001$), highly significant statistically.

The mean duration of motor block in Group RD and Group R were 425 ± 38.2 min (11.12 h) and 226 ± 36.4 min (6.2 h) respectively ($P < 0.0001$), highly significant statistically.

Interpretation: The pain scores of RD group were significantly less than the ropivacaine group (Figure 2).

Incidence of nausea in Group RD was 4%, in Group R was 16%, which is statistically significant.

Incidence of tingling/numbness in the early post-operative period is 4% in Group RD, 8% in Group R, which is statistically not significant.

DISCUSSION

Regional anesthesia is a simple, safe, effective technique of anesthesia having distinct advantages over general and IV regional anesthesia very particularly for day care surgeries. Hence, regional anesthesia techniques are gaining prominence now-a-days. The main reason is they can be utilized for analgesia during post-operative period besides avoiding all the problems associated with general anaesthesia.[10]

Supraclavicular brachial plexus block is also simple to perform, safe and effective technique which produces a reliable block of the upper extremity.[11] Several adjuvants like ketamine, epinephrine, opioids, alpha-2 agonists etc. can be added to local anesthetics to prolong the duration of regional blocks and also to intensify the quality of regional blocks.[12,13] In our study we evaluated the efficacy of IV. Dexamethasone added to ropivacaine for supraclavicular brachial plexus block.[14]

Intra operative assessments regarding the onset, duration and quality of both sensory and motor blocks were carried out by an observer anesthetist who was blinded to group allocation and the study drug.

The demographic profiles of the patients in both the groups were comparable with regards to age, sex and weight, ASA status and mean duration of surgery. Statistically not significant ($P > 0.05$).

The mean time to onset of sensory block in minutes was 12.5 ± 2.6 in Group R and 11.9±2.8 in Group RD ($P = 0.875$). Statistically not significant (Table 2).

The mean time to onset of motor block in minutes in Group R and Group RD was 17.3 ± 2.7 and 16.2 ± 1.89 respectively ($P = 0.74$). Statistically not significant.

Steroids are very potent anti-inflammatory and immunosuppressive agents. Perineural/IV injection of

Table 1: Comparison of demographic data

Demographic data	R	RD	*P* value
Age	51.0±12.6	50.6±14.0	0.959 (>0.05)^{NS}
Sex (M: F)	15:10	16:9	0.382 (>0.05)^{NS}
Weight	62.4±6.8	63.3±3.2	0.905 (>0.05)^{NS}
ASA I/II	22/3	21/4	0.858 (>0.05)^{NS}
Surgical duration (min)	93±36	98±42	0.5692^{NS}

Values are expressed as mean±standard deviation, NS: Not significant

Table 2: Comparison of block characteristics in two groups

	R	RD	*P* value
Onset of sensory block (min)	12.5±2.6	11.9±2.8	0.875 (>0.05)
Onset of motor block (min)	17.3±2.7	16.2±1.89	0.740 (>0.05)
Duration of analgesia (min)	342±48.7	934±68.1	0.0001 (<0.05)
Duration of motor block (min)	226±36.4	425±38.2	0.0001 (<0.05)

steroids is reported to influence post-operative analgesia as well.[15,16]

IV/perineural use of dexamethasone has an equivalence analgesic effect in a study done by Desmet *et al.*[17] When given systemically after intracellular uptake glucocorticoids will activate cytoplasmatic glucocorticoid receptors which will bind to glucocorticoid response elements in DNA. This leads to both decreased production of inflammatory proteins (Ox-2, iNOS, cytoplasmic phospholipase A2, interleukins [ILs] inflammatory chemokines, etc.) and increased production of anti-inflammatory proteins (lipocortin-1 [IL-1]) receptor antagonist.

Though the safety of perineural dexamethasone has been questioned, the use of dexamethasone at doses between 4 and 12 mg via IV, perineural and epidural routes is described in regional anesthesia and pain medicine text books.[18] However *in vivo* and *in vitro* animal studies also proved that locally applied corticosteroids have no long term effects on the structure, electric properties or function of peripheral nerves.[19]

Synthetic glucocorticoid dexamethasone is preferred in various studies because of its potential and lack of mineralocorticoid activity. Dexamethasone is also known for its anti-emetic property. Dexamethasone is the preferred anti-emetic agent in cases of refractory nausea and vomiting.

Limitations of our study are we did not use ultrasound guided block as our experience was insufficient to use US based technique. Analgesics were only administered on request and a post-operative regimen with regular analgesic administration might have impacted our secondary outcomes. Such a regimen is often not easy to implement in an ambulatory setting.

We did not follow up the patients for long periods >3 months for chronic neurological effects of dexamethasone. The dose we used in our study is a safe dose, which was proved in several clinical trials. No significant side-effects were noted in the study group in our study.

Kopacz and Holte *et al.*, found that addition of small amounts of dexamethasone to bupivacaine incorporated in micro capsules prolonged local analgesia compared with microcapsules with plain bupivacaine after subcutaneous administration in humans Pathak *et al.*, showed that there was no significant difference in the onset time to sensory and motor blocks between two groups in their study, which correlated with the findings of our study.[20]

In our study, the mean duration of analgesia in Group RD was 934 ± 68 min (15.56 h) whereas in Group R it was 342 ± 48.7 min (5.7 h) ($P < 0.0001$), highly significant statistically (Table 3).

The mean duration of motor block in Group RD and Group R were 425 ± 38.2 min (11.12 h) and 226 ± 36.4 min (6.2 h) respectively ($P < 0.0001$), highly significant statistically.

In a previous study by Cummings *et al.*, they reported that dexamethasone prolonged analgesia from interscalene blocks using ropivacaine or bupivacaine, with the effect being stronger with ropivacaine. Dexamethasone with either drug prolonged the duration of analgesia.[21]

In a study by Shrestha *et al.*, the authors found that there was significantly faster onset of action (14.5 ± 2.10 min

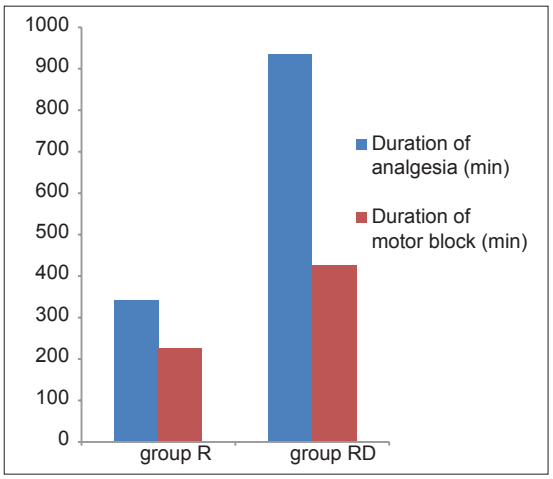

Figure 1: Peri-operative block characteristics

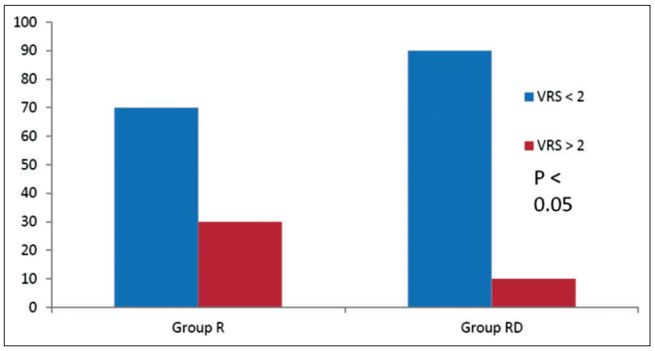

Figure 2: Comparison of verbal rating scale of two groups

Table 3: Quality of analgesia in two groups

	Group-R	Group-RD	*P* value
Excellent	38	27	>0.05
Good	2	2	
Fair	0	1	
Poor	0	0	
Time to first analgesic request (h)	5.7±0.40	15.56±0.30	<0.0001
Post-operative analgesic consumption during the first 24 h (*n* [%])	30 (75)	18 (45)	0.0115

Values are expressed as mean±standard deviation, numbers or %

vs. 18.15 ± 4.25 min; $P < 0.05$) and prolonged duration of analgesia (12.75 ± 5.33 h vs. 3.16 ± 0.48 h; $P < 0.001$) in the dexamethasone group than in the other group.[22]

Parrington *et al.*, showed that dexamethasone added to mepivacaine prolongs the duration of analgesia (332 min vs. 228 min in control group) after supraclavicular brachial plexus block. The onset time of sensory and motor blocks were similar in both the groups.[23]

Several studies have shown that addition of 4-8 mg of dexamethasone to local anesthetics effectively and significantly prolongs the duration of analgesia.

There is no significant hemodynamic variability between the two groups.

Incidence of nausea in Group RD was 4%, in Group R was 16%, which is statistically significant. Lower incidence of nausea is because of antiemetic action of dexamethasone.

Incidence of tingling/numbness in the early post-operative period is 4% in Group RD, 8% in Group R, which is statistically not significant. The tingling/numbness disappeared few hours later post-operatively.

CONCLUSION

Administration of IV dexamethasone along with supraclavicular brachial plexus block with local anesthetics significantly helps in prolonging duration of analgesia in patients undergoing upper limb surgeries and is comparatively safe and cost-effective method of providing post-operative analgesia.

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