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Research Article

Comparison Between Dexamethasone Versus Clonidine as Adjuvants to 0.75% Ropivacaine in Ultrasound Guided Brachial Plexus Block for Upper Limb Orthopedic Surgeries: A Randomized Prospective Clinical Study

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ABSTRACT

Background: Ropivacaine is an amino-amide local anesthetic, extensively used for peripheral nerve blocks, numerous adjuvants have been added to Ropivacaine to prolong the duration of analgesia. Aim: To compare the effectiveness of adding Dexamethasone to Ropivacaine versus adding Clonidine to Ropivacaine in ultrasound guided supraclavicular brachial plexus block in terms of analgesic duration, onset & duration of sensory and motor blockade.

Methods: A prospective randomized single blinded study carried out in 70 patients of ASA grade I and II, aged 20 to 60 years scheduled for elective upper limb orthopedic surgeries. Patients were randomly allocated into two groups, Group RC - patients received 20ml of 0.75% ropivacaine along with 1mcg/kg of clonidine diluted to 2ml of normal saline, Group RD - patients received 20ml of 0.75% ropivacaine along with 8mg of dexamethasone (2ml). Statistical Analysis: Onset & duration of sensorimotor blockade, duration of analgesia was assessed by Unpaired t-test. If p-value <0.05, results were statistically significant & p-value <0.001 were highly significant.

Results: Duration of analgesia is superior and statistically significant in Group RD (1,172.57± 18.37 vs 931.09± 16.3). Onset time for sensory (3.14 ± 1.00 vs 9.71± 1.23) and motor (7.60 ± 1.54 vs 13.66± 1.03) block is rapid in Group RD. Duration of sensory (1,106.57± 20.28 vs 786.26± 31.43) and motor (997.74 ± 24.9 vs 674.57 ± 2.18) block is enhanced in Group RD.

Conclusion: Dexamethasone as an adjuvant to ropivacaine provided superior post-operative analgesia, faster onset and longer duration of sensory and motor blockade.

Introduction

For upper limb surgery, peripheral nerve blocks are better anaesthetic choice as they offer long-lasting pain relief [1]. Supraclavicular brachial plexus block provides most reliable anaesthesia of entire upper extremity in time efficient manner. Block is free of systemic side effects & provide intraoperative anaesthesia and postoperative analgesia [2]. With the development of ultrasound imaging, it is now easy to locate brachial plexus prior to the block, direct the block needle to the target nerves, and visualize local anesthetic spread, all of which results in a denser block and lesser incidence of complications [3].

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Ropivacaine is derived from the parent chiral compound propivacaine and is an optically pure S (-) enantiomer. Ropivacaine blocks impulse conduction in nerve fibers by causing reversible suppression of sodium ion inflow. Due to it is lower lipophilicity & stereoselective characteristics, ropivacaine has substantially greater threshold for CVS and CNS toxicity than bupivacaine [4].

Clonidine, an imidazoline with selective partial agonist activity at α-2 adrenergic receptors has been used as an adjuvant to ropivacaine for regional anesthesia, including epidural anesthesia. It has also been utilized as a centrally acting anti-hypertensive drug. The clinical application of peripheral nerve blocks has taken on a new dimension with the addition of α-2 adrenoceptor agonist. It has been discovered that adding clonidine to a local anesthetic increases the duration of nerve block [5].

Steroids have anti-inflammatory and analgesic properties. Perineural administration of steroids has been reported to improve post-operative analgesia & to prolong regional anaesthesia [6].

Recent studies suggest that 8mg dexamethasone added to perineural local anaesthetic injections increase the analgesia of peripheral nerve blocks [7].

Methods

On approval from Institutions Ethical committee, a randomized prospective single blinded study with CTRI/2020/11/029387 was done at Rajarajeswari Medical College in 70 patients belonging to ASA grade I and II, aged 20 to 60 years, posted for upper limb orthopedic procedures by ultrasound guided supraclavicular brachial plexus block. Patients with local anesthetic hypersensitivity, bleeding disorders, seizure disorder, neurological diseases, liver disease, renal disease, uncontrolled diabetes mellitus, pregnant & lactating women were not included in the study. General anaesthesia was induced in case of unsuccessful block & those patients were excluded from the study. Patients were allocated into Group RD & Group RC based on sealed envelope method. With respect to previous study by Gupta S et al, [8] with a confidence level of 95% and keeping the mean time of duration of analgesia as one of the primary variables at the p value of < 0.05, we selected 35 patients in each group for our study. Group RC - patients receiving 20ml of 0.75% ropivacaine with 1mcg/kg clonidine constituted to 2ml normal saline, Group RD - patients receiving 20ml of 0.75% ropivacaine with 8mg dexamethasone(2ml). All patients underwent detailed pre-anesthetic workup and evaluation on the day before surgery. Patients were informed regarding the procedure, taught to interpret the visual analogue scale (VAS) & written consent was taken. Fasting guidelines were followed. Oral alprazolam 0.25mg & ranitidine 150mg night before surgery was advised. Inj. Ondansetron 4mg & inj. Ranitidine 50mg, half an hour prior to surgery were given.

Standard anesthesia monitoring such as heart rate, non-invasive blood pressure, ECG & oxygen saturation (SpO2) were started once the patient gets shifted to operation theatre. In the unaffected limb intravenous line with 18G cannula was secured & fluids were given accordingly.

Tray containing all necessary drugs and equipments for giving brachial plexus block was prepared. Group RD & Group RC were unaware of the composition of the drugs. Patients were positioned supine on the operating table with pillow under the shoulder & head turned 45 degrees to the contralateral side. Sonosite machine with 12 MHz linear type probe used. Supraclavicular fossa was scanned to locate the subclavian artery, first rib, pleura and brachial plexus cluster (Figure1) after aseptic skin preparation. Skin was infiltrated with local anesthetic & 23G spinal needle was directed from lateral to medial direction along the long axis of ultrasound beam & advanced towards the 'corner pocket', half of the prepared volume of ropivacaine mixture either with 1mcg/kg clonidine constituted to 2ml normal saline or 8mg dexamethasone injected after negative aspiration. Needle was repositioned & remaining volume of anesthetic mixture was injected just above and lateral to subclavian artery.

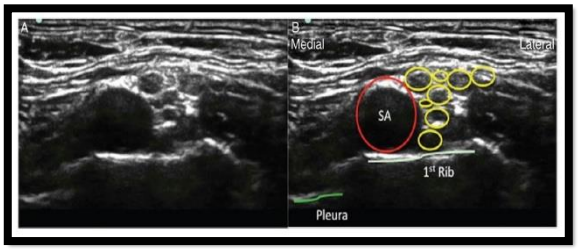

Figure 1- Ultrasound image of brachial plexus

Assessment of sensorimotor block was done soon after the block procedure was completed. Patients were followed post-operatively for analgesic duration and other block characteristics at regular intervals.

The study characteristics were defined as below:

Duration of analgesia defined as time between complete sensory block & first analgesic request by the patient.

Sensory onset defined as time interval between end of local anaesthetic administration & complete sensory block.

Duration of sensory block defined as time interval between complete sensory block & complete resolution of anesthesia in the area of distribution of the concerned nerves.

Motor onset defined as time interval between total local anaesthetic administration & complete motor block in the patient.

Duration of motor block defined as time interval from complete motor block to complete recovery of motor function of hand and forearm.

Assessment of sensory block was done by placing a wisp of cotton over the patient's skin & appreciating the patient's response to the stimuli.

Assessment of motor block was evaluated by thumb opposition (median nerve), thumb abduction (radial nerve) & thumb adduction (ulnar nerve) on a 3-point scale.

0= normal motor function,

1= reduced motor strength but able to move fingers,

2= complete motor block

Ramsay Sedation Scale (RSS) was used intra-operatively & post-operatively to assess sedation score.

1= awake, anxious, agitated, or restless;

2= awake, cooperative, oriented, or tranquil;

3= awake, responds to commands only;

4= asleep, brisk response to light, glabellar tap or loud noise;

5= asleep, sluggish response to light, glabellar tap or loud noise;

6= asleep, no response to light, glabellar tap or loud noise;

Adverse events such as respiratory depression, hypoxemia, bradycardia, sedation, hypotension, nausea & vomiting were documented. Bradycardia defined as HR<50bpm. Hypotension defined as decline in BP<20% from baseline recordings. Intra-operatively & post-operatively haemodynamics were assessed. To assess pain VAS was used & if VAS >4, rescue analgesic was considered. Inj. paracetamol 1g i.v was the rescue analgesic used and it's requirement in post-operative period was documented in both groups and computed accordingly.

Data processed in MS excel/analyzed using SPSS software version 16. Demographic & hemodynamic data analysis done by Student t-test. Unpaired t-test used to assess onset and duration of sensorimotor blockade, duration of analgesia. If p-value <0.05, results were statistically significant & p-value <0.001 were highly significant.

Results

Seventy patients were recruited for the study and were divided into two groups, Group RC- receiving 20ml of 0.75% ropivacaine with 1mcg/kg clonidine constituted to 2ml of normal saline. Group RD- receiving 20ml of 0.75% ropivacaine with 8mg of dexamethasone(2ml).

Successful ultrasound guided brachial plexus block was given, none of the patients were excluded from the study in either of the groups. According to our observation analgesic duration noted to be longer in Group RD (1,172.57± 18.37) when compared to Group RC (931.09± 16.3) with p-value of <0.001 (Table 1).

On addition of dexamethasone to ropivacaine, we noted early occurrence of sensorimotor blockade. Onset time for sensory (3.14 ± 1.00 vs 9.71± 1.23) and motor blockade (7.60 ± 1.54 vs 13.66± 1.03) was significant statistically (Table 2).

Sensory blockade duration was prolonged in Group RD (1,106.57± 20.28) when compared to Group RC (786.26± 31.43). Motor blockade was also enhanced to greater degree in Group RD (997.74 ± 24.9) when compared to Group RC (674.57 ± 2.18) (Table 3).

Sedation score in Group RC was high. Group RD had less VAS score compared to Group RC. We used inj.paracetamol 1g slow i.v as rescue analgesic in postoperative period among both the groups. Total analgesic requirement was reduced in Group RD. Rescue analgesic request was early in Group RC.

No apparent local anaesthetic toxicity was noted in either of the group. We did not encounter any significant haemodynamic disturbances or adverse effects in both groups.

Table 1- Duration of Analgesia

Variables	Group RD	Group RC	P value
Duration of Analgesia	1,172.57 +/- 18.37	931.09± 16.3	<0.001

Table 2- Onset time of Sensory and Motor block

Variables	Group RD	Group RC	P value
Onset of sensory block	3.14 ± 1.00	9.71± 1.23	<0.001
Onset of motor block	7.60 ± 1.54	13.66± 1.03	<0.001

Table 3- Duration of Sensory and Motor block

Variables	Group RD	Group RC	P value
Duration of sensory block	1,106.57± 20.28	786.26± 31.43	<0.001
Duration of motor block	997.74 ± 24.9	674.57 ± 2.18	<0.001

Discussion

Excellent analgesia is provided by USG guided brachial plexus block. It is used for majority of peripheral nerve blocks. Nerve clusters are better visualised and identified and hence block quality is considered superior. Occurrence of accidental intra- arterial injection can also be avoided. As the pleura is visible, there is negligible chance of pneumothorax. Relatively lower volume of local anaesthetic is required for USG guided block.

Our randomised single blinded study has shown that post-operative analgesia achieved was of superior degree when dexamethasone was used as an adjuvant to ropivacaine. Even duration of sensorimotor blockade was prolonged. We used ropivacaine in our study as it is cardio-stable and minimally neurotoxic.

Due to common adverse effects like bradycardia, sedation & hypotension we used small dose 1mcg/kg clonidine. Peter Marhofer et.al, [9] used 4mg

dexamethasone in axillary plexus block & concluded dexamethasone 4mg to have no relevant clinical effect on the duration of sensory block provided, hence based on these observations we used 8mg of dexamethasone perinuerally for our study.

Numerous studies have used clonidine and dexamethasone as an adjuvant to local anaesthetic in peripheral blocks. In our study we have used 8mg of dexamethasone with comparison of 1mcg/kg clonidine as adjuvant in patients undergoing upper limb procedures and found dexamethasone to prolong duration of both sensory and motor blockade. Duration of analgesia was lengthened with the use of dexamethasone. Rescue analgesic requirement was less in Group RD.

Singelyn et.al, [10] demonstrated that ropivacaine is equipotent to bupivacaine having similar pharmacokinetic profile. We used ropivacaine in our study due to it is lower CVS & CNS toxicity.

Ferhoz Ahmed Dar et.al, [11] investigated that dexamethasone added to ropivacaine enhanced analgesic duration & block duration. VAS score was less in the group which received dexamethasone. This is in accordance with our study.

Ali et.al, [12] noted significant increase in motor and sensory blockade when clonidine was added to ropivacaine & found out higher incidence of bradycardia in clonidine group. Even sedation scores were more in the patients whom clonidine was used as an adjuvant to ropivacaine, this showed significant statistical difference in terms of arousability in patients whom clonidine was used. Our study showed similar observations.

Nahel et.al, [13] conducted an observational study of prospectively collected data of patients who received brachial plexus block (BPB). Multiple, rescue, unsuccessful, and distal nerve blocks of the upper extremity were excluded. The duration was calculated from the time the block was performed until the resolution of the block by patient report. After exclusions, 3,706 nerve blocks were analyzed and they found that dexamethasone was superior to clonidine, hence block duration was enhanced with dexamethasone.

In a study conducted by Thiago Mamoro Sagae et.al, [14] they were of the opinion that perineural dexamethasone was more effective than intravenous dexamethasone in prolonging the duration of blockade. Incidence of postoperative nausea and vomiting was less with both intravenous and perineural dexamethasone. VAS score revealed perineural dexamethasone was responsible for prolonged postoperative analgesia when compared to intravenous dexamethasone.

In a similar study conducted by Eric Albercht et.al, [15] they concluded that steroids are superior to alpha 2 agonists when used as adjuvants in peripheral nerve blocks. Alpha 2 agonists had risks of hypotension and sedation, though they had some adjuvant effects.

There are few limitations in our study. Further research is required with large sample size to examine perineural efficacy of clonidine and dexamethasone when added to local anaesthetics as there are limited human clinical trials.

Conclusion

Our study revealed that dexamethasone has superior analgesic profile when compared to clonidine on addition to ropivacaine. Onset of sensory and motor block was rapid in patients who received dexamethasone. Duration of sensory and motor block was prolonged with dexamethasone group. No adverse events were noted in either of the group. Dexamethasone enhanced the block characteristics on addition to ropivacaine. Analgesic requirement was reduced in patients who received dexamethasone. Hereby, we conclude that dexamethasone on addition to ropivacaine produces better block characteristics and is one of the potential adjuvant to ropivacaine in ultrasound guided brachial plexus block when compared to clonidine.

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