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DEXAMETHASONE VERSUS DEXMEDETOMIDINE AS ADJUVANTS TO ROPIVACAINE FOR SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK- PROSPECTIVE, RANDOMISED, DOUBLE BLIND STUDY

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Abstract
Background: Supraclavicular brachial plexus blockade (SBPB) is commonly performed regional anesthetic technique for forearm and hand surgeries, and its blockage provides good surgical anesthesia. **Aim:** Considering the efficacy of adjuvant for ropivacaine in SBPBs, we designed a double-blind randomized control study to compare the characteristics and side effects of ropivacaine along with dexamethasone versus dexmedetomidine in SBPBs in patients scheduled for upper limb surgeries. **Material and Methods:** Present study was single-center, prospective, randomised, double blind study, conducted patients aged 18-70 years, belonging to American Society of Anaesthesiologists physical status (ASA) of I or II, scheduled for Upper limb surgeries under SBPB. **Results:** In present study, 108 patients were studied, 54 patients received 20 ml 0.5% Ropivacaine with 50 mcg Dexamethasone (Group A, n=54), while other 54 patients received 20 ml 0.5% Ropivacaine with 50 mcg Dexmedetomidine (Group B, n=54). Age, weight, gender, ASA grade & duration of surgery were comparable in both groups. Dexamethasone group has earlier onset of sensory block, earlier onset of motor block, prolonged duration of sensory block & prolonged duration of motor block as compared to dexmedetomidine group & difference was statistically significant ($p< 0.05$). Dexamethasone group duration of analgesia, delayed first rescue analgesic requirement & less doses of rescue analgesia required as compared to dexmedetomidine group & difference was statistically significant ($p< 0.05$). **Conclusion:** Dexamethasone is a better alternative than dexmedetomidine since it shortens the onset of sensory and motor block, prolongs the duration of sensory and motor block and prolongs the duration of analgesia.
Keywords: Dexmedetomidine, dexamethasone, adjuvants, ropivacaine, supraclavicular brachial plexus blockade

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Introduction

Supraclavicular brachial plexus blockade (SBPB) is commonly performed regional anesthetic technique for forearm and hand surgeries, and its blockage provides good surgical anesthesia. It is most compactly arranged in supraclavicular region, and hence smaller volume of local anesthetic drug produces reliable and intense block with optimal tourniquet coverage.[1]

Many additives to local anesthetics such as dexmedetomidine, dexamethasone, opioids, clonidine, neostigmine and tramadol etc. have been used to increase the duration of the block, to improve postoperative pain management and to avoid the need for placing catheter for continuous local anesthetic drug infusion.[2,3] Adding an adjuvant, such as, to a nerve block improves its quality and reduces perioperative analgesic consumption. LA adjuvants act by several mechanisms, they may cause local vasoconstriction limiting systemic uptake or they may have direct effects on peripheral nerves.[4,5]

Due to unique pharmacologic properties and fewer side effects, ropivacaine is being preferred by an increasing number of anesthesiologists for peripheral nerve blocks.[4,5] Considering the efficacy of adjuvant for ropivacaine in SBPBs, we designed a double-blind randomized control study to compare the characteristics and side effects of ropivacaine along with dexamethasone versus dexmedetomidine in SBPBs in patients scheduled for upper limb surgeries.

Material And Methods

Present study was single-center, prospective, randomised, double blind study, conducted in department of Anaesthesiology, at Subbaiah Institute of Medical Sciences, Shivamogga, India. Study duration was of 2 years (January 2020 to December 2019). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients aged 18-70 years, belonging to American Society of Anaesthesiologists physical status (ASA) of I or II, scheduled for Upper limb surgeries, Willing to participate in present study

Exclusion criteria

- Refusal to SBPB,
- Presence of coagulopathy or bleeding disorder,
- Local infection at the injection site,
- Hypersensitivity to local amide anaesthetics, or were hypersensitive or allergic to dexmedetomidine
- Cardiac conduction block,
- Patients on β-adrenergic antagonist or an antiplatelet agent,
- Body mass index >35 kg/m2,
- Uncontrolled diabetes mellitus,
- Significant cardiopulmonary disease, or psychiatric disease

Study was explained to patients in local language & written consent was taken for participation & study. Patients' demographic, clinical, radiological & laboratory details were noted in case record proforma. Preanesthetic checkup and routine investigations such as complete blood count, serum creatinine, and electrocardiogram (ECG) were done. Patients were kept nil by mouth for 6 h. Patients fit for surgery, were randomly allocated into two groups using standard computer-generated randomization.

- Group A - patients received 20 ml 0.5% Ropivacaine with 50 mcg Dexamethasone (n=54)

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- Group B - patients received 20 ml 0.5% Ropivacaine with 50 mcg Dexmedetomidine (n=54)

Method of concealment was sequentially numbered, sealed, opaque envelopes. Participant, investigator and outcome assessor were blinded for study.) **Sample size (n= 108)** was calculated for independent sample t test with keeping level of significance as 5% and power of the study at 80%.

After shifting the patient into operation theatre, intravenous (IV) line access was established using 18-G cannula. All non-invasive monitors such as non-invasive blood pressure, pulse rate, oxygen saturation (SpO2), and ECG were applied to all patients, and their baseline vital signs were measured. All patients were provided with supplemental oxygen using nasal cannula at 2 L/min. Patients were sedated with IV administration of midazolam 1 mg and fentanyl 30 μg before the block.

After aseptic preparation of the area, supraclavicular brachial plexus block was performed under ultrasound guidance (Sonosite, Micromaxx machine with high frequency (13 MHz) linear probe) with 30 ml of study drug (I) by an anaesthesiologist who was unaware of the nature of study drug solution. The spread of injected drug was observed sonologically in real time to achieve a satisfactory spread of the drug around the brachial plexus. Intravenous infusion of 50 ml study drug (II) was also started at the time of starting the block.

The parameters assessed were hemodynamic parameters, time of onset of sensory and motor block and duration of sensory and motor block and postoperative pain assessment by VAS score. After taking a preoperative baseline value, vital parameters, like, systolic blood pressure (SBP), diastolic blood pressure (DBP), arterial saturation (SpO2), respiratory rate (RR), and heart rate (HR) were monitored at every 3 min interval till 30 min of LA injection and then every 5 min till 1st h and thereafter every 30 min till the end of surgery.

Duration of analgesia was assessed using standard Visual analogue scale (VAS) and sedation was assessed with Ramsey sedation Score for any sedation. Rescue analgesics was given in the form of inj. Diclofenac (1.5 mg/kg) intramuscularly when VAS score is > 4 on patients request and the time of administration was noted.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

Results

In present study, 108 patients were studied, 54 patients received 20 ml 0.5% Ropivacaine with 50 mcg Dexamethasone (Group A, n=54), while other 54 patients received 20 ml 0.5% Ropivacaine with 50 mcg Dexmedetomidine (Group B, n=54). Age, weight, gender, ASA grade & duration of surgery were comparable in both groups.

Table 1: General characteristics

Characteristics	**Group A (n=54) Mean ± SD/ no. of patients (%)**	**Group B (n=54) Mean ± SD/ no. of patients (%)**	**P value**
Age (Years)	36.35 ± 7.23	35.57 ± 8.68	0.74
Height (cm)	167.2±7.9	165.2±10.1	0.317
Weight (in Kg)	59.96 ± 11.36	62.14 ± 10.46	0.52
Gender			

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Male	45 (83.33 %)	43 (79.63 %)	1.146
Female	9 (16.67 %)	11 (20.37 %)	
ASA			
Grade I	42 (77.78 %)	44 (81.48 %)	1.24
Grade II	12 (22.22 %)	10 (18.52 %)	
Duration of Surgery (min)	63.16 ± 21.68	67.37 ± 20.26	0.437

Dexamethasone group has earlier onset of sensory block (10.58 ± 3.24 min vs 12.14 ± 3.12 min), Earlier onset of motor block (13.24 ± 3.58 min vs 16.24 ± 4.18 min), prolonged duration of sensory block (732.95 ± 51.51 min vs 664.82 ± 59.36 min) & prolonged duration of motor block (829 ± 45.72 min vs 733.82 ± 42.58 min) as compared to dexmedetomidine group & difference was statistically significant ($p< 0.05$).

Table 2: Comparison of sensory and motor block characteristics.

Characteristics	**Group A (Mean ± SD)**	**Group B (Mean ± SD)**	**P value**
Onset of sensory block (min)	10.58 ± 3.24	12.14 ± 3.12	0.033
Onset of motor block(min)	13.24 ± 3.58	16.24 ± 4.18	0.012
Duration of sensory block	732.95 ± 51.51	664.82 ± 59.36	0.0001
Duration of motor block	829 ± 45.72	733.82 ± 42.58	0.0001

Dexamethasone group duration of analgesia (956.97 ± 42.57 min vs 821.46 ± 38.91 min), delayed first rescue analgesic requirement (14.57 ± 3.16 hours vs 11.25 ± 2.08 hours) & less doses of rescue analgesia required (1.2 ± 0.56 vs 1.5 ± 0.57) as compared to dexmedetomidine group & difference was statistically significant ($p< 0.05$).

Table 3: Duration of analgesia and time for first rescue analgesia in both groups.

Characteristics	**Group A (Mean ± SD)**	**Group B (Mean ± SD)**	**P value**
Duration of Analgesia (min)	956.97 ± 42.57	821.46 ± 38.91	0.0001
Time for first rescue analgesic requirement (hours)	14.57 ± 3.16	11.25 ± 2.08	0.0001
Mean total doses of rescue analgesia required	1.2 ± 0.56	1.5 ± 0.57	0.0001

Adverse effects such as nausea, vomiting, sedation, hypotension & bradycardia were noted in present study. Except sedation, other were comparable among both groups. Sedation was seen only in dexmedetomidine group.

Table 4: Comparison of adverse effects.

Characteristics	**Group A no. of patients (%)**	**Group B no. of patients (%)**	**P value**
Nausea	3 (5.56 %)	1 (1.85 %)	0.62
Vomiting	2 (3.7 %)	3 (5.56 %)	0.84
Sedation	0	6 (11.11 %)	-
Hypotension	1 (1.85 %)	3 (5.56 %)	0.62
Bradycardia	1 (1.85 %)	2 (3.7 %)	0.87

Discussion

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Advantages of Regional anesthesia over to general anesthesia are minimal preoperative preparation, no need for specialized costly equipment, minimal physiological and metabolic alterations, less stress response, minimal monitoring, longer duration of postoperative analgesia, less postoperative nausea & vomiting, decreased incidence of deep vein thrombosis, low burden on hospital management.[6,7]

Supraclavicular brachial plexus blockade is a time-tested anaesthetic technique for upper limb surgeries. Brachial plexus block also causes sympathetic block with resultant improvement in blood flow, reduction in vasospasm & edema which is more favorable for acute hand injury and reconstructive plastic surgery.[8] The purpose of adding an adjuvant to local anesthetics for peripheral nerve block is to have an early onset of sensory and motor block and to prolong the duration of post-operative analgesia with lesser adverse effects.[9]

Dexmedetomidine has eight times higher affinity and α2 agonist property compared with clonidine.[10,11] The mechanism of action varies from peripheral α2A action, blockade of hyperpolarization-activated cation current, and inhibition of compound action potential.[11] Dexamethasone is a glucocorticosteroid exerting its action by attenuating the release of inflammatory mediators, inhibiting potassium channel-mediated discharge of nociceptive C-fibers, and reducing ectopic neuronal discharge. [12]

Venkatraman R *et al.*,[13] noted that duration of analgesia was significantly longer in dexamethasone (867.2 ± 217.6 min) as compared to dexmedetomidine (654.2 ± 179.9 min) ($P < 0.001$). The onset of sensory and motor blockade was quicker with dexmedetomidine than dexamethasone and morphine. They concluded that dexamethasone is an ideal adjuvant to ropivacaine in brachial plexus block to prolong postoperative analgesia and devoid of adverse effects. Dexmedetomidine has a quicker onset of sensory and motor blockade.

In study by Mokkarala RR *et al.*,[14] mean duration of analgesia was significantly prolong in dexmedetomidine group than dexamethasone group (1142.47±28.32 min vs 1045.95±78.55 min). Time for first rescue analgesic requirement was significantly prolong in dexmedetomidine (group DM) than dexamethasone group (DS) (17.44±2.41-hour vs 13.54±1.98 hours). The duration of sensory and motor block was significantly prolonged in dexmedetomidine than dexamethasone group.

Albrecht *et al.*, [15] in his meta-analysis concluded that dexamethasone may be a superior adjunct; it improves the duration of analgesia by a statistically significant increase, albeit clinically modest, equivalent to 2.5 hours more than dexmedetomidine, without the risks of hypotension or sedation. In a systematic review of 9 studies and 801 patients, S. Choi *et al.*,[12] noted that there is reliable prolongation of sensory and motor block after local anaesthesia brachial plexus block via the addition of dexamethasone to the injectate.

Singh N *et al.*, [16] noted that, onset of sensory and motor block was faster in dexmedetomidine group (13.5 ± 4.1 and 17.0 ± 4.1 min) than dexamethasone group (15.6 ± 3.6 and 18.5 ± 3.7 min). Duration of analgesia was prolonged in dexmedetomidine group than dexamethasone group (1218.0 ± 224.6 and 1128.0 ± 207.5 min, respectively. Twenty-four hours analgesic consumption postoperatively was reduced in the two study groups. Both dexmedetomidine and dexamethasone when used as adjuvants to ropivacaine for SCBP block, block onset time, and prolong' block duration.

In the upper limb, surface ultrasound can clearly identify neural elements of the brachial plexus as well as surrounding structures.[17] Ultrasound guided brachial plexus block gains the advantage of accurate nerve localization, real time visualization of brachial plexus, blood vessels, needle placement, local anaesthetic spread. It minimizes the number of needle attempts. Present study has some limitations, as we included low risk patients, posted for elective surgery & sample size was small, large, multicenter trials in future can confirm the conclusion better.

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Conclusion

Dexmedetomidine and dexamethasone are good as adjuvants to ropivacaine for supraclavicular brachial plexus blockade. Dexamethasone is a better alternative than dexmedetomidine since it shortens the onset of sensory and motor block, prolongs the duration of sensory and motor block and prolongs the duration of analgesia.

Conflict of Interest: None to declare
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