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A Clinical Comparative Study of Dexmedetomidine and Buprenorphine as an Adjuvant to 0.5% Bupivacaine for Ultrasound Guided Supraclavicular Brachial Plexus Block

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Abstract

Background and Aims: We compared the block characteristics between dexmedetomidine versus buprenorphine as an adjuvant to bupivacaine in ultrasound guided supraclavicular brachial plexus block. Duration of sensory and motor block along with duration of analgesia were the primary endpoints.

Materials and Methods: A comparative two group randomized clinical study was designed in which sixty ASA 1 and ASA 2 patients who were scheduled for elective upper limb surgeries under ultrasound guided supraclavicular brachial plexus block were randomly divided into two equal groups. Group D (n=30), received 24 ml 0.5% bupivacaine + 1 ml (50 µg) dexmedetomidine and Group B (n=30), received 24 ml 0.5% bupivacaine + 1 ml (100 µg) buprenorphine. Duration of sensory, motor blockade and analgesia were assessed along with onset of sensory and motor blockade, sedation, and side effects among the two groups.

Results: Duration of sensory and motor block in Group D (588.7±38.2 & 481.7±16.8) was longer than Group B (395.7±15.5 & 334.3±23.8; p <0.001). Duration of analgesia in Group D (805.7±54.1) was longer than Group B (579.0±41.4). There was no significant difference among the groups with respect to onset of sensory and motor blockade. Bradycardia was observed in one patient in Group D and vomiting was seen in two patients in Group B, no other adverse effects were observed.

Conclusion: Dexmedetomidine prolongs the duration of sensory and motor blockade and duration of analgesia as compared with buprenorphine when used as an adjuvant to bupivacaine in supraclavicular brachial plexus block, with no adverse side effects.

Keywords: Dexmedetomidine; Buprenorphine; Brachial plexus block; Ultrasound.

Introduction

Supraclavicular brachial plexus block provides Anesthesia for surgeries around the elbow, forearm and hand.[1,2] It also provides analgesia in the postoperative period, shortens the patient recovery time and avoids the undesirable side effects of general Anesthesia. Using ultrasound helps in better delineation of the anatomical structures, hence avoids complications. It also reduces the number of needle passes required to produce a more effective analgesic block after surgery despite the low volume of local anesthetic used.[3,4]

Various adjuvants like opioids and non opioid agents along with local anesthetics have been used in brachial plexus block to achieve quick, dense and prolonged block with better postoperative

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pain relief.[5] Dexmedetomidine is a highly selective alpha-2 adrenoreceptor agonist.[6] In various studies, use of dexmedetomidine as an adjuvant to local anesthetic in regional blocks has shown to prolong the duration of block and postoperative analgesia.[7-9]

Buprenorphine is a highly potent semisynthetic agonist–antagonist opioid. Some studies have concluded that buprenorphine added to bupivacaine in brachial plexus block provide a longer period of postoperative analgesia than other opioid variants.[10,11]

This study compares the effect of dexmedetomidine and buprenorphine added to bupivacaine in ultrasound guided supraclavicular brachial plexus block. The primary outcome was to compare the duration of the sensory and motor blockade, and duration of analgesia. Secondary outcomes included time to onset of sensory and motor blockade, sedation score, complications and side effects.

Material and Methods

After the approval of hospital ethical committee, patients were explained about the procedure and drugs. Informed written consent was taken from all the patients. Sample size calculation was done based on outcome variable on motor block for a two randomized groups with minimum mean difference of 12 and standard deviation of 20.3 (derived from previous literature), 90% statistical power and at 5% level of significance, the sample size of 60 (30 in each group), was adequate for a randomized two group clinical study.

A comparative two group randomized clinical study carried out on 60 ASA grade 1 and 2 patients of either sex, aged 18-60 years, posted for upper limb orthopaedic surgeries under ultrasound guided brachial plexus block. Patients were allocated into two groups of 30 patients each by systematic random sampling. The groups were, Group D: bupivacaine 0.5% 24 ml + dexmedetomidine 50g in 1 ml of normal saline and Group B: bupivacaine 0.5% 24 ml + buprenorphine 100g in 1 ml of normal saline. Exclusion criteria were patient refusal for block, history of significant neurological, cardiovascular, psychiatric, neuromuscular, pulmonary or hepatorenal disease. Patients on anti-coagulants, bleeding disorders, local infection at injection site, known hypersensitivity to local anesthetic drugs, uncontrolled diabetes mellitus, pregnant women were also excluded.

On the day of surgery, standard monitoring including non invasive blood pressure, pulse oximetry and ECG were attached to the patient. Intravenous access was obtained in the limb opposite to that undergoing surgery with a 18G bore IV cannula. Baseline systolic blood pressure and diastolic blood pressure, heart rate, SpO_2 were recorded at interval of every 5 minutes for the first 30 minutes and every 30 minutes thereafter. Patients were put in supine position with head turned away from the site to be blocked. Arm to be anesthetised was adducted and extended towards the ipsilateral knee as far as possible. Under strict aseptic precautions supraclavicular area was painted and draped. The brachial plexus was scanned using high frequency (8-14 MHz) linear ultrasound probe. After local infiltration of skin, a 22G, 5 cm short bevelled echogenic needle was inserted in line with the ultrasound beam till the tip of the needle was positioned near the brachial plexus which showed a bunch of grapes appearance on ultrasound. After negative aspiration of blood, 25 ml of respective drug was injected depending on whetherthe patient was allotted to either Group B or Group D.

The onset of sensory blockade was defined as time taken from the completion of injection of drug till the patient did not feel the pin prick. Sensory block was assessed by pin prick with 23G hypodermic needle in skin dermatomes C5-T1 once in every 2 min for initial 30 min and then after every 30 min till patient regained normal sensations. Sensory block was graded into three: Grade 0- Normal response to pin prick. Grade 1- Analgesia, dull sensation felt. Grade 2- Anesthesia, no sensation felt.[12] Duration of sensory blockade was defined as time taken from the onset of sensory blockade till the patient feels pin prick.

Onset of motor blockade was defined as the time taken from the injection of the drug till the patient develops loss of movement in ipsilateral upper limb. Quality of motor block was assessed at the same interval and graded using modified Bromage scale for upper extremities.[12] Duration of motor blockade was defined as time taken from the onset of the motor blockade till complete recovery of motor function of the hand and forearm.

Sedation was assessed to the patients after administration of drugs every 30 min in first two hours then every 2 hours till 6 hours postoperative using modified Ramsay sedation scale.[13] Pain was assessed using Visual analog scale (VAS 0-10; 0= no pain, 10= worst pain imaginable), every hourly postoperatively. At VAS score of 4, rescue analgesia (inj. diclofenac sodium 75 mg I.M.) was given. Duration of analgesia was the time between

complete sensory block to the time of first rescue analgesia. All patients were observed for any side effects like nausea, vomiting, bradycardia, respiratory depression, hypotension, pruritis and urinary retention.

Statistical analysis

The data was analyzed by SPSS version 18.0 (Statistical Package for Social Sciences) software and Microsoft word and Excel were used to generate graphs and tables. Demographic and hemodynamic data were subjected to student's T-test and for statistical analysis of onset time and duration of sensory, motor blockade, and duration of analgesia, unpaired T-Test was applied. P value <0.05 was considered as statistically significant and P <0.001 as highly significant. Chi-square/ Fischer's exact test were used to analyze any adverse effects.

Results

There were no significant difference in between the two groups for age, gender, body weight, and duration of surgery in the two groups (Table 1). The onset time of sensory and motor block was found to be comparable in both the groups (Table 2). The duration of sensory and motor blockade was significantly longer in Group D as compared to Group B (Table 2). Duration of analgesia (time for rescue analgesia) was significantly longer in Group D than Group B (Table 2).

The hemodynamic parameters (HR, BP and MAP) were comparable in both the groups with no statistical significance. One patient in Group D had bradycardia, treated with inj atropine 0.6 mg IV. Two patients in Group B had vomiting. There were no other side effects such as pneumothorax, Horner's syndrome, phrenic nerve palsy or respiratory depression in any of the patients.

Modified RSS for Group D was 2/6 (13 patients), for Group B it was 1/6 (6 patients) (Table 3). Most of the patients (41.7%) were cooperative, oriented and tranquil alert. 23.3% patients were anxious, agitated or restless. 35% patients were responding only to commands.

Table 1: Demographic data

Patient characteristics	Group D	Group B
Age in years	41.1±11.8	37.8±10.3
Weight in KG	71.4±9.1	74.5±8.7
Gender (M/F)	20/10	23/7
Duration of surgery (DOS)	94.7±14.8	96.0±19.0

Table 2: Sensory and motor block onset, duration of blockade and analgesia.

	Group D (n=30)	Group B	P value
Onset time (min) of sensory block (mean ± SD)	4.7 ± 1.4	5.2 ± 1.6	0.189
Onset time (min) of motor block (mean ± SD)	8.5 ± 1.4	9.2 ± 1.5	0.073
Duration (min) of Sensory block (mean ± SD)	588.7 ± 38.2	395.7 ± 15.5	<0.001
Duration (min)of motor block (mean ± SD)	481.7 ± 16.8	334.3 ± 23.8	<0.001
Duration(min) of Analgesia (mean ± SD)	805.7 ± 54.1	579.0 ± 41.4	<0.001

Table 3: Ramsay Sedation scale distribution in two groups of patients studied

Sedation	Group D	Group B	Total
1	8(26.7%)	6(20%)	14(23.3%)
2	13(43.3%)	12(40%)	25(41.7%)
3	9(30%)	12(40%)	21(35%)
4	0(0%)	0(0%)	0(0%)
5	0(0%)	0(0%)	0(0%)
6	0(0%)	0(0%)	0(0%)
Total	30(100%)	30(100%)	60(100%)

Discussion

Brachial plexus nerve block has been used as ideal alternative to general Anesthesia. The advantages of brachial plexus block includes better intraoperative and postoperative analgesia, minimal anesthetic exposure, reduced need of systemic analgesia and early discharge.[14] Usage of ultrasound helps in delineating the anatomical structures and locating the brachial plexus. It improves the quality of the block and reduces the failure rate when compared with paraesthesia technique and electrical nerve stimulus technique.[15,16]

Local anesthetics alone for supraclavicular brachial plexus block provides good operative conditions but have a shorter duration of postoperative analgesia. Hence various drugs such as opioids, alpha2 receptor agonists, dexamethasone, midazolam, magnesium sulphate etc were used as adjuvant with local anesthetics in brachial plexus block to achieve quick, dense, prolonged block and duration of analgesia postoperatively.[17–20] In this randomised comparative clinical study, we compared dexmedetomidine and buprenorphine as an adjuvant to bupivacaine in ultrasound guided supraclavicular brachial plexus block.

Swami et al. concluded that dexmedetomidine when added to bupivacaine 0.25% in supraclavicular brachial plexus block increased the duration of sensory and motor blockade and also the duration of analgesia which is similar to our study.[12] Dexmedetomidine as an adjuvant for nerve blocks have shown that the duration of analgesia is prolonged due to hyperpolarisation activated cation current flow ($I_h$current).[21]

Esmaoglu et al. added dexmedetomidine to levobupivacaine for axillary brachial plexus block showed that it shortens the onset time of both sensory and motor block, prolongs the duration of block and the duration of postoperative analgesia.[8] However in our study we found that onset of sensory and motor blockade was faster with Group D as compared with Group B, but it was statistically not significant. The duration of sensory, motor blockade and analgesia in Group D was longer than Group B, and it was statistically significant.

Viel and colleagues conducted comparision study for post operative pain relief in brachial plexus block with buprenorphine and morphine.They concluded that buprenorphine in supraclavicular brachial plexus block produces significantly longer analgesia than morphine after upper limb surgeries.[22] Trivedi V, Shah J, conducted a comparative study between buprenorphine versus butorphanol in supraclavicular brachial plexus block and concluded that buprenorphine produces prolonged sensory, motor blockade and duration of analgesia than butorphanol.[23]

In our study we have compared dexmedetomidine 50g versus buprenorphine 100g as an adjuvant to 0.5% bupivacaine via ultrasound guided supraclavicular brachial plexus block. Group D (dexmedetomidine) had prolonged duration of sensory and motor blockade, and duration of analgesia compared to Group B (buprenorphine). Sedation after block was assessed using the sedation score described by Ramsay. The results of our study were similar to that obtained by Agarwal S et al., where dexmedetomidine was added to bupivacaine and sedation was assessed using modified Ramsay sedation score. They observed that patients who received dexmedetomodine had higher sedation score.[24] One patient had bradycardia in Group D and two patients in Group B had vomiting. No other side effects were observed in any group. None of the patients in Group D required sedation intra operatively and they were comfortable throughout the surgery with arousable sedative effect.

Conclusion

We conclude that dexmedetomidine prolongs the duration of sensory and motor blockade and duration of analgesia as compared with buprenorphine when used as an adjuvant to bupivacaine in ultrasound guided supraclavicular brachial plexus block.

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