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Original Research Article

Effects of Dexmedetomidine as an Adjuvant with Bupivacaine in Supraclavicular Brachial Plexus Block in Upper Limb Surgeries

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Abstract:

Background an Aim: Brachial plexus block is widely used as an efficient and cost effective alternative to general anesthesia for upper limb surgeries. A variety of adjuvants to local anesthetics have been used and compared, however, drugs which prolong the duration of anaesthesia and analgesia are being constantly studied for patient satisfaction and cost effectiveness. This study was conducted to compare and evaluate the effects of dexmedetomidine as an adjuvant with bupivacaine in supraclavicular brachial plexus block in upper limb surgeries.

Material and Methods: This Prospective Randomized control study was conducted in department of Anaesthesiology between September 2019 and September 2021. After taking thorough history and preoperative assessment, 60 adult patients of ASA I/II who were satisfying the inclusion criteria were enrolled into the study. Patients were divided into two groups according to the local anaesthetic mixture they received. Group N: Inj. Bupivacaine 0.5% 30ml + Inj. Normal Saline 0.9% 0.5 ml, Group D: Inj. Bupivacaine 0.5% 30 ml + Inj. Dexmedetomidine 0.5 ml (50 mcg) The time of onset and duration of sensory and motor block was noted. Hemodynamic variables were measured from baseline until the use of first rescue analgesic.

Results: Onset of sensory and motor block was significantly faster in Group D compared to Group N. Duration of sensory and motor block was significantly prolonged in Group D compared to Group N. Rescue analgesia was required at 928+22.81 min in Group D and 435.7+46.33 min in Group N which was significantly prolonged. Postoperative period after one hour, mean pulse rate, systolic and diastolic blood pressures were comparable in both the groups.

Conclusion: Dexmedetomidine 50 mcg when added to bupivacaine for supraclavicular brachial plexus block shortens the onset time of sensory and motor block prolongs the duration of sensory and motor block and postoperative analgesia.

Keywords: Brachial Plexus Block, Bupivacaine, Dexmedetomidine, Rescue Analgesia.

Introduction

Anaesthesia is fundamental to the overall practice of medicine worldwide. [1] Modern anaesthesia has been developed and refined to enable surgery, interventions, pain relief and stabilization, as well as organ support. Various methods of providing Anaesthesia in recent times for upper limb surgeries have evolved from General Anaesthesia to Regional and Local Anaesthesia. [2]

Supraclavicular Brachial plexus block is a very popular mode of anaesthesia for various upper limb surgeries. This approach gives the most effective block for upper extremity (below shoulder) and is carried out at the level of trunk of brachial plexus. The plexus is blocked where it is most compact i.e. at the middle of brachial plexus, resulting in homogenous spread of anaesthetic drug throughout the plexus with a faster onset and complete block. [3] The analgesic effects of single shot injection of local anaesthetic in supraclavicular block for upper limb surgeries are time limited. Administration of perineural adjuvants like epinephrine, opioid (morphine), midazolam, corticosteroid (dexamethasone), ketamine with local anaesthetic in supraclavicular block has been proven to prolong postoperative analgesia but they are also associated with less systemic side effects.

There has always been a search for adjuvants to the regional nerve block with drugs that prolong the duration of analgesia but with lesser adverse effects. [3,4] Adrenergic receptor agonists like clonidine and dexmedetomidine have been the focus of interest during anaesthesia for their sedative, analgesic, perioperative sympatholytic and cardiovascular stabilizing effects with reduced anaesthesia requirement. [5] Dexmedetomidine, the pharmacologically active D-isomer of

medetomidine imidazole, is a highly specific and selective α-2 adrenoreceptor agonist, was first proposed as an adjuvant capable of prolonging duration of sensory and motor block by Memis and colleagues. [4] In humans, dexmedetomidine has also shown to prolong duration of block and postoperative analgesia when added to local anaesthetics in various regional blocks. [6] This study was conducted to compare and evaluate the effects of dexmedetomidine as an adjuvant with bupivacaine in supraclavicular brachial plexus block in upper limb surgeries in terms of onset, block characteristic and postoperative analgesia (requirement of rescue analgesia).

Material and Methods

This Prospective Randomized control study was conducted in department of Anaesthesiology between September 2019 and September 2021. After taking thorough history and preoperative assessment, 60 adult patients of ASA I/II who were satisfying the inclusion criteria were enrolled into the study.

Patients were divided into two groups according to the local anaesthetic mixture they received.

Group N: Inj. Bupivacaine 0.5% 30ml + Inj. Normal Saline 0.9% 0.5 ml

Group D: Inj. Bupivacaine 0.5% 30 ml + Inj. Dexmedetomidine 0.5 ml (50 mcg)

Inclusion Criteria

- Patients aged between 18 and 60 years of either gender
- Patients with American Society of Anaesthesiologists I & II physical status
- Patients weighing: 40-70 kg
- Patients who were planned to undergo upper limbsurgeries (elective and below shoulder surgeries) under supraclavicular brachial plexus block.
- Patients with normal sensory and motor functions in operating limb.

Exclusion Criteria

- Patients who refused to give consent
- Pregnant women,
- History of local anaesthetics allergy
- Peripheral neuropathy
- Patients on anticoagulants,
- Severe respiratory disease
- Neurological deficit involving brachial plexus
- Local infection at the injection site

All patients underwent a thorough pre-anaesthetic checkup which included detailed history taking, general examination and systemic examination. Routine investigations like Haemoglobin, blood urea, serum creatinine, random blood sugar, ECG, chest X-ray were carried out for all patients. Coagulation profile was done to rule out bleeding disorders.

Patient was kept Nil by mouth for 6 hours. In the pre-operative room, intravenous access was secured with 18-gauge cannula on the contralateral hand and injection ringer lactate was started.

Supraclavicular brachial plexus block was performed under aseptic precautions with the patient in the supine position, with ring under head and sandbag under shoulder, with the patient's head turned away from the side to be blocked.

After appropriate preparation, a skin wheal was raised by a 25 gauge 1 inch needle with 5 ml syringe using 2% 2 ml lignocaine 1 cm above the midpoint of clavicle. A 23 gauge 1.5 inch needle was inserted through the skin wheal and directed caudally, slightly medial and posterior direction until the brachial plexus is located by muscle twitch with help of nerve locator.

During the conduct of block and thereafter, the patients were observed vigilantly for any complications and toxicity of the drugs injected. After injection of the local anaesthetic, the following parameters were studied:

- Onset of Sensory block
- Duration of Sensory block
- Onset of motor block
- Duration of motor block
- Time of Requirement of Rescue Analgesia
- Sedation score
- Hemodynamic parameters
- Intraoperative complications

Post-operative follow-up was carried out in the recovery and postoperative ward. Hemodynamic vitals (Pulse rate, blood pressure, SpO_2) and the duration of analgesia according to 0-10 visual analogue scale (VAS)[7]forpain were noted till 18 hrs.

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2019) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA).

Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

Table 1: Demographic Data

	Group D	Group N	P Value
Age (Yr)	33±9.79	34.8±12.57	>0.05
Male	15(50%)	17(56.66%)	>0.05
Female	15(50%)	13(43.33%)	>0.05
Weight (Kg)	60.7±5.25	60.8±5.49	>0.05

Table 1 shows demographic data of two groups. Patients in Group N and Group D were comparable with the respect to the patient's age, weight and sex and were statistically not significant (p>0.05).

Table 2: Onset of Sensory and Motor Block

Parameter	Group D	Group N	P Value
Onset time of sensory block (min)	7.10±0.57	11.40±0.58	<0.0001
Onset time of motor block (min)	8.47±0.65	14.48±0.85	<0.0001

Table 2 shows mean time of onset of sensory and motor block. The onset of sensory and motor blockade were significantly more rapid in the group D as compared to group N (p<0.0001) (highly significant). In this study, intraoperative (after 10 minutes of block) till one hour postoperative mean pulse rate, postoperative systolic blood pressure and postoperative diastolic blood pressure were gradually decreased in group D compared to group N which was statistically significant (p<0.05). Postoperatively after one hour, these vitals were comparable in both the groups (p>0.05)There was no significant difference observed in $Spo_2$of two groups (p>0.05). Sedation was assessed by Ramsay Sedation Score during intraoperative period. Sedation was observed in almost all the patients of Group D except 4 patients during intraoperative period.

Table 3: Duration of Motor Block and Sensory Block

Parameter	Group D	Group N	P Value
Sensory block (min)	703.83±29.03	308.16±44.07	<0.0001
Motor block (min)	600.83±32.10	264.33±34.13	<0.0001

Table 3 shows mean time of duration of motor block and mean time to first rescue analgesia. The duration of motor blockade and time to first rescue analgesia were significantly longer in the group D as compared to group N (p<0.0001).

Table 4: Time of Requirement of Rescue Analgesia

Parameter	Group D	Group N	P Value
Analgesia (min)	928.5±22.81	435.7±46.33	<0.0001

Pain was assessed by VAS[7]. Time required for rescue analgesia was significantly prolonged in Group D as compared to Group N (p<0.0001) No complications were observed in our study.

Discussion

The supraclavicular block is used extensively and effectively for the distal upper extremity surgical operation. This approach is attractive due to its effectiveness in terms of cost and performance, margin of safety along with good postoperative analgesia. Supraclavicular approach to brachial plexus block involves injection of local anaesthetic around the divisions of the brachial plexus. Due to a compact arrangement of all the three trunks of plexus in this region, Supraclavicular block provides complete regional anaesthesia for surgeries of upper limb distal to shoulder.

Although Supraclavicular block provides good operative condition, it has shorter duration of post-operative analgesia and therefore in order to prolong the post-operative analgesia, various adjuncts such as opioids, tramadol, clonidine, dexmedetomidine and neostigmine are added to local anaesthetic in supraclavicular brachial plexus block. [8,9]

The aim of the present study was to compare the postoperative analgesic efficacy and safety of dexmedetomidine for brachial plexus blockade along with bupivacaine. Total 60 adult patients of ASA 1 or 2 posted for various effective upper limb surgeries were randomly allocated in two groups, each group was having 30 patients.

Demographic data were comparable in both the groups. There was no significant difference in both the groups (p<0.05) The onset time of sensory and motor block was significantly shorter in Group D compared to Group N (p<0.001). NazirNazia et al [10], Sandhya Agarwal et al [11], Shahryar Sane et al [12] and Rachna Gandhi et al [13] found similar results.

Dexmedetomidine enhances both central and peripheral neural blockade done by local anaesthetics; however, the peripheral neural blockade is due to binding to α2A adrenoreceptors.

It shortened the onset of both sensory and motor block, prolonged the duration of block and the duration of postoperative analgesia because peripheral α2-agonist produce analgesia by reducing release of norepinephrine leading to α2 receptor independent inhibitory effect on nerve fiber Action Potential.

Duration of sensory and motor block was significantly prolonged in Group D compared to Group N (P<0.001). In the study conducted by A Esmaoglu et al [14] in which duration of sensory block (887±66 min) and motor block (773±67 min) in dexmedetomidine containing group was significantly longer compared to group not containing dexmedetomidine where duration of sensory block was 673±74 min and motor block was 575±65 min with p value <0.001.

In the study of Rachna Gandhi et al [13], duration of motor block (660.2±60.4 min) and sensory block (732.4±48.9 min) in dexmederomidine and bupivacaine were significantly longer compared to duration of motor block (100.7±48.3 min) and sensory block (146.5±96.4 min) in bupivacaine alone with p value <0.0001.

Rescue analgesia was required at 928±22.81 min in Group D and 435.7±46.33 min in Group N which was significantly prolonged (p<0.001). These results were comparable with previous studies which also used VAS score for pain assessment. Intraoperatively mean pulse rate was gradually decreased in Group D compared to Group N. That was due to sedation achieved by Dexmedetomidine which relieved the anxiety related to surgery and surrounding environment, Effect of Dexmedetomidine on pulse rate and Pain relief itself. Intraoperatively systolic and diastolic blood pressures were significantly lower than baseline in Group D compared to Group N. That was due to pain relief and cardiovascular effect of dexmedetomidine. Our study findings were comparable to previous studies conducted by A Esmaoglu et al [14], NaziaNazir et al [10], Shahryar sane et al [12], Sandhya Agarwal et al [11], Rachna Gandhi et al [13].

Sedation was observed in almost all the patients of Group D except 4 patients during intraoperative period. This can be explained on the basis that some amount of systemic absorption of drug could be present. As α-2 agonist produce sedation by central action, they produce inhibition of substance P release in the nociceptive pathway at the level of the dorsal horn neuron and by activation of α-2 adrenoreceptor in locus ceruleus. Our study was comparable with previous study of Khade et al [15] and other studies which concluded that dexmedetomidine as an adjuvant to bupivacaine reduces requirement of intraoperative sedation. No complications were observed in our study.

Limitation of the study is sample size is too small for generalization of the study findings.

Conclusion

Dexmedetomidine 50 mcg when added to bupivacaine for supraclavicular brachial plexus block shortens the onset time of sensory and motor block, prolongs the duration of sensory and motor block and postoperative analgesia. The added advantage of conscious sedation, hemodynamic stability and lack of significant side effects makes dexmedetomidine an attractive choice as an adjuvant in peripheral nerve blocks.

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