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Comparison of two different doses of Dexmedetomidine added to Bupivacaine in patients posted for upper limb surgery under supraclavicular brachial plexus block

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Abstract
Objective: To compare the effect of two different doses of dexmedetomidine to Bupivacaine, on onset and duration of analgesia for supraclavicular brachial plexus block in patients scheduled for upper limb orthopedic surgery.
Methodology: Present study was a prospective randomized double blind comparative study, conducted on 60 patients aged between 18-60 years after ethical committee approval and informed consent, which were scheduled for upper limb surgery and randomly divided into two groups, 30 patients in each. Group D1 received LA (0.5% Bupivacaine 12.5ml plus Lignocaine Adrenaline 12.5ml plus dexmedetomidine 1 µg/kg diluted with normal saline up to 5 ml total volume 30 ml) and Group D2 received LA (12.5ml of 0.5% Bupivacaine plus Lignocaine Adrenaline 12.5ml plus dexmedetomidine 2 µg/kg diluted with normal saline up to 5 ml total volume 30 ml). The onset and duration of sensory and motor block, duration of analgesia, hemodynamic parameters, sedation score, VAS and side effects were recorded in two groups.
Results: Onset time of sensory and motor block were earlier and duration of analgesia were longer in Group D2 than in GroupD 1 ($p<0.001$). There was no significant difference in the incidence of hypotension and bradycardia between both the groups ($p > 0.05$) and also found reduction in number of rescue analgesic doses consumption in 24 hours in GroupD2 than in GroupD1.

Keywords: dexmedetomidine, supraclavicular brachial plexus block, analgesia

Introduction
Patients undergoing orthopedic surgery often report postoperative pain that is intense and difficult to control. Adequate postoperative pain relief is one of the most important factor for a favorable surgical outcome[1].Keeping these concerns in focus and based on patient characteristics, the anaesthesiologist can choose from a range of anaesthesia techniques such as local, neuraxial (spinal or epidural) or general anaesthesia.
The supraclavicular brachial plexus block is one of the most commonly performed upper limb brachial plexus block to provide anaesthesia below the mid arm surgeries. Various studies have investigated the role of novel analgesic adjunct to brachial plexus block for post-operative analgesia, the goal of which is to reduce the onset time, prolong the analgesic effect without the disadvantage of systemic side effects or prolonged motor blockade and also allow for the reduction in the total dose of local anaesthetic. The search for the ideal additive continues, and led us to the novel α2 adrenergic agents, dexmedetomidine [2, 3], their sedative, analgesic, perioperative, sympatholytic, cardiovascular stabilizing effects and reduction in anaesthetic requirements [4, 5].

Material and methods: The study was conducted in department of Anaesthesia at IGMC Shimla on 60 American Society of Anaesthesiologist (ASA) Grade I and II patients of either sex aged 18- 60 years, undergoing various orthopaedic surgeries on the upper limb in supraclavicular brachial plexus block. The patients were divided in two groups of 30 patients each and randomly assigned using computer generated random numbers to one of the following groups:
GroupD1: Bupivacaine 0.5% (12.5 cc) + Lignocaine ADR (12.5cc) + dexmedetomidine 1µg/kg diluted in 5cc normal saline, total volume 30cc.
GroupD2: Bupivacaine 0.5% (12.5cc) ++ Lignocaine ADR (12.5cc) + dexmedetomidine 2µg/kg diluted in 5cc normal saline, total volume 30cc.
Both, patient & investigator performing the study and observing the result were blinded to the test drug by giving serial numbers to the patients and serial numbers were decoded in the end. All the observations were made by the same observer.

Inclusion criteria
- Patients of either sex, aged between 18-60 years
- Patients with ASA grade I and II physical status
- Upper limb surgeries

Exclusion criteria
- History of hypersensitivity to local anaesthetic drugs
- Patients on adrenoreceptors agonist or antagonist therapy
- Bleeding disorders
- Pregnant and lactating women
- Pre- existing peripheral neuropathy
- History of significant systemic disease

All patients were premedicated with tablet alprazolam 0.5 mg orally a night before surgery.
Investigations: Hb, bleeding time, clotting time, serum urea and creatinine, blood sugar, ECG and chest X-ray

posteroanterior view depending on age and associated comorbidities.

Resuscitation Equipments: The anaesthesia machine, emergency oxygen source pipe line oxygen supply, working laryngoscope appropriate size endotracheal tubes and connectors, working suction apparatus with a suction catheter, or pharyngeal airways, iv fluids, anaesthetic agents and resuscitation drugs were checked and kept ready.

Procedure: On operation table, after patient's identification, monitor was attached and oxygen saturation (SpO_2), noninvasive blood pressure, respiratory rate and ECG were recorded. Intravenous line was started with ringer lactate and midazolam 0.02mg/kg was given intravenously, before procedure. Starting time of procedure was recorded and then depending upon the group, block was carried out and end point of procedure was noted.

The patient was kept supine with head slightly elevated away from the site to be blocked. Part was prepared for the block to be performed with iodine solution. A Sonosite Micromax-HFL linear probe was used for conducting the block in every case. The probe was then placed in the coronal oblique plane in the supraclavicular fossa. The subclavian artery, vein, and the brachial plexus were visualized. The brachial plexus and the surrounding structures were scanned and plexus was identified super lateral to the subclavian artery.

Skin was anesthetized at the proposed site of entry with 1% lignocaine (1-2 mL) and a 20 G, 50 mm needle was connected to a 10cm extension line and primed with the drug. Once the needle reached the plexus, after negative aspiration, drug was injected and the spread of the drug was observed.

Sensory block was assessed by the pin prick method. Assessment of sensory block was done at every minute after completion of drug injection in the dermatomes corresponding to median nerve, radial nerve, ulnar nerve and musculocutaneous nerve till complete sensory blockade. Sensory onset was considered when there was a dull sensation to pin prick along the distribution of any of the above-mentioned nerves.

Sensory block was graded as-

Grade 0: Sharp pin prick felt

Grade 1: Analgesia and dull sensation felt

Grade 2: Anaesthesia and no sensation felt.

Assessment of motor block was carried out by the same observer at each minute till complete motor blockade after drug injection. Onset of motor blockade was considered when Grade 1 motor blockade was achieved. Motor blockade was determined as per modified Bromage scale for upper extremities on a 3-point scale.[5]

Motor block was graded as:

Grade 0: Normal motor function with full flexion and extension of forearm, wrist and fingers

Grade 1: Decreased motor strength with ability to move the fingers only

Grade 2: Complete motor block with inability to move the fingers

The block was considered incomplete/partial when any of the segments supplied by median, radial, ulnar and musculocutaneous nerve was not having analgesia even after 30 min of drug injection. These patients were supplemented with intravenous fentanyl (1μg/ kg) and midazolam (0.02 mg/kg). When more than one nerve remains unaffected, it was considered a failed block.

In this case, general anaesthesia was given intraoperatively and patient was excluded from the study. Patients were monitored for hemodynamic variables such as heart rate, blood pressure and oxygen saturation every 5 min after the block for 30 min then every 15 min till surgery ended. Sedation of patients was assessed by the Ramsay Sedation Score.

At the end of the procedure, quality of operative conditions were assessed according to the following numeric scale:

Grade 4: (Excellent) No complaints by patient

Grade 3: (Good) Minor complaint with no need for the supplemental analgesics

Grade 2: (Moderate) Complaint that required supplemental analgesia

Grade 1: (Unsuccessful) Patient given general anaesthesia

Assessment of blood loss was done and fluids were administered as per the loss. The intra- and post-operative assessment was done by an anesthesiologist who was unaware of the drug used.

All patients were observed for any side-effects like nausea, vomiting, dryness of mouth and complications like pneumothorax, hematoma, local anesthetic toxicity and post-block neuropathy in the intra-operative and post-operative periods. The duration of sensory block was defined as the time interval between onset of the sensory block and the complete resolution of anaesthesia on all nerves. The duration of motor block was defined as the time interval between the onset of motor block and the complete recovery of motor function of the hand and forearm.

Duration of analgesia was observed i.e. time between end of drug administration in the brachial block and first rescue analgesic dose administered. Post-operative pain was assessed by visual analogue scale which ranges from 1-10. Patients were assessed for duration of analgesia till the score of 5 on visual analogue scale. The rescue analgesia was given in the form of inj. diclofenac sodium (1.5 mg/kg) intramuscularly at the visual analogue Scale of 5 and the time of administration was noted.

The data obtained was tabulated and statistically analyzed using Chi-Square test, student t test was applied and the results thus obtained were presented in the light of statistical and clinical significance.

Observations

The present study was conducted in a double blind randomized controlled manner on 60 patients of both the sexes belonging to ASA grade I and II, between the age group of 18-60 years undergoing upper limb orthopaedic surgery under supraclavicular brachial plexus block. Patients were randomly divided into two groups; GroupD1 and GroupD2.

Mean age (in years) in groupD1 was 37.66 ±10.90, and in group D2 was 36.21 ± 11.52. p-Value was 0.631 which was not significant statistically (p-value > 0.05). Mean weight (in Kg) in group D1 was 62.70 ± 7.79, in group D2 was 63.33 ±7.66. p- Value was 0.752 which was not statistically significant (p-value > 0.05). The ratio of male versus female was 18:12 in group D1 and 24:6 in group D2. p-value was 0.573 which was not statistically significant (p-value > 0.05).Both the groups were comparable in age, weight and sex distribution.

Table I: Baseline Parameters

Parameter	Mean ± S.D		p-value
	Group C	Group D	
HR (bpm)	84.76±14.27	87.68±11.07	0.368
MAP(mmHg)	93.33±8.15	93.16±7.52	0.432
SpO2	95.96±1.94	95.56±1.91	0.698

Baseline mean HR (beats per minute) and mean arterial pressure (mmHg) in group D1 and D2 was 84.76±14.27, 87.68± 11.07and 93.33±8.15, 93.16±7.52 respectively which was not statistically significant (p-value >0.05). Similarly baselines mean SpO2 in both groups was 95.96±1.94 and 95.56±1.91 respectively which was statistically insignificant (p-value >0.05).The baseline parameters were found to be comparable and the differences were statistically insignificant (p-value > 0.05). (Table I)
There was also no statistically significant difference between the vital signs (HR, NIBP and SpO2) in both the groups intraoperatively.

Table II: Comparison of blockade and analgesia between two groups

Variables	GroupD1	GroupD2	p-Value
Onset of sensory block(min)	3.44±0.68	2.20±0.75	<0.0001
Onset of motor block(min)	7.40±0.87	5.75±1.21	<0.001
Duration of sensory block (min)	766.96±29.0	899.50±30.15	<0.001
Duration of motor block (min)	800.29±28.63	1003.17±37.40	<0.001
Duration of analgesia (min)	870.73±32.22	1050.62±43.84	<0.001

The onset of sensory and motor blockade was earlier and duration of analgesia and sensory motor blockade was longer in Group D2 as compared to Group D1 (statistically highly significant, p < 0.001) as shown in table II.

Group	Grade 1	Grade 2	Grade 3	Grade 4
D1	0	0	19	11
D2	0	0	16	14

Table III: Block Quality Grade

Group	Block Quality Grade	p- value
Group D1	3.40 ± 0.50	0.78
Group D2	3.47 ± 0.50	

The grade of block quality was 3.40±0.50 in group D1 and 3.47±0.51 in group D2 in a scale of grade 1 to 4 where grade 4 was complete analgesia and no complaint intraoperatively. The difference in two study groups was found to be statistically insignificant. (Table III)

Table IV: Comparison of rescue analgesia between two groups

	Groups	N	Mean	SD	p-Value
Rescue analgesia (No. of Diclofenac inj.)	D1	30	2.10	0.583	0.0001
	D2	30	1.45	0.465	

Injection diclofenac aqueous solution in dose of 1.5mg/kg was given IV for rescue analgesia till 24 hours from the start of surgery. Total number of diclofenac injections were recorded. The mean value of injection diclofenac used for first 24 hours post-operatively was 2.10±.583 injections in group D1 and 1.45±.465 injections in group D2. (Table IV)
Patients of groupD2 had significant prolongation of post-operative analgesia and their demand of rescue analgesia was also less compared to groupD2 and these values were found to be statistically significant with p value of <0.0001.

Table V: Comparison of Side Effects between two groups

Side effects	GroupD1	GroupD2
Bradycardia	2(6.7%)	3(10.0%)
Hypotension	2(6.7%)	4(13.3%)
Nausea/ vomitting	1(3.3%)	1(3.3%)
Dryness of mouth	nil	nil
Hematoma	nil	nil
Pneumothorax	nil	nil
LA toxicity	nil	nil
Post block neuropathy	nil	nil

In group D1 side effects bradycardia seen 6.7% whereas in group D2 10% similarly hypotension also seen more in group D2 (13.3%) but there was no big difference in side effects in both groups.

Discussion

In our prospective randomized, double blinded comparative study demonstrate that adding 2 µg/kg dexmedetomidine to 0.5% Bupivacaine and lignocaine adr fasten the onset of sensory and motor block and prolonged the duration of postoperative analgesia in supraclavicular block. There was no significant change in hemodynamic parameters throughout the study period with both the doses.
With the use of dexmedetomidine as adjuvant to Bupivacaine and lignocaine adr causes faster onset of action of LA, rapid onset of both sensory and motor blockade, prolonged postoperative analgesia. Both of these drugs have been widely used by several researchers for brachial plexus block in different doses with different local anesthetic agents.[6-8] We found that onset of sensory and motor block was earlier in Group D2 than in Group D1 and the difference was statistically significant (p < 0.001). We also found that very few studies were done on different doses of dexmeditomidine as adjunct to bupivacaine and lignocaine adr in brachial plexus block in past. In present study higher dose of dexmedetomidine resulted in faster onset of sensory

and motor blockade were comparable to other studies [9, 10]. Duration of sensory and motor block and analgesia were more prolonged in GroupD 2 as compared to GroupD 1 ($p < 0.001$) which were highly significant, also consumption of rescue analgesic is reduced. These results were comparable with other studies [11-13].

Our results suggested that only slight decrease in heart rate was observed of effect on α-2 adreno-receptor in central nervous system. They inhibit the release of norepinephrine, terminating the propagation of pain signals and their post synaptic activation and inhibitions of sympathetic activity, thereby decreasing HR and BP [5].

Both groups showed hemodynamic stability, with maximum fall of mean HR 6.7% at 20 min in Group D1 and 10% at 30 min in GroupD2 which were comparable. These results were consistent with other studies [13, 14].

In our study we observed fall in saturation in both groups which was easily managed by administering oxygen via ventimask at 4-5 L/min and we observed no significant episodes of hypoxemia like earlier studies [14].

So keeping the results of present study in view, we recommend that dexmedetomidine in a dose of 2 µg/kg can be safely and effectively used as an adjuvant in brachial plexus block for upper limb surgeries.

Conclusion

Higher dose of dexmedetomidine (2 µg/kg) with 0.5% bupivacaine and lignocaine adr 2% in brachial plexus block resulted in faster onset, prolonged duration of sensorimotor blockade and provided prolonged analgesia in postoperative period with less hemodynamic alterations, when compared to lower dose of dexmedetomidine (1µg/kg) with 0.5% bupivacaine and lignocaine adr 2%.

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