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Ultrasound Guided supraclavicular brachial plexus block to compare the effect of addition of clonidine or dexmedetomidine with 0.5%Bupivacaine: A comparative study

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Abstract

Aim: To compare the effect of addition of Clonidine or Dexmedetomidine with 0.5% Bupivacaine under ultrasound guided supraclavicular brachial plexus block in the patients undergoing bony orthopaedic surgeries of the upper limbs.

Method and material: The present study was conducted in the Department of Anaesthesiology, Nehru Hospital, B.R.D. Medical college, Gorakhpur, U.P., India after approval by the ethical committee of the institution, a written consent was taken from the patients after explaining to them in detail about the implications of the anaesthetic and the surgical procedure. Our study had 45 patients of ASA Grade I and II patients of either sex, aged 18-60 years, undergoing various bony orthopaedic surgeries on the upper limb under ultrasound guided supraclavicular brachial plexus block.

The patients were randomly assigned using "slips in a box technique" to one of the following groups of 15 patients each:

Group A(control): Bupivacaine 0.5% (19 ml) +Distil water (1ml)

Group B: Bupivacaine 0.5% (19 ml) + Dexmedetomidine 1 μg/kg (1ml)

Group C: Bupivacaine 0.5% (19 ml) + Clonidine 1 μg/kg (1 ml)

All volumes were made equal by addition of normal saline.

Result: There were early onset of sensory and motor block, better quality of block,longer duration of analgesia in group B than group C, without significant difference in heamodynamic parameters and associated complications.

Conclusion: Dexmedetomidine with 0.5% Bupivacaine provides better quality of block,early onset and longer duration of sensory and motor block and longer duration of postoperative analgesia as compare to clonidine with 0.5% Bupivacaine in supraclavicular AIbrachial plexus block.

Keywords: clonidine, dexmedetomidine, supraclavicular brachial plexus block, ultrasound guided, upper limb orthopaedic surgery

Introduction

Upper limb surgeries are mostly performed under peripheral nerve blocks mainly Brachial plexus block. Peripheral nerve block not only provides intra-operative anaesthesia but also extends analgesia in the post operative period [1]. The other important advantage of brachial plexus block is that it allows for the avoidance of general anaesthesia and therefore its complications and side effects. Although brachial plexus block is not without risk, it is usually less invasive and affects fewer organ systems than general anaesthesia [2].

There are several techniques for blocking the nerves of the brachial plexus. These techniques are classified by the level at which the needle or catheter is inserted for injecting the local anaesthetic -interscalene block on the neck, supraclavicular block immediately above the clavicle, infraclavicular block below the clavicle and axillaries block in the axilla [3].

Supraclavicular approach gives the most effective block for all portion of upper extremity and is carried out at the level of trunks of brachial plexus [2]. The plexus is blocked where it is most compact [4] i.e. at the middle of brachial plexus, resulting in homogenous spread of anaesthetic throughout the plexus with a fast onset and complete block [5].

Fundamental to the success of regional anaesthesia is the correct positioning of the needle tip in the perineural sheath, prior to injection of local anaesthetic. Ultrasonography (USG) is being increasingly used for brachial plexus block because it allows operators to visualize the needle, nerve, and spread of local anaesthetic agents (LA) [6].

Lignocaine, Bupivacaine are the most common local anaesthetic used in peripheral nerve blocks. There has always been a search for adjuvant that prolong the duration of analgesia but with lesser side effects. Novel analgesic adjuncts when added to brachial plexus block prolong analgesic effect without the disadvantage of systemic side effects or prolonged motor block. It may also allow for a reduction in the total dose of local anaesthetic used.

Novel adjuncts with local anaesthetic agents which are studied till now includes, opioids [tramadol morphine, fentanyl, sufentanil, alfentanil], Epinephrine, bicarbonate, neostigmine and Alpha-2 agonists [Clonidine, Dexmedetomidine] [7].

The search for the ideal additive continues, and led us to try the novel α2 adrenergic agent, dexmedetomidine.

Alpha-2 agonists are mixed with local anaesthetic agents to extend the duration of spinal, extradural and peripheral nerve block. The pharmacologic properties of Alpha-2 agonists have been studied and employed clinically to achieve the desired effects in regional anaesthesia [8].

Alpha 2 adrenergic receptor agonists have been the focus of interest because of their sedative, analgesic, perioperative sympatholytic and cardiovascular stabilizing effects with reduced anaesthetic requirements [9, 10]. Clonidine, an α-2 adrenoceptor agonist, is a common adjunct in both central and peripheral blocks and now a new more selective alpha 2 agonist. Dexmedetomidine is gaining popularity for the said purpose [11]. Dexmedetomidine, a potent α2 adrenoceptor agonist, is approximately eight-times more selective towards the α2 adrenoceptor than clonidine [12]. In previous clinical studies, intravenous dexmedetomidine resulted in significant opioid sparing effects as well as a decrease in inhalational anaesthetic requirements [13]. In various animal studies, dexmedetomidine has been reported to enhance sensory and motor blockade along with increased duration of analgesia [14, 15]. In humans, dexmedetomidine has also shown to prolong the duration of block and post-operative analgesia when added to local anaesthetic in various regional blocks [16].

Very few studies are available that have compared the efficacy of these two alpha 2 agonist [Clonidine Vs Dexmedetomidine] as adjuvant for peripheral nerve blocks. Hence we have designed a randomised study to compare the efficacy of these two drugs in brachial plexus block for upper limb surgeries in our hospital.

Aims and objective

To compare Dexmedetomidine and Clonidine as adjuvant in brachial plexus block under the following heading-

1. To study Onset time and Recovery time of sensory and motor blockade.
2. To compare quality of block.
3. To study Hemodynamic effect intraoperatively with these two drugs.
4. To study side effect and complication of these two drugs.

Material and method

The present study on *"*Ultrasound Guided Supraclavicular Brachial Plexus Block To Compare the Effect Of Addition Of Clonidine Or Dexmedetomidine With 0.5% Bupivacaine: A Comparative Study*".* was conducted in the Department of Anaesthesiology, Nehru Hospital, B.R.D. Medical college, Gorakhpur, U.P., India after approval by the ethical committee of the institution, a written consent was taken from the patients after explaining to them in detail about the implications of the anaesthetic and the surgical procedure.

Our study had 45 patients of ASA Grade I and II patients of either sex, aged 18-60 years, undergoing various bony orthopaedic surgeries on the upper limb under ultrasound guided supraclavicular brachial plexus block.

The study was conducted in three groups of 15 patients each. The patients were randomly assigned using "slips in a box technique" to one of the following groups:

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Group C: Bupivacaine 0.5% (19 ml) + Clonidine 1 μg/kg (1 ml)

All volumes were made equal by addition of normal saline.

Routine investigations like haemoglobin in gm%, total leukocyte count, differential leucocyte count, urine examination, bleeding time, clotting time, electrocardiogram and other investigation were done preoperatively in all the patients.

On arrival in the operation room, baseline heart rate, blood pressure and oxygen saturation were recorded. An intravenous line was secured in the unaffected limb and Ringer's lactate was started.

Technique

All the patients received brachial plexus block through the supraclavicular approach by an experienced anaesthesiologist different from the one assessing the patient intra- and post-operatively. Both were blinded to the treatment groups. Neural localization was achieved by using a nerve locator (Innervator 272 Fisher and Paykel, New Zealand) connected to a 22 G, 10cm long,blunt tipped insulated stimulating needle (B- Braun, Germany) under Ultrasound guidance (Sono Site, Micromaxx). The location end point was a distal motor response with an output lower than 0.5 mA in the median nerve region. Linear probe (Micromaxx L38e/10-5 MHZ) was used to visualize brachial plexus and was kept in position until drug was injected. 20 mL of a solution containing local anaesthetic combined with clonidine or dexmedetomidine as mentioned above was injected and uniform distribution of drug around the brachial plexus was observed under ultrasound guidance.

Sensory block assessment by the pin prick method was done at each minute after completion of drug injection in the dermatomal areas 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.

Complete sensory block was considered when there was complete loss of sensation to pin prick.

Sensory block was graded as-

Grade 0: Sharp pin felt

Grade 1: Analgesia, dull sensation felt

Grade 2: Anaesthesia, no sensation felt.

Assessment of motor block was carried out by the same observer at each minute till complete motor blockade after drug injection. Motor block was determined according to a modified Bromage scale for upper extremities on a 3-point scale.

Onset of motor blockade was considered when there was Grade 1 motor blockade. Peak motor block was considered when there was Grade 2 motor blockade.

Modified Bromage Scale

Grade 0: Normal motor function with full flexion and extension of elbow, 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 when any of the segments supplied by median, radial, ulnar and musculocutaneous nerve did not have analgesia even after 30 min of drug injection. These patients were supplemented

with intravenous fentanyl (1 μg/ kg) and midazolam (0.02 mg/kg). When more than one nerve remained unaffected, it was considered a failed block. In this case, general anaesthesia was given intra operatively. Patients were monitored for haemodynamic variables such as heart rate, blood pressure and oxygen saturation every 30 min after the block intra operatively and every 60 min post-operatively.

At the end of the procedure, quality of block were assessed according to the following numeric scale.

Numeric Scale for Quality of Block

Grade IV: (Excellent) No complaint from patient.

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

Grade II: (Moderate) Complaint that required supplemental analgesia.

Grade I: (Unsuccessful) Patient given general anaesthesia.

The intra- and post-operative assessment was done by an anaesthesiologist who was unaware of the drug used. Patients were assessed for Duration of analgesia as per a numeric rating scale of 0 to 10. The numeric rating scale was recorded post-operatively every 60 min till the score of 5. The rescue analgesia was given in the form of inj. diclofenac sodium (1.5mg/kg) intramuscularly at the Neumeric Rating Scale of 5 and the time of administration was noted. All patients were observed for any side-effects like nausea, vomiting, dryness of mouth and complications like pneumothorax, haematoma, local anaesthetic toxicity and post-block neuropathy in the intra- and post-operative periods.

The duration of sensory block was defined as the time interval between the end of local anaesthetic administration and the complete resolution of anaesthesia on all nerves.

The duration of motor block was defined as the time interval between the end of local anaesthetic administration and the recovery of complete motor function of the hand and forearm.

Comparability of the groups was analysed by Student's unpaired "t" test, Analysis of Variance test. ANOVA test was applied for Demographic data; Student's unpaired "t" test was applied for onset and duration of sensory and motor blockade and for duration of analgesia. Student' paired "t" test was applied for hemodynamic parameters. For all statistical analysis, the value of $p < 0.05$ was considered significant, the value of $p < 0.01$ was considered highly significant and value of $p > 0.05$ was considered as non significant. Mann Whitney test was applied for comparisons of Quality of Block and Sedation.

Observation

Table 1A: Comparision of onset of sensory block in each group

Groups	Total No. of patients	Mean duration	SD
Group-A	15	9.93	1.94
Group-B	15	2.93	0.88
Group-C	15	5.67	1.59

Table 1B

Groups	't' value	'p' value
A and B	12.72	<0.0001**
A and C	6.57	<0.0001**
B and C	5.83	<0.0001**

p>0.05= Insignificant, p<0.05= Significant (*), p<0.01 = highly Significant (**)

Table 2A: Comparision of onset of motor block in each group

Groups	Total No. of patients	Mean duration	SD
Group-A	15	14.4	2.44
Group-B	15	5.6	1.76
Group-C	15	8.8	2.18

Table 2B

Groups	't' value	'p' value
A and B	11.32	<0.0001**
A and C	6.62	<0.0001**
B and C	4.42	<0.0001**

p>0.05= Insignificant, p<0.05= Significant (*), p<0.01= highly Significant (**)

Table 3A: Comparision of duration of sensory block in each group

Groups	Total No. of patients	Mean duration	SD
Group-A	15	266	19.25
Group-B	15	589.07	44.17
Group-C	15	419.07	81.89

Table 3B

Groups	't' value	'p' value
A and B	25.96	<0.0001**
A and C	7.04	<0.0001**
B and C	7.07	<0.0001**

p>0.05= Insignificant, p<0.05= Significant (*), p<0.01= highly Significant(**)

Table 4A: Comparision of duration of motor block in each group

Groups	Total No. of patients	Mean duration	SD
Group-A	15	400.8	41.71
Group-B	15	686.71	70.71
Group-C	15	493.67	96.09

Table 4B

Groups	't' value	'p' value
A and B	13.48	<0.0001**
A and C	3.43	<0.001**
B and C	6.26	<0.0001**

p>0.05= Insignificant, p<0.05= Significant (*), p<0.01= highly Significant(**)

Table 5A: Comparision of duration of analgesia in each group

Groups	Total No. of patients	Mean duration	SD
Group-A	15	363.93	32.4
Group-B	15	644.73	57.68
Group-C	15	463.73	90.98

Table 5B

Groups	't' value	'p' value
A and B	16.43	<0.0001**
A and C	4	<0.001**
B and C	6.5	<0.0001**

p>0.05= Insignificant, p<0.05= Significant (*), p<0.01= highly Significant (**)

Table 6: Comparison of quality of block

Grade	Group A (%)	Group B (%)	Group C (%)
I	00.0(00.0)	00.0(00.0)	00.0(00.0)
II	08(53.0)	01(06.6)	03(20.0)
III	06(40.0)	04(26.6)	08(53.3)
IV	01(06.6)	10(66.6)	04(26.6)

	Group A	Group B	Group C
MEDIAN	2	4	3
IQR (Inter Quartile Range)	2.0-3.0	4.0-4.0	3.0-3.5
Groups		'p' value	
A and B		0.0001**	
A and C		0.06	
B and C		0.008**	

p>0.05= Insignificant, p<0.05= Significant (*), p<0.01=highly Significant (**)

Result

There were no statistically significant difference in demographic profile of all the patients. With careful appraisal of the present study, following result was drawn-

The time of onset of sensory block was significantly earlier in Group-B (2.93±0.88 min) as compared to Group-A (9.93±1.94 min) and Group-C (5.67±1.59min) (p<0.0001) Table 1(A, B).

The time for onset of motor blockade (Grade-2) was highly significantly earlier in Group-B (5.6±1.76 min) as compared to Group-A (14.40±2.44 min) and Group-C (8.80±2.18 min)(p<0.0001) Table 2(A,B).

The duration of sensory blockade was highly significantly longer in Group-B (589.07± 44.17min) as compared to Group-A (266.00±19.25 min) and Group-C(419.07±81.89 min).) (p<0.0001) Table 3(A, B).

The duration of motor blockade was highly significantly longer in Group-B (686.71± 70.71min) as compared to Group-A (400.80±41.71 min) and Group-C (493.67±96.09min) Table 4(A, B).

The time taken for rescue analgesia in Group-B was highly significantly longer (644.73± 57.68 min) as compared to Group- A (363.93±32.40 min) and Group-C (463.73±90.98 min). This difference was highly significant between Group-A and Group-B and Group-B and Group-C (p<0.0001) and between Group-A and Group-C (p<0.001) Table 5(A, B).

So requirement of rescue analgesia was much delayed in Group B as compared to other groups. Dexmedetomidine provided prolonged postoperative analgesia as compared to other groups.

The number of patients achieving Grade-IV quality (excellent) of block was higher in group B (66.6%) as compared with Group C (26.6%) and with group A(6.6%).This difference was highly significant between group A and group B(p<0.0001),between group B and group C (p<0.001) Table 6.

There was no significant difference in between group A and group C(p>0.05)

All patients in group A,group B and group C there was no significant change in mean blood pressure, mean respiratory rate and in mean arterial oxygen saturation at immediately after block,at 30,60,90 In,and 120 minas compared to pre – block.

Complications

Incidence of nausea and vomiting was 6.6%% in Group-B and Group-C. In Group A nausea, vomiting did not occurred. Dry mouth was observed in 13.3% patients in Group-B and 6.6% in Group-C. Shivering was observed in 6.6% of patients in Group-A and Group -C,but not in Group B. Pruritis, hypotension, bradycardia was observed in none of the groups.

No significant difference was observed in incidence of haemodynamic changes or side-effects.

Discussion

In recent past, many advancement has occurred in regional anaesthesia. Brachial plexus blocks are regional anaesthesia techniques that are used for surgery of the shoulder, arm, forearm, wrist and hand.The supraclavicular brachial plexus block provides anaesthesia of the entire upper extremity in the most consistent and time-efficient manner and currently use of ultrasound for brachial plexus block helps in improving quality of block.

A number of studies has been done to improve quality and to decrease side effect of brachial plexus block.This led to mixing of different groups of drugs with local anaesthetics. These include opioids [tramadol,morphine, fentanyl, sufentanil, alfentanil], Epinephrine, bicarbonate, neostigmine and Alpha-2 agonists [7].

Alpha 2 adrenergic receptor agonists have been the focus of interest because of their sedative, analgesic, perioperative sympatholytic and cardiovascular stabilizing effects with reduced anaesthetic requirements [9, 10].

Clonidine has been used as an adjunct to local anaesthetic agents in various regional techniques to extend the duration of block. The results of previous studies on the usefulness of clonidine on brachial plexus block have been mixed. Now Dexmedetomidine, a potent α2 adrenoceptor agonist (approximately eight-times more selective towards the α2 adrenoceptor than clonidine) [12] has gained more attention recently.

In a study done by Bernard J M *et al.* [1997] small doses of clonidine 30–90 μg in combination with lidocaine administered with axillary block reduced sensory block onset time and significantly prolonged analgesia (*P*, 0.010).[17] Singh S, Aggarwal A [2010].compared the effects of clonidine added to bupivacaine with bupivacaine alone on supraclavicular brachial plexus block. It was observed that addition of clonidine to bupivacaine resulted in faster onset of sensory block and longer duration of analgesia. [18] A study by Brumett *et al.* [2008] showed that dexmedetomidine enhances duration of bupivacaine anaesthesia and analgesia of sciatic nerve block in rats without any damage to the nerve [19] Rachana *et al.* [2012] in the similar study observed the effect of dexmedetomidine when added to bupivacaine undergoing upper limb surgery. The duration for sensory and motor block was longer in dexmedetomidine group (p <0.001) [20]. Thus the results of above studies are comparable to our study.

Ammar AS, Mahmoud KM [2012] designed a study to test the efficacy of adding dexmedetomidine to bupivacaine during placement of infraclavicular brachial plexus

blockade (ICB) under ultrasound guidance In their study they observed statistically significant shorter time to onset of sensory (13.2 vs 19.4 min, *P*=0.003) and motor block (15.3 vs 22.2 min, *P*=0.003) in dexmedetomidine group.[21] Swami SS *et al.* (2012*)* compared clonidine and dexmedetomidine as an adjuvant to local anaesthetic agent in supraclavicular brachial plexus block. Onset of sensory block was faster in Dexmedetomidine group (1.77±1.28 min) than in Clonidine group(2.33±1.21 min) but the difference was not statistically significant (*P*>0.05). Though they have observed faster onset of sensory block in Dexmedetomidine group [22]. However in our study, this difference was highly significant. The number of patients achieving Grade-IV quality (excellent) of block was higher in Dexmedetomidine group (80%) as compared with Clonidine Group (40%) *(p<0.05)* similar to our study.

Conclusion

So this study re-established the fact, that alpha 2 agonists when added as adjuvants to bupivacaine provide a faster onset of action with rapid establishment of sensory and motor block and prolonged duration of analgesia in the postoperative period.

We conclude from this study that Dexmedetomidine is a better adjuvant than clonidine for providing early onset of sensory analgesia and prolonged post-operative analgesia. However more studies with larger population are needed to prove that Dexmedetomidine has an edge over clonidine when used as an adjuvant with local anaesthetic agent in peripheral nerve blocks.

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