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Dexmedetomidine is a Better Adjuvant than Clonidine, with Ropivacaine in Supraclavicular Brachial Plexus Block

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Abstract

Regional anesthesia has some advantages over general anesthesia such as it can be used in outpatient anesthesia, for patients with full stomach, for diabetic patients, associated cardiac, pulmonary, hepatic or renal damage and poly-trauma. Alpha-2 agonists added to local anaesthetic drugs increases the duration of painless period during and after surgery. Here we elicit the clinical Performance of this two drugs dexmedetomidine and clonidine as an additive agent to local anaesthetics like ropivacaine in blocking the brachial plexus by supraclavicular method. The clinical parameters we study here are onset, duration of Duration of blockade (both S and M) and analgesia time and hemodynamic stability. *Material and Methods:* Prospective study was done on patients undergoing upper arm surgeries under brachial block were split into two equivalent groups. D-group received 0.375% ropivacaine (30 ml) plus one mcg/kg dexmedetomidine, C- group received 0.375% ropivacaine (30 ml) plus one mcg/kg clonidine. *Results:* Statistical analysis shows significant difference in onset of sensory (S) and motor (M) blockade, highly significance in duration of sensory and motor blockade between D and C groups (p=0.0001). High Statistical significance was seen analgesia duration (p=0.0001) and number of rescue analgesics used (p=0.0001) among D and C groups. *Conclusion:* Dexmedetomidine has more additive benefits than clonidine when combined with ropivacaine by making the onset of clinical effect earlier, prolonging the blockade extent (both S and M) and painless period during post surgery with fewer requirements of rescue analgesics after arm, forearm and hand surgeries.

Keywords: Ropivacaine; Clonidine; Dexmedetomidine; Sensory blockade (S); Motor blockade(M); Local anaesthetic.

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Introduction

Surgerie's done for arm, forearm and hand under peripheral nerve block provides excellent intra-operative analgesia and prolongs the post-operative analgesia duration with least complications[1]. Pain transferred by nerve fibers is the basis for regional block working mechanism and the transfer of pain can be interrupted along their pathway. Other important advantages are postoperative analgesia, early ambulation, no airway manipulation, early feed intake by oral route and lesser incidence of postoperative respiratory, gastric, intestinal and thrombo-embolic complications.[2] Regional

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anesthesia provides better operating conditions, good muscle relaxation and better hemodynamic stability after nerve block. Using supraclavicular nerve block anesthesia can be given to forearm and arm procedures using LA (Local anaesthetic).[3] Initial and earliest supraclavicular block was clinically done by Kulen Kampff[4] in 1912, and Pearson in 1955 clinically performed the use of electrostimulation to find out nerves,[5] nerves stimulator was first use in anaesthesiology by Greenblatt and Denson[6] in 1962 that introduced the nerve stimulator into anaesthesiology clinical practice. Even though they have pharmacological similarity with bupivacaine, extent of ropivacaine action is very longer and very huge margin of safety.[7-8] Ropivacaine is a amide local anaesthetic which has less cardiovascular and CNS toxic effects than bupivacaine.[9] Simultaneous administration of Alpha-2 adrenergic agonists enhances the clinical performance of LA solutions. Alpha 2 receptor activity is highly is highly selective for dexmedetomidine and higher binding effect to alpha 2 adrenoceptor than affinity for clonidine. With ropivacaine, by increasing the dose of the drug results in enhanced duration of blockade(both S and M).[10,11,12,13]

Materials and Methods

This study was conducted in Sri Venkateshwara Medical College Hospital & Research Centre after approval of the medical college ethical board and informed written consent was taken from all patients. A double blinded randomised clinical study was performed on sixty male and female adults patients (ASA-1 & 2), posted for upper limb surgeries during the period of December 2016 to January 2018. The randomization was made by envelope technique which was sealed one. Analysis of statistics was done with software SPSS V(23) and *T*- test was used for comparing and computing $\overline{X} \pm \sigma$ for continuous variables. We used 95% CI and the results were accepted as statistically significant if p<0.001. Prospective study by blinding both study performer and patients was done and patients undergoing upper arm surgeries under brachial block were split into two equivalent groups. D-group received 0.375% ropivacaine (30 ml) plus one mcg/kg dexmedetomidine, C- group received 0.375% ropivacaine (30 ml) plus one mcg/kg clonidine. Following parameters including onset, duration of blockade (both S and M) and duration of painless period after surgical operation were record. SBP, DBP, Heart rate, SpO_2 were recorded.

Results

Statistical analysis shows significant difference in onset of S & M blockade (Table-1), highly significance in duration of S & M blockade between D and C groups (p=0.0001) (Table-2). High Statistical significance was seen analgesia duration (*p*=0.0001) and number of rescue analgesics used (*p*=0.0001) among D and C groups (Table-3) this values are shown in tables below. Non significant difference in HR, SBP, DBP (*p*>0.05) among both groups.

Table 1: Onset of sensory and motor block in two groups (Minutes)

Onset	Group (D)	Group (C)	*p*
S-Block	9.17 ± 2.37	11.27 ± 2.66	0.002
M-Block	12.97 ± 2.76	14.57 ± 3.25	0.04

S: Sensory, M: Motor.

Table 2: Sensory and motor block duration in two groups

Duration	Group (D)	Group (C)	*p*
S-Block	500.57 ± 46.28	313.3 ± 48.94	0.0001
M-Block	476.17 ± 45.67	290.43 ± 65.64	0.0001

Table 3: Duration of analgesia and Rescue analgesics among two groups

Duration	Group (D)	Group (C)	*p*
Duration of Analgesia	592.93 ± 45.95	441.53 ± 18.19	0.0001
No of rescue analgesics	2.13 ± 0.63	3.53 ± 0.82	0.0001

Discussion

The supraclavicular approach is considered to be the easiest and most effective approach for anesthesia of forearm and arm procedures. The classical approach using the anatomical Ultrasonography (USG) guidance and peripheral nerve stimulator (PNS) have improved the success rates and safety margin.benefits of this block include quick onset, expected and deeper anesthesia with maximum success. Main disadvantage of using local anaesthetics along is delayed on setoff block, short duration of block and shorter duration of analgesia after surgery to compensate this deficiency many additives like alpha 2 agonists, steroids like Dexamethasone, benzodiazepines, anti-cholinesterase's etc., are being commonly added to local anaesthetics and used. We consider this presently done study to evaluate the effect of clonidine and dexmedetomidine which is added to local anaesthetic ropivacaine as additive in brachial nerve block done over supra-clavicular region

mainly in the limb operations of arm and forearm. Duration of S and M blockade was significantly extended in study done by Don Sebastian et al[14], Vania k *et al.*[15], Kamlesh k *et al.*[16], Saritha S swami *et al.*[17], Chaudhary *et al.*[18] (p=0.01, p=0.0001, p=0.001, p=0.001, p=0.001) with high statistical significance. Duration of painless period was extended in Don Sebastian *et al.*[14], Kamlesh k *et al.*[16], Saritha S swami *et al.*[17], and statistically significant.

In our current study onset of S & M block (p=0.002), (p=0.04) were slower in clonidine group of patients and faster in group of patients receiving dexmedetomidine. Duration of sensory block (p=0.0001), motor block (p=0.0001) were longer in dexmedetomidine group and highly significant statistically. Duration of analgesia (p=0.0001) is longer and number of rescue analgesics (p=0.0001) used were lesser in dexmedetomidine group and statistically highly significant in comparison with clonidine group. Hence the result of this present study has correlated with Sarita S Swami[17], Chaudhary *et al.*[18],Vania k *et al.*[15], and Don sebastin[14] study by extending the duration of S & M block, duration of painless period and decreased need for extra dose of analgesics.

Dexmedetomidine action is mainly through the alpha 2 receptor which is adrenergic in nature the selectivity to this receptor is very high and acts as agonist. The activity at alpha 1 recepyor and alpha 2 receptor is 1:220 times for clonidine and 1:1620 times for dexmedetomidine. Following are the mechanisms of action at alpha 2 receptor level as agonist (1) analgesia is provided mostly by central action (2) by acting over the peripheral nerve directly (3)vaso-constriction mediated by receptors (4) knocking off the inflammatory mechanism. Extended duration of action is due to the peri-neural administration of alpha 2 receptor agonist as additive to local anaesthetics.[19]

Nerve hyperpolarisation is the mechanism for extending the painless period. it is brought about by blocking the cation Ih current in the nerve. This blocking also results in prolonged action over C fibers (pain) than in A alpha fibers (motor). Action potential is inhibited at higher level by dexmedetomidine than clonidine. Loss of pain and sedation mechanism by blocking the release of pain producing substance P at the level of dorsal root and by stimulating the alpha 2 receptors belonging to the adrenergic group at L. coerleus. Other mode is by blocking the noci-ceptive neurotransmission of the nor-adrenergic system at the descending pathway. Clonidine by producing alpha one mediated vaso-constriction and decreases the uptake of clonidine-local anesthesia mixture and reduces the uptake into the circulatory system,whereas dexmedetomidine has limited action on alpha one receptors.[19]

Experimental studies done on rats especially by brumett and his team have proved that alpha 2 agonists in large doses have extended the time of nerve blocks done on sciatic nerve when added to local anaesthetics. On examination done on histopathology of sciatic nerve, it has been found that myelin sheath of the nerve and axon were not affected by the perineural alpha 2 agonists mainly dexmedetomidine. There was increase in cytokines numbers at the site of nerve damage.this is the main reason for the use of alpha 2 agonists as additives to local anaesthetics and a concrete evidence for the neuro protective effect produced by dexmedetomidine. High safety margin of this drugmakes it abetter choice for intrathecal use. In addition it produces glomerular filtration enhancement, enhancement of threshold for seizures, reduces salivary secretion and IOP (intra ocular pressure).[19]

Conclusion

Dexmedetomidine has more additive benefits than clonidine when combined with ropivacaine by making the onset of clinical effect earlier, prolonging the blockade extent (both S and M) and painless period during post surgery with fewer requirements of rescue analgesics after arm, forearm and hand surgeries.

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