

Original article:

Comparative Analysis of Dexmedetomidine and Clonidine (α_2 Agonist Drugs) as an Adjuvant to Local Anaesthesia in Supraclavicular Brachial Plexus Block at a Tertiary Care Centre

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ABSTRACT

Background: To compare dexmedetomidine and clonidine as an adjuvant to local anaesthesia in supraclavicular brachial plexus block.

Materials & Methods: A total of 30 American Society of Anaesthesiologist (ASA) Grade I and II patients of either sex, aged 20-55 years were enrolled. The subjects were undergoing various bony orthopaedic surgeries on the upper limb under supraclavicular brachial plexus block. The data was analysed by SPSS software. Unpaired t-test was done. P-value was considered significant if <0.05 .

Results: Onset of sensory block was faster in Group B than in Group A, while onset of motor block was faster in Group A than in Group B, but the difference was not statistically significant ($P>0.001$). There was significant increase in duration of analgesia in Group B (488.63min) as compared with Group A (293.26 min). The difference was statistically significant ($P=0.001$)

Conclusion: Dexmedetomidine when added to local anaesthetic in supraclavicular brachial plexus block increased the duration of sensory and motor block and also the duration of analgesia.

Key words: Anesthesia, Clonidine, Dexmedetomidine.

INTRODUCTION

Acute postoperative pain is the result of a complex physiological reaction to tissue injury. The dorsal horn of the spinal cord is the site of termination of primary afferents and there is complex interaction between such afferent fibers, intrinsic spinal neurons, descending pain modulating fibers, and various associated neurotransmitters such as serotonin, norepinephrine, acetylcholine, adenosine, and glutamate in the dorsal horn.¹ Local anesthetics administered as regional nerve blocks are utilized in providing postoperative pain relief in many surgical procedures by blocking signal traffic to the dorsal horn. Certain drugs may be used as adjuvant to local anesthetics to lower doses of each agent and enhance analgesic efficacy while reducing the incidence of adverse reactions. Tramadol and fentanyl had been successfully used as adjuvants to local anesthetic in brachial plexus block.^{2,3} The concurrent injection of Alpha₂ adrenergic agonist drugs has been suggested to improve the nerve block characteristic of local anesthetic solutions through either local vasoconstriction and facilitation of C fiber

blockade or a spinal action caused by slow retrograde axonal transport or simple diffusion along the nerve.⁴⁻⁶ Clonidine is a selective Alpha2 adrenergic agonist with some Alpha1 agonist property. In clinical studies, the addition of clonidine to local anesthetic solutions improved peripheral nerve blocks by reducing the onset time, improving the efficacy of the block during surgery and extending postoperative analgesia.^{7,8} The effect of clonidine is dose related between 0.1 and 0.5 µg/kg.⁸ Clonidine possibly enhances or amplifies the sodium channel blockade action of local anesthetics by opening up the potassium channels resulting in membrane hyperpolarization, a state in which the cell is unresponsive to excitatory input.⁹

Dexmedetomidine, a potent α2 adrenoceptor agonist, is approximately eight-times more selective towards the α2 adrenoceptor than clonidine.¹⁰ In previous clinical studies, intravenous dexmedetomidine resulted in significant opioid sparing effects as well as a decrease in inhalational anaesthetic requirements.¹¹ In various animal studies, dexmedetomidine has been reported to enhance sensory and motor blockade along with increased duration of analgesia.¹²⁻¹⁴ 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.^{15,16} Hence, this study was conducted to compare dexmedetomidine and clonidine as an adjuvant to local anaesthesia in supraclavicular brachial plexus block.

MATERIALS & METHODS

A total of 30 American Society of Anaesthesiologist (ASA) Grade I and II patients of either sex, aged 20-55 years were enrolled. The subjects were undergoing various bony orthopaedic surgeries on the upper limb under supraclavicular brachial plexus block. The study was conducted in two groups of 15 patients each;

Group A: Bupivacaine 0.25% (35 cc) + clonidine 1 µg/kg

Group B: Bupivacaine 0.25% (35 cc) + dexmedetomidine 1 µg/kg

Quality of operative conditions was assessed. Grade 1: Patient given general anaesthesia, Grade 2: Moderate, Grade 3: Minor complaint and Grade 4: No complaint. The data was analysed by SPSS (Statistical Package for Social Sciences) software. Unpaired t-test was done. P-value was considered significant if <0.05.

RESULTS

A total of 30 subjects were included. Onset of sensory block was faster in Group B than in Group A, while onset of motor block was faster in Group A than in Group B, but the difference was not statistically significant ($P > 0.001$). Duration of sensory block was 245 min in Group A as compared with 452.20 min in Group B. Statistically significant longer duration of sensory block was observed in Group B ($P = 0.001$). There was significant increase in duration of analgesia in Group B (488.63min) as compared with Group A (293.26 min). The difference was statistically significant ($P = 0.001$)

In Group B, 73.3% of the patients achieved Grade IV quality of block as compared to 46.7% in Group A ($P < 0.05$). There were a total 7 patients in Group A with Grade II and III block and 4 subjects in Group B who required sedation or sedation with analgesia.

Table 1: Sensory and motor block onset time, block and analgesia durations in both groups

	Group A (mean)	Group B (mean)	P- value
Onset time of sensory block (min)	2.15	1.68	0.09
Onset time of motor block (min)	3.29	4.20	0.15
Duration of sensory block (min)	245	452.20	0.001*
Duration of motor block (min)	302.26	502.69	0.001*
Duration of analgesia (min)	293.26	488.63	0.001*

*: Significant

Table 2: Quality of block

Grade	Group A (n, %)	Group B (n, %)	p- value
I	1 (6.7)	-	0.01*
II	3 (20)	1(6.7)	
III	4 (26.6)	3 (20)	
IV	7 (46.7)	11 (73.3)	

*: Significant

DISCUSSION

Clonidine was initially used for its antihypertensive properties. The central actions are mediated through α_2 adrenoceptors, which are situated at locus coeruleus and dorsal horn of spinal cord. But, specific peripheral effects of clonidine appear to be less obvious because α_2 adrenoceptors are not present on the axon of the normal peripheral nerve.¹⁷ There have been four proposed mechanisms for the action of clonidine in peripheral nerve blocks. These mechanisms are centrally mediated analgesia, $\alpha_2 \beta$ adrenoceptor-mediated vasoconstrictive effects, attenuation of inflammatory response and direct action on peripheral nerve.¹⁸ The direct action of clonidine on the nerve can be explained on the basis of a study conducted by Dalle et al. They proposed that clonidine, by enhancing activity-dependent hyperpolarisation generated by the Na/K pump during repetitive stimulation, increases the threshold for initiating the action potential causing slowing or blockage of conduction.¹⁹ Hence, this study was conducted to compare dexmedetomidine and clonidine as an adjuvant to local anaesthesia in supraclavicular brachial plexus block.

In the present study, a total of 30 subjects were included. Onset of sensory block was faster in Group B than in Group A, while onset of motor block was faster in Group A than in Group B, but the difference was not statistically significant ($P>0.001$). Duration of sensory block was 245 min in Group A as compared with 452.20 min in Group B. Statistically significant longer duration of sensory block was observed in Group B ($P=0.001$). There was significant increase in duration of analgesia in Group B (488.63min) as compared with Group A (293.26 min). The difference was statistically significant ($P=0.001$). A study by Swami SS et al, studied sixty ASA I and II patients scheduled for elective upper limb surgeries under supraclavicular brachial plexus block were divided into two equal groups in a randomized, double-blinded fashion. Group C received clonidine 1 $\mu\text{g}/\text{kg}$ and Group D received dexmedetomidine 1 $\mu\text{g}/\text{kg}$ added to bupivacaine 0.25% (35 cc). Duration of sensory block and motor block was 227.00 ± 48.36 and 292.67 ± 59.13 min, respectively, in group C, while it was 413.97 ± 87.13 and 472.24 ± 90.06 min, respectively, in group D. The duration of analgesia (time to requirement of rescue analgesia) in group D was 456 ± 97 min, while in group C, it was 289 ± 62 min. Statistically, this

difference was significant ($P=0.001$). The number of patients achieving grade IV quality (excellent) of block was higher in group D (80%) as compared with group C (40%) ($P<0.05$).²⁰

In the present study, in Group B, 73.3% of the patients achieved Grade IV quality of block as compared to 46.7% in Group A ($P<0.05$). There were a total 7 patients in Group A with Grade II and III block and 4 subjects in Group B who required sedation or sedation with analgesia. Another study by Chakraborty S et al, studied randomized double-blind placebo-controlled trial with 70 patients of American Society of Anesthesiologists Grade I or II status undergoing upper limb orthopedic procedures. Group A ($n = 35$) patients received 25 ml of 0.5% bupivacaine and 0.2 ml (30 mcg) clonidine, whereas group B ($n = 35$) received 25 ml of 0.5% bupivacaine and 0.2 ml normal saline through a supraclavicular approach for brachial plexus block. Duration of analgesia was taken as the time from placement of block till injection of rescue analgesic. Analgesia duration was 415.4 ± 38.18 min (mean \pm standard deviation) in Group A (clonidine) compared to 194.2 ± 28.74 min in Group B (control). No clinically significant difference was observed in heart rate, blood pressure, and oxygen saturation. Sedation score was higher in the clonidine group.²¹ Bernard and Macarie,⁸ evaluating the effects of adding 30-300 μ g clonidine to lignocaine for axillary brachial plexus anesthesia, reported that the addition hastened the onset of the block and improved the efficacy of surgical anesthesia. There are reported differences in the effects of administration of low-dose clonidine on time of onset and efficacy of nerve block, which may be explained by differences in the type of nerve block, exact mixture injected, and technique used to perform the block (single injection versus multiple injections). In fact, a multiple-injection technique was used, which is known to improve both onset time and quality of nerve block, and this could have reduced the differences in onset time between the two groups.²²

CONCLUSION

Dexmedetomidine when added to local anaesthetic in supraclavicular brachial plexus block increased the duration of sensory and motor block and also the duration of analgesia.

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