IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 3 Ver. V (Mar. 2015), PP 91-97
www.iosrjournals.org

Comparison of Dexmedetomidine and Clonidine as Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Nerve Blocks

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Abstract: *Adjuncts to local anaesthetics for brachial plexus block enhances the quality and duration of analgesia. The purpose of this study was to compare two alpha-2 agonists clonidine and dexmedetomidine, when added as adjuvant to ropivacaine, in respect to onset, duration of sensory and motor block along with duration of analgesia. After informed consent, Sixty ASA I and II patients scheduled for elective upper limb surgeries under supraclavicular brachial plexus block in R L Jalappa Hospital were divided into two equal groups in a randomized, double-blinded fashion. To ropivacaine 29 ml (0.5%), Group C received clonidine 1 ml (50 µg) and Group D received dexmedetomidine 1ml (50µg). Onset and duration of sensory and motor block, duration of analgesia were studied in both the groups. Both groups were comparable with regard to age sex distribution, pulse rate and mean arterial blood pressure. There was no statistically significant difference. Onset of sensory and motor blockade was faster in Group D, which is statistically significant. The Duration of sensory block and motor block, analgesia was also greatest in group D, which is statistically significant. There was no statistically significant difference between two groups in number of rescue analgesia requirement during first 24 hrs. There were no adverse events noted in either group. All patients were haemodynamically stable without requiring anaesthetist's intervention. Dexmedetomidine when added to ropivacaine in supraclavicular brachial plexus block had faster onset, greater duration of sensory and motor block and also, the duration of analgesia, than clonidine. Dexmedetomidine is better adjuvant than clonidine when added as adjuvant to ropivacaine in supraclavicular brachial plexus block.*

Keywords *- Ropivacaine, Dexmedetomidine, Clonidine, Supraclavicular Brachial plexus block*

I. Introduction

Brachial plexus block is one of the peripheral nerve blockade which has been used for surgeries of upper limb. It provides both intraoperative anaesthesia as well as postoperative analgesia. Being a regional anaesthesia technique, it has many advantages over general anaesthesia like effective analgesia with good motor blockade, awake patient, extended postoperative analgesia, early mobilization, no airway manipulation, avoiding polypharmacy and decreased incidence of postoperative nausea and vomiting.[1]

Many local anaesthetics has been used to produce brachial plexus block. Most common among them being bupivacaine, because of its higher potency and prolonged duration of action. One of the disadvantage is that its cardiotoxicity, especially with inadvertent injection into subclavian artery. So ropivacaine was developed with properties similar to bupivacaine, having lower lipid solubility and less cardiotoxicity.[2]

Many drugs are used as adjuvants for faster onset, denser block and for prolonging the duration of peripheral nerve blockade. Alpha-2-adrenergic agonists were chosen for their sedative, analgesic, antihypertensive and antiemetic properties along with decreased requirement of drugs. Clonidine a partial alpha 2 agonist has been shown to prolong the duration of anaesthesia and analgesia in nerve blocks.[7] Dexmedetomidine, a selective alpha2 agonist, with affinity eight times that of clonidine, also has been shown to prolong the sensory and motor duration when added as an adjuvant to local anaesthetic in nerve blocks[3,4,5,6]

As not much literature is available with regard to use of dexmedetomidine as adjuvant in supraclavcicular brachial plexus block with ropivacaine, the study was done.

II. Methodology

A randomized double blind clinical study was done in R L Jalappa Hospital during the period from February 2013 to May 2014. The study was done to compare the effects of clonidine 1ml (50 microgram) and dexmedetomidine 1ml (50 microgram) when added as adjuvant to 29 ml ropivacaine 0.5% in supraclavicular brachial plexus block using nerve stimulator for elective upper limb surgeries.

The study was undertaken after obtaining ethical committee clearance as well as informed consent from all patients. Sixty patients aged between 18 to 55 years with ASA class I and II posted for elective upper limb surgeries were included in the study. The study population were randomly divided using computer

generated numbers into 2 groups with 30 patients in each group. Group C (n = 30) received 29 ml 0.5% ropivacaine + 1 ml (50 microgram) clonidine Group D (n = 30) received 29 ml 0.5% ropivacaine + 1ml (50 microgram) dexmedetomidine. Patients with any bleeding disorder or patient on anticoagulants, neurological deficits involving brachial plexus, patients with allergy to local anaesthetics, patients with history of drug allergy to dexmedetomidine, clonidine, local infection at the injection site, patients on any sedatives or antipsychotics, patients suffering from cardiac and pulmonary disease were excluded from study.

On arrival of patients in the operating room, an 18 gauge intravenous cannula was inserted on the non-operating hand and an infusion of Ringer Lactate was started. The patient's heart rate (HR), noninvasive measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), continuous electrocardiogram (ECG) monitoring and haemoglobin oxygen saturation (SPO2) were monitored. The baseline blood pressure and heart rate were recorded. The heart rate and rhythm were also monitored from a continuous visual display of electrocardiogram from lead II.

The supraclavicular brachial plexus block was performed by the classical approach using a single-injection, nerve-stimulator technique. The electrical stimulation was started with an intensity of 2.0mA and a pulse width of 100μs. Once the desired response was obtained – that is a muscle twitch of the fingers that is clearly visible – the current strength was reduced in increments of 0.2mA gradually to 0.4mA. If the desired response persisted at 0.4mA the drug solution was injected. The study drug was injected in 3ml increments, after a negative aspiration test, with repeat aspirations every 3ml. During the intraoperative period heart rate, systolic, diastolic and mean arterial pressures were noted every 5 minutes (mins) during the first 15mins, then every 15 mins throughout the surgery and hourly thereafter.

The following parameters were studied:
Onset and duration of Sensory block:

Sensory block was assessed by pinprick test using the blunt end of a 26-gauge needle at each minute after completion of drug injection in the dermatomal areas corresponding to median nerve, ulnar nerve, radial nerve and musculocutaneous nerve till complete blockade.

Sensory block was assessed by a 3-point scale:
0 - normal sensation,
1 - loss of sensation of pinprick (analgesia),
2 - loss of sensation of touch (anaesthesia).

Onset time was defined as the time interval between the end of total local anaesthetic administration and complete sensory block (score 2).

Duration of sensory block was defined as the time interval between the end of local anaesthetic administration and the complete resolution of anaesthesia (score 0).

Onset and duration of motor block:
Motor blockade was assessed by Modified Bromage Scale
0- Normal motor function,
1- Ability to move only fingers,
2- Complete motor block with inability to move elbow, wrist and finger

Motor block onset time was defined as the time interval between the end of total local anaesthetic administration and complete motor block (MBS score 2).

Duration of motor block was defined as the time interval from the onset to the recovery of complete motor function (MBS score 0).

Duration of analgesia or first request for analgesic/ requirements in first 24 hrs:

Pain was assessed using a standard 10 cm Visual Analogue Scale (VAS) by an independent anaesthesiologist. Time for first request for postoperative analgesic (duration of analgesia) was noted. Intravenous inj tramadol 100mg with inj ondansetron 4mg was given as rescue analgesic if VAS score was greater than or equal to 4. Number of requirements of rescue analgesia in first 24 hrs was noted.

Management of unsuccessful block:

Inadequate sensory and motor blockade beyond 30mins following the infiltration was considered as unsuccessful block. In that circumstance, the block was supplemented with general anaesthesia.

Incidence of nausea, vomiting, horner's syndrome, phrenic nerve palsy, pneumothorax, respiratory depression and signs and symptoms of local anaesthetic toxicity were looked for and noted along with any side

effects, if any. The above assessments were made by the principal investigator who was blinded to the drugs used in the study.

III. Statistical Analysis

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented as Mean ± SD and results on categorical measurements are presented in Number (%). The student 't' test was used to determine whether there was a statistical difference between study groups in the parameters measured.

In the above tests the "p" value of less than 0.05 was accepted as indicating statistical significance. Data analysis was carried out using Statistical Package for Social Science (SPSS version 17) and Microsoft word and Excel have been used to generate graphs, tables etc.

IV. Observations And Results

There was no significant difference in the patient characteristics including age and gender. The haemodynamic parameters taken into consideration were the heart rate mean arterial blood pressure and oxygen saturation. Pulse rate in both the groups were comparable without any statistical significance. The mean arterial pressures were also comparable in both the groups without any statistical significance.(Figure 1,2)

Onset of sensory and motor block :

The mean time for onset of sensory block in group C was 11.6 ± 1.754 min and in group D was 9.37 ± 1.68 min. The mean time for onset of motor block in group C was 15.77 ± 1.612 min and in group D was 12.87± 1.592 min. Both differences were statistically significant ($P < 0.01$).(Table 1 and Figure 3)

Duration of sensory and motor block :

The mean duration of sensory block in group C was 463.5 ± 40.325 min and in group D was 647.67 ± 49.857 min. This difference was statistically significant ($P < 0.01$). The mean duration of motor block in group C was 424.33 ± 44.658 min and in group D was 600.83 ± 46.722 min. This difference was also statistically significant ($P < 0.01$) (figure 4)

Duration of Analgesia:

In group C duration of analgesia was 510.83 ± 42.306 min while for group D it was 720.83 ± 44.16 min which is statistically significant. The number of rescue analgesic requirement in first 24 hours is similar in two groups (not statistically significant). (Table 2)

V. Complications

No complications / adverse effects were noted in the study groups during the procedure.

VI. Discussion

For upper limb surgeries brachial plexus block provide both intraoperative anaesthesia as well as postoperative analgesia and, it has an advantage over general anaesthesia like avoiding airway instrumentation, polypharmacy, decreased incidence of nausea and vomiting, early mobilisation and extended postoperative analgesia[1]. Of various approaches to brachial plexus, supraclavicular route is preferred as the narrowest part of plexus is located there and there will be rapid, dense and predictable anaesthesia of entire upper limb.[7] Using nerve stimulator we can avoid problems associated with the conventional technique like patient discomfort to paresthesia , injury to nerve and surrounding structures , higher failure rates.[8]

The advantage of ropivacaine over bupivacaine is that it has similar properties to bupivacaine but with lower lipid solubility and less cardiotoxicity.[6] Adjuvants added to local anaesthetics results in faster onset denser block and prolonged duration of analgesia especially alpha-2 agonists.[9] In one study they used Fentanyl and Tramadol as additives with Ropivacaine for Supraclavicular Brachial plexus blocks and they observed that in fentanyl group the duration of sensory, motor block and analgesia was more ; VAS scores were also better in fentanyl group.[10]

Various studies were done with clonidine as adjuvant to local anaesthetics. El Saied et al conducted a study in which axillary brachial plexus blockade was performed with addition of clonidine to ropivacaine.[5] The study showed that addition resulted in prolongation of sensory and motor block and analgesia without increased incidence of side effects. In another study Giovanni Cucchiaro et al, evaluated the effects of clonidine on the duration of sensory and motor block and analgesia time in children who underwent a variety of peripheral nerve block including brachial plexus block and concluded that the addition of clonidine to bupivacaine and ropivacaine can extend sensory and motor blocks.[11] In another study Casati et al. added clonidine to ropivacaine (0.75%) for axillary brachial plexus block which provided increased post operative analgesia , without

clinically relevant effects on the degree of sedation and cardiovascular homeostasis.[12] The above studies show that selective α2- adrenoceptor agonist like clonidine when added as adjuvant to ropivacaine in different peripheral nerve blocks potentiates the sensory and motor blockade and also prolonged duration of analgesia.

Dexmedetomidine is an α2 selective agonist. It acts in a manner similar to clonidine which is also an α2 selective agonist. Dexmedetomidine, the pharmacologically active d-isomer of medetomidine is a highly specific and selective α2 adrenoceptor agonist with α2:α1 binding selectivity ratio of 1620:1 as compared to 220:1 for clonidine, thus decreasing the unwanted side effects of α1 receptors. One of the highest densities of α_2 receptors has been located in the locus coeruleus. The hypnotic and sedative effects of α_2-adrenoceptor activation have been attributed to this site in the CNS. It is also the site of origin for the descending medullospinal noradrenergic pathway, known to be an important modulator of nociceptive neurotransmission. In this region of the brain, α_2-adrenergic and opioidergic systems have common effector mechanisms, indicating that dexmedetomidine has a supraspinal site of action.. Presynaptic activation of α2 adrenoceptor in central nervous system (CNS) inhibits the release of norepinephrine, terminating the propagation of pain signals and their postsynaptic activation inhibits sympathetic activity, thereby decreasing HR and BP.[13]

Aggarwal S, Aggarwal R, Gupta P compared the effects of adding dexmedetomidine to bupivacaine in supraclavicular brachial plexus block in fifty patients.[14] They concluded that dexmedetomidine added as an adjuvant to bupivacaine for supraclavicular brachial plexus block significantly shortens the onset time and prolongs the duration of sensory and motor blocks and duration of analgesia. Patients in dexmedetomidine group were adequately sedated with no adverse effects except bradycardia in one.

Feroz Ahmad Dar, Mohd Rafiq Najar, Neelofar Jan evaluated the effect of adding dexmedetomidine to ropivacaine for axillary brachial plexus blockade in eighty patients scheduled for elective forearm and hand surgeries. Sensory and motor block onset times were shorter when dexmedetomidine was added, also sensory and motor blockade durations were longer along with duration of analgesia.[15]

Saumya Biswas, Ratan Kumar Das, Gauri Mukherjee, Tapas Ghose evaluated the effect of combining dexmedetomidine with levobupivacine with respect to duration of motor and sensory block and duration of analgesia. They found sensory and motor block durations were longer when dexmedetomidine was added as adjuvant. Duration of analgesia was also significantly longer with addition of dexmedetomidine.[16]

These studies shows that dexmedetomidine has faster onset of sensory and motor blockade with prolonged duration of sensory and motor blockade with increased duration of analgesia when added as adjuvant to local anaesthetics. So the study was done to compare clonidine and dexmedetomidine, two alpha-2 agonists, as adjuvant to ropivacaine in respect to onset, duration of sensory and motor block along with duration of analgesia.

The result of our study shows that all patients in both groups were comparable with respect to demographic profile. Onset of sensory and motor blockade was faster in Group D which was statistically significant. Duration of sensory and motor blockade was more in Group D which was also statistically significant. The duration of analgesia was more in Group D, also statistically significant. These results show that dexmedetomidine has faster onset of sensory and motor blockade, prolonged duration of sensory and motor blockade and also increased duration of analgesia.

These results are consistant with other studies. Harshavardhana H S did a study aiming to test the hypothesis that dexmedetomidine produces a better analgesia, motor block and post operative analgesia when added as an adjuvant to ropivacaine 0.5% in supraclavicular brachial plexus block compared with clonidine. He found that dexmedetomidine prolonged the duration of sensory and motor block and enhances the quality of block as compared with clonidine when used as an adjuvant to ropivacaine in peripheral nerve block and concluded that dexmedetomidine when added to ropivacaine for brachial plexus block is a better adjuvant compared to clonidine.[17]

Swami SS, Keniya VM, Ladi SD, Rao R. compared clonidine and dexmedetomidine as an adjuvant to local anaesthetic agent in supraclavicular brachial plexus block with respect to onset and duration of sensory and motor block and duration of analgesia. Their finding was that dexmedetomidine, when added to local anaesthetic in supraclavicular brachial plexus block enhanced the duration of sensory and motor block and also the duration of analgesia. The time for rescue analgesia was prolonged in patients receiving dexmedetomidine and also enhanced the quality of block as compared with clonidine.[3]

Saurabh Singh , H. S. Nanda conducted a comparative study of clonidine and dexmedetomidine as adjuvant to 0.25% bupivacaine in supraclavicular brachial plexus block for duration of action and haemodynamic changes. Their findings was that dexmedetomidine significantly prolonged the duration of action , and significant decrease in haemodynamic parameters, but did not require any active intervention for the same.[18]

Both groups were comparable with regard to pulse rate, mean arterial blood pressure and oxygen saturation. There was no statistically significant difference ($P > 0.05$). No adverse effects like bradycardia, hypotension etc were noted in the study. The number of rescue analgesic requirements in first 24 hours is similar in two groups (not statistically significant).

To conclude, dexmedetomidine has faster onset, prolonged duration of sensory and motor block and increased duration of analgesia as compared with clonidine when used as an adjuvant to ropivacaine in peripheral nerve block.

VII. Conclusion

We conclude that dexmedetomidine, when added as adjuvant to ropivacaine in supraclavicular brachial plexus block has faster onset of sensory and motor blockade and, prolonged duration of sensory and motor blockade and duration of analgesia, when compared with clonidine. No significant side effects were noted. So dexmedetomidine is better adjuvant than clonidine in supraclavicular brachial plexus block for upper limb surgeries.

References

[1]. Cousins MJ Bridenbaugh. Neural blockade in clinical anaesthesia and pain medicine. 4th ed.: Lippincott Williams and Wilkins; 2009.

[2]. McClure JH. Ropivacaine. British Journal of Anaesthesia 1996; 76:300-7.

[3]. Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (α2 agonist drugs) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. Indian J Anaesth 2012; 5(): 243-9.

[4]. Yoshitomi T, Kohjitani A, Maeda S, Higuchi H, Shimada M, Miyawaki T. Dexmedetomidine Enhances the Local Anaesthetic Action of Lidocaine via an α-2A Adrenoceptor. Anesth Analg 2008; 107:96 –101.

[5]. Saadawy I, Boker A, Elshahawy MA, Almazrooa A, Melibar S, Abdellatif AA, et al. Effect of dexmedetomidine on the characteristics of bupivacaine in a caudal block in paediatrics. Acta Anaesthesiol Scand 2009; 53: 251–256.

[6]. Esmaoglu A, Yegenoglu F, Akin A, Yildirim C. Dexmedetomidine Added to Levobupivacaine Prolongs Axillary Brachial Plexus Block. Anesth Analg 2010; 111:1548-51.

[7]. Edward G Morgan, Maged S Mikhail, Micheal J Murray. Peripheral nerve blocks,4th ed. Chapter 17. In: Clinical anaesthesiology, New Delhi: Tata McGraw-Hill; 2009.

[8]. Yasuda I, Hirano T, Ojima T, Ohhira N, Kaneko T and Yamamuro M. Supraclavicular brachial plexus block using a nerve stimulator and an insulated needle. Br J Anaesth 1980; 52: 409.

[9]. El Saied AH, Steyn MP, Ansermino JM; Clonidine prolongs the effect of ropivacaine for axillary brachial plexus blockade. Can J Anaesth 2000; 47: 962–967.

[10]. Ravi Madhusudhana*, Krishna Kumar , Ramesh Kumar , Somasekharam Potli, Dinesh Karthik, Manu Kapil. Supraclavicular brachial plexus block with 0.75 % ropivaciane and with additivestramadol, fentanyl- a comparative pilot study. Int J Biol Med Res. 2011; 2(4): 1061 – 1063.

[11]. Cucchiaro G, Ganesh A; The effects of clonidine on postoperative analgesia after peripheral nerve blockade in children. Anesth Analg 2007;104: 532-537.

[12]. Casati A, Magistris L, Beccaria P, Cappelleri G, Aldegheri G, Fanelli G; Improving postoperative analgesia after axillary brachial plexus anesthesia with 0.75% ropivacaine: A double-blind evaluation of adding clonidine. Minerva Anestesiol 2001; 67: 407–412.

[13]. 12 Gertler R, Brown HC, Mitchell DH, Silvius EN. Dexmedetomidine: a novel sedative-analgesic agent. BUMC Proceedings 2001; 14:13–21.

[14]. Agarwal S, Aggarwal R, Gupta P. Dexmedetomidine prolongs the effect of bupivacaine in supraclavicular brachial plexus block. J Anaesthesiol Clin Pharmacol 2014;30;36-40.

[15]. Dar F A , Najar M R, Jan N .Dexmedetomidine Added to Ropivacaine Prolongs Axillary Brachial Plexus Block. International Journal of Biomedical and Advance Research 2013; 4: 719-722.

[16]. Biswas S, Das RK, Mukherjee G, Ghose T. Dexmedetomidine an Adjuvant to Levobupivacaine in Supraclavicular Brachial Plexus Block: A Randomized Double Blind Prospective Study. Ethiop J Health Sci 2014; 24: 203–208.

[17]. Harshavardhana H S .Efficacy of Dexmedetomidine Compared to Clonidine added to Ropivacaine in Supraclavicular Nerve Blocks: A Prospective, Randomized, Double Blind Study. Int J Med Health Sci 2014;3;127-133.

[18]. Singh S, Nanda H S et al. A comparative study of clonidine and dexmedetomidine as adjuvant o 0.25% bupivacaine in supraclavicular brachial plexus block for post operative analgesia and sedation. International Journal of Current Research 2014 ; 9: 876-879.

Figure 1: comparison of the pulse rate between the groups at different time intervals

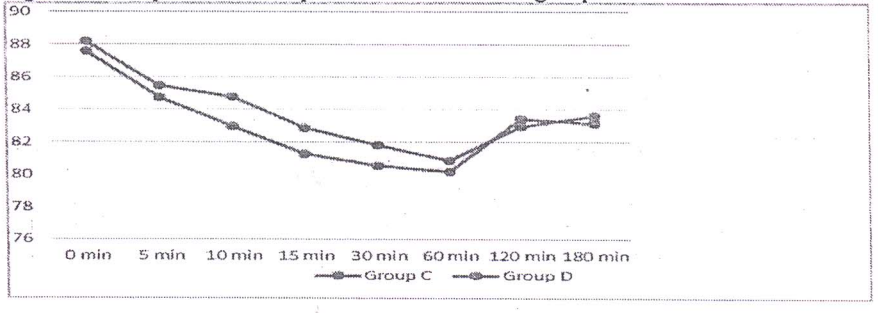

Figure 2: comparison of the mean arterial blood pressure between the groups at different time intervals

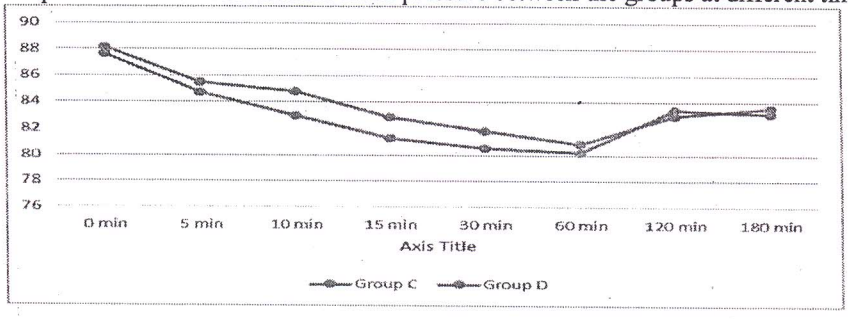

Table 1: Sensory and motor block onset time, duration of sensory and motor block and analgesia durations in both groups

	Group C Mean±SD	Group D Mean±SD	P Value
Onset time of sensory block (min)	11.6 ± 1.754	9.27 ± 1.68	< 0.01
Onset time of motor block (min)	15.77 ± 1.612	12.87± 1.592	< 0.01
Duration of sensory block (min)	463.50 ±40.325	647.67± 49.857	< 0.01
Duration of motor block (min)	424.33 ± 44.658	600.83 ± 46.722	< 0.01
Duration of analgesia (min)	510.83±42.306	720.83±44.16	< 0.01

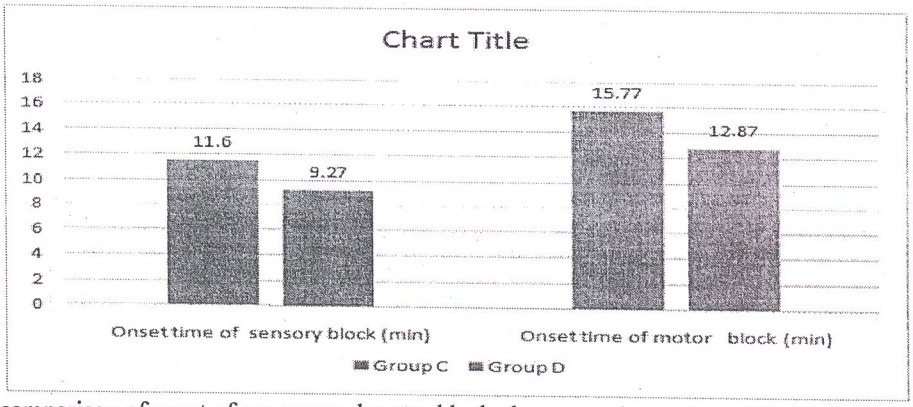

Figure 3: comparison of onset of sensory and motor blockade among dexmedetomidine and clonidine groups.

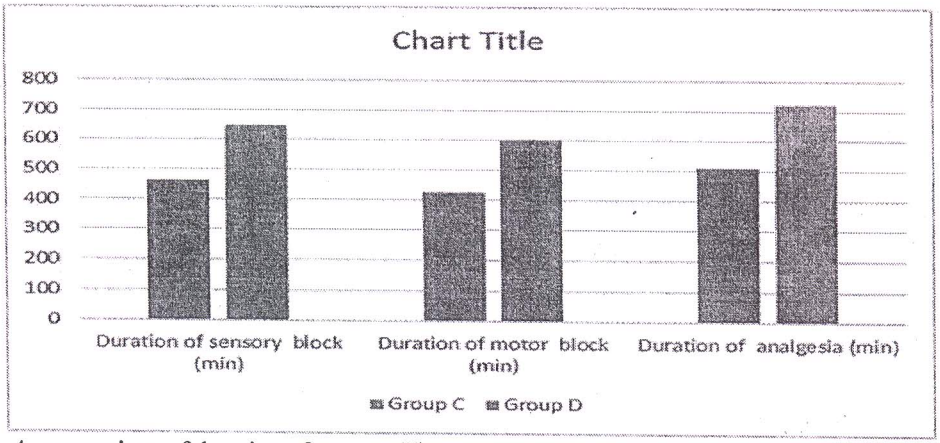

Figure 4: comparison of duration of sensory blockade, motor blockade and duration of analgesia among dexmedetomidine and clonidine groups. .

Table 2 : shows the number of times the patients in both dexmedetomidine and clonidine groups required rescue analgesia in 24 hrs. There is no significant statistical difference between the groups (P>0.05).

	Clonidine	Dexmedetomidine	P value
Number of rescue analgesia in 24 hrs	1.5 ± 0.5085	1.4666 ± 0.5074	0.7687