

ORIGINAL ARTICLE

Comparative Study between Dexmedetomidine and Clonidine as an Adjunct to Bupivacaine in Brachial Plexus Block in Orthopaedic Surgeries

Kakad RR¹, Chaudhari DR², Lawhale SS³, Ghodki SG⁴, Bite BM⁵

- 1- Assistant Professor, Department of Anaesthesiology, Dr. Ulhas Patil Medical College & Hospital, Jalgaon, Maharashtra
- 2- Associate Professor, Department of Pharmacology, Dr. Ulhas Patil Medical College & Hospital, Jalgaon, Maharashtra
- 3- Professor, Department of Anaesthesiology, Dr. Panjabrao (Bhauasaheb) Deshmukh Memorial Medical College, Amravati,
- 4- Assistant Professor, R.K.D.F. Medical College & Research Centre, Bhopal, M.P., India.
- 5- Assistant Professor, Department of Pharmacology, Dr. Ulhas Patil Medical College & Hospital, Jalgaon, Maharashtra

Abstract

Aims & Objectives: To compare the effects of dexmedetomidine and clonidine as an adjunct on onset and duration of block. To compare their effects on pulse rate, blood pressure, sedation and post operative analgesic requirement. **Materials & Methods:** This study was conducted on 70 patients undergoing upper limb orthopedic surgeries aged between 18 to 65 years under supraclavicular block at Dr. PDMMC Hospital, Amravati over a period of 18 months. Supraclavicular block was given by using nerve stimulator – Stimuplex HNS 12 ,B'braun ,Germany and Stimuplex A needle, 22 G. **Results:** Addition of dexmedetomidine showed faster onset of sensory and motor block, longer duration of sensory and motor block, decreased pulse rate, systolic and diastolic blood pressure as compared to the baseline readings and less number of rescue analgesics in post-induction 12 hours **Conclusions:** Dexmedetomidine is a better alternative adjuvant than clonidine for brachial plexus block in surgeries of moderate duration and for prolonged post operative analgesia.

Keywords: Analgesia, Brachial plexus block, Clonidine, Dexmedetomidine, Sedation

Address for correspondence: Dr. Devendra R. Chaudhari, Associate Professor, Department of Pharmacology, Dr. Ulhas Patil Medical College & Hospital, Jalgaon Kh, Tal & Dist Jalgaon 425309. Maharashtra, India. Phone: 09890772487 (M), 0257-2366700 (O). Fax: 0257-2366648. E-mail: devendra7681@gmail.com

DOI:10.18049/jcmad/339 Revised : 02/12/2015

Received on : 27/11/2015 Accepted : 06/12/2015

Introduction

Brachial plexus blocks provide a useful alternative to general anesthesia for upper limb surgeries. Various drugs like neostigmine, opioids, hyaluronidase, midazolam etc. have been added to local anesthetics in order to modify the block in terms of quick onset, good quality, prolonged duration of anesthesia and post-operative analgesia. But these presented with adverse systemic effects or doubtful efficacy.^{1,2,3}

Clonidine, an imidazoline α_2 adrenergic receptor agonist has been mainly used as an anti-hypertensive agent. α_2 receptors mediate sedation, analgesia, and sympatholysis. Clonidine is known to produce anti-nociception and enhance the effect of local anaesthetics

when given intrathecally, epidurally and in peripheral nerve blocks. Among the α_2 agonists clonidine and dexmedetomidine are commonly used. Clonidine has been widely used in all types of regional anaesthetic techniques.⁴ Dexmedetomidine is a highly selective α_2 agonist with sedative and analgesic properties with minimal respiratory depression. It has a α_2/α_1 selectivity ratio of (1600:1) which is eight times more potent than clonidine (200:1). It is shorter acting drug than clonidine with a distribution half- life of 9 min and elimination half- life of 2 hours.^{5,6}

Aims & Objectives

To compare the effect of dexmedetomidine and clonidine as an adjunct to bupivacaine for brachial plexus block. The primary endpoints

are the onset and duration of sensory and motor block, duration of analgesia and cardio-respiratory stability.

Materials & Methods

This study was conducted on 70 patients between 18 to 65 years undergoing upper limb orthopedic surgeries aged under supraclavicular block at Dr. PDMMC Hospital, Amravati over a period of 18 months. Patients were divided into two equal groups of 35 Group C (clonidine) and group D (dexmedetomidine) by randomization by coding. Equipments used were, Nerve stimulator– Stimuplex HNS 12 ,B'braun, Germany, 22 G Stimuplex needle and a chest lead. Standard monitoring equipments and emergency resuscitation equipments.

Group C

Received 40 ml of mixture of Bupivacaine (0.375%) + inj Clonidine 1µg/kg

Group D

Received 40 ml of mixture of Bupivacaine (0.375%) + inj Dexmedetomidine 1µg/kg

The mixtures were injected perineurally after eliciting motor response at 0.4-0.8 mA current

Sensory block was graded as

Grade 0: Sharp pin prick felt

Grade 1: Analgesia, dull sensation felt

Grade 2: Anesthesia, no sensation felt.

Motor block

Motor block was determined according to a modified Bromage scale for upper extremities on a 3-point scale.⁷

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

Sedation score

Sedation score described by University of Michigan Sedation Scale (UMSS) was used to assess sedation.⁸

Study approval was obtained from institutional ethics committee. Informed written consent was taken from all patients participating in study.

Data was analyzed by SPSS software version 16 for Windows and Graph pad Prism 5.

Comparison between different groups for onset and duration of sensory and motor block and rescue analgesic requirements was done by student unpaired 't' test. The 'P' value less than 0.05 considered as significant and less than 0.001 considered as highly significant. Analysis of variables in the groups from their baseline readings for PR, SBP and DBP was done by ANOVA.

Results

Out of seventy patients, two patients were disqualified from the study because of inadequate anesthesia and given general anesthesia as an alternative. So effective number of patients selected for statistical analysis were 68. At the end, the study data, it was found that one patient from the either group was excluded from the study. Therefore: Total number of study subjects (N = 68, Group C=34 and Group D=34)

The mean time for onset of sensory block in group C was 11.33 ± 1.13 min and in group D was 8.74 ± 1.32 min. The mean time for onset of motor block in group C was 9.85 ± 0.74 min and in group D was 8.54 ± 1.14 min. The statistical analysis by student's unpaired 't' test showed that, the time for onset of sensory block in group D was less when compared to group C and it was statistically highly significant ($P < 0.001$) table- 1.

The mean duration of sensory block in group C was 340.59 ± 35.5 minutes and in group D was 470.59 ± 34.8 minutes. The mean duration of motor block in group C was 312.65 ± 30.8 minutes and the group D was 415.88 ± 30.8 minutes (Table- 2).

In group C, pulse rate (PR) variation was statistically significant at 15, 30, 60, 120, 240 minutes as compared to baseline pulse rate (80.06 ± 7.11 min). The results were found to be statistically insignificant at 360, 480, 600, 720 minutes as compared to baseline pulse rate. In group D, pulse rate variation was statistically highly significant for 15 to 720 minutes from the baseline PR (82.44 ± 6.38 min). However, there was no evidence of bradycardia in both the groups (Table- 3).

In group C baseline systolic blood pressure was 122.1 ± 6.75 mm of Hg and the other readings of the same group increased to some extent but statistically insignificant when compared with

the baseline systolic blood pressure in group C. In group D, there was gradual fall in subsequent systolic blood pressure from the baseline (127.1

± 6.97 mm of Hg) to the lesser extent but it was statistically significant (P < 0.05) table- 4.

Table- 1: Time for onset of sensory and motor block (min)

Variable	Group C (n=34) (X ± SD)	Group D (n=34) (X ± SD)	t*	p
Time for onset of sensory block (min.)	11.33±1.13	8.74±1.32	8.6	<0.001(HS)
Onset time of motor block (min)	9.85 ± 0.74	8.54±1.14	1.4	<0.001(HS)

*Student's unpaired t test, HS – Highly significant

Table- 2: Duration of sensory and motor block (min)

Variable	Group C (n=34) (X ± SD)	Group D (n=34) (X ± SD)	t*	p
Duration of sensory block (min.)	340.59 ± 35.5	470.59 ± 34.8	15.2	<0.001(HS)
Duration of motor block (min)	312.65 ± 30.8	415.88 ± 30.8	13.7	<0.001(HS)

*Student's unpaired t test, HS – Highly significant

The Diastolic BP in group C and group D at different intervals were comparable with the baseline readings (79.18 ± 3.72 and 81.24 ± 5.76, respectively) and were statistically insignificant. However, the blood pressure was slightly on lower side in Group D as compared to Group C (Table- 5).

Table- 5: Diastolic BP (Mean±SD)

Duration (Minute)	Group C (mm of Hg)	Group D (mm of Hg)
0	79.18 ± 3.72	81.24 ± 5.76
15	81.65 ± 3.36	78.18 ± 5.62
30	78.71 ± 4.26	78.00 ± 6.77
60	78.76 ± 5.81	78.18 ± 6.52
120	76.71 ± 4.87	77.18 ± 6.55
240	78.88 ± 3.85	77.06 ± 3.69

Table- 3: Pulse rate at various interval of time (Mean±SD)

Duration (Minute)	Group C (PR/min)	Group D (PR/min)
0	80.06 ± 7.11	82.44 ± 6.38
15	79.26 ± 6.41	80.62 ± 6.05
30	75.15 ± 5.06	77.35 ± 5.38
60	71.85 ± 4.26	75.00 ± 5.34
120	71.38 ± 4.41	74.24 ± 5.17
240	74.50 ± 4.66	73.12 ± 5.48
360	75.53 ± 3.99	72.38 ± 5.72
480	77.47 ± 3.99	72.15 ± 6.67
600	78.88 ± 3.22	72.21 ± 5.46
720	78.88 ± 3.76	71.97 ± 3.50

The mean requirement of rescue analgesic in group C was 1.97±0.57 as compared to 1.09 ± 0.28 in group D. The statistical analysis by students unpaired 't' test showed that the difference between requirement of rescue analgesia in group D was significantly lesser when compared to group C and statistically highly significant (P < 0.001) figure- 1.

Figure- 1: Post-operative rescue analgesia

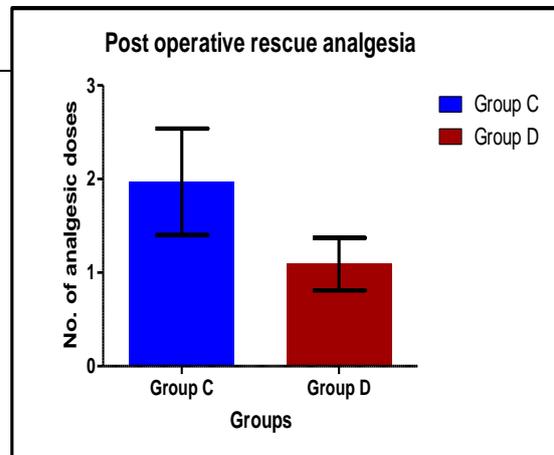


Table- 4: Systolic BP (Mean±SD)

Duration (Minute)	Group C (mm of Hg)	Group D (mm of Hg)
0	122.1 ± 6.75	127.1 ± 6.97
15	122.9 ± 6.54	123.4 ± 6.34
30	122.2 ± 6.26	121.4 ± 6.16
60	122.5 ± 7.63	119.5 ± 6.16
120	122.8 ± 5.85	120.0 ± 5.23
240	123.6 ± 5.43	120.0 ± 5.16
360	124.4 ± 5.62	121.2 ± 6.09
480	124.3 ± 4.83	121.3 ± 6.64
600	124.1 ± 4.15	121.8 ± 5.16
720	123.6 ± 4.28	121.1 ± 3.88

Discussion

In our study we found that the onset of sensory and motor blocks was significantly faster in patients who received a combination of dexmedetomidine and bupivacaine as compared to clonidine and bupivacaine. Mean time of onset of sensory block in group C was 11.33 ± 1.13 min and in group D was 8.74 ± 1.32 min. Mean time of onset of motor block in group C was 9.85 ± 0.74 min while in group D was 8.54 ± 1.14 min). Similar results were obtained by Sandhya Agarwal et al with dexmedetomidine.⁹ Winnie et al,¹⁰ observed and attributed this to the somatotrophic arrangement of fibers in a nerve bundle at the level of the trunks in which motor fibers are located more peripherally than sensory fibers. Hence, a local anesthetic injected perineurally will begin to block motor fibers before it arrives at the centrally located sensory fibers.

Our results showed that sensory block tend to last longer as compared to motor block which agrees with the observation by de Jong et al.¹¹ These authors explained that larger fibers require a higher concentration of local anesthetic than smaller fibers. The minimal effective concentration of local anesthetic for large (motor) fibers is greater than for small (sensory) fibers. Thus, motor function return before pain perception and duration of motor block is shorter than the sensory block.

In our study, duration of motor block was more prolonged when dexmedetomidine was added to bupivacaine as compared to clonidine was added to bupivacaine. We also observed the mean duration of sensory block was significantly higher ($P < 0.001$) in group D. McCartney et al.¹² found that a bupivacaine and clonidine combination prolonged postoperative analgesia compared to bupivacaine alone when administered for various peripheral nerve blocks. Eledjam J.J et al.¹³, showed clonidine is an attractive alternative to epinephrine to prolong duration of analgesia in supraclavicular brachial plexus block. Esmaoglu A et al¹⁴ showed, dexmedetomidine added to levobupivacaine for axillary brachial plexus block shortens the onset time and prolongs the duration of the block and the duration of postoperative analgesia. However, dexmedetomidine also may lead to bradycardia.

We observed addition of dexmedetomidine reduces the onset time and prolongs the duration of the block and the duration of postoperative analgesia. Fall in the BP in terms of SBP and DBP in group D was more as compared to group C. Decrease in pulse rate was also significant at most of the time intervals from baseline PR in group D as compared to group C. But there were no evidence of bradycardia in both the groups. Ammar AS, Mahmoud KM.¹⁵ found that adding dexmedetomidine to bupivacaine during the placement of an ICB provides:

1. Enhancement of onset of sensory and motor blockade
2. Prolonged duration of analgesia
3. Increases duration of sensory and motor block
4. Yields lower VRS pain scores
5. Reduces supplemental opioid requirements.

Conclusion

We conclude that, the addition of dexmedetomidine ($1\mu\text{g} / \text{kg}$) as an adjuvant to bupivacaine (0.375%) has following effects in comparison with addition of clonidine ($1\mu\text{g} / \text{kg}$) as an adjuvant to bupivacaine (0.375%)

- i) Faster onset of sensory block.
- ii) Faster onset of motor block.
- iii) Longer duration of sensory block.
- iv) Longer duration of motor block.
- v) Less number of rescue analgesics in post-induction 12 hours.
- vi) Decreased pulse rate, decrease in Systolic and Diastolic Blood Pressure as compared to the baseline readings.
- vii) Sedation score was equal in both the groups at given interval of time.

Dexmedetomidine is thus good alternative adjuvant for the brachial plexus block required in surgeries which are of moderate duration and for prolonged post operative analgesia. However, the cost effectiveness of the dexmedetomidine as compared to clonidine will be the major issue for its regular usage the developing countries like India.

Conflict of Interest: None declared

Source of Support: Nil

Ethical Permission: Obtained

References

1. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P. The addition of local anesthetics in brachial plexus block : The comparative effects of morphine, buprenorphine and sufentanil. *Anaesthesia* 1997;52:858-62. [\[PubMed\]](#)
<http://dx.doi.org/10.1111/j.1365-2044.1997.174-az0311.x>
2. Bone HG, van Aken H, Brooke M, Burkle H, Brooke M, Burkle H. Enhancement of axillary brachial plexus block anesthesia by coadministration of neostigmine. *Reg Anesth Pain Med* 1999;24:405-10. [\[PubMed\]](#)
<http://dx.doi.org/10.1097/00115550-199924050-00006>
3. Keeler JF, Simpson KH, Ellis FR, Kay SP. Effect of addition of Hyaluronidase to bupivacaine during axillary brachial plexus block. *Br J Anaesth* 1992;68:68-71. [\[PubMed\]](#)
<http://dx.doi.org/10.1093/bja/68.1.68>
4. Jamali S, Monin S, Begon C, Dubousset A, Ecoffey C. Clonidine in paediatric caudal anesthesia. *Anaesth Analg* 1994;78:663-6. [\[PubMed\]](#)
<http://dx.doi.org/10.1213/00000539-199404000-00008>
5. El-Hennawy AM, Abd-Elwahab AM, Abd-Elmaksoud Am, El-Ozairy HS, Boulis SR. Addition of clonidine or dexmedetomidine to bupivacaine prolongs caudal analgesia in children. *Br J Anaesth* 2009;103(2):268-274. [\[PubMed\]](#)
<http://dx.doi.org/10.1093/bja/aep159>
6. Saadawy I, Boker A, El-Shahawy MA, et al. Effect of dexmedetomidine on the characteristics of bupivacaine in a caudal block in pediatrics. *Acta Anaesthesiol Scand* 2008;53:251-6. [\[PubMed\]](#)
<http://dx.doi.org/10.1111/j.1399-6576.2008.01818.x>
7. Sarkar DJ, Khurana G, Chaudhary A, Sharma J P. A comparative study on the effects of adding fentanyl and buprenorphine to local anaesthetics in brachial plexus block. *Journal of Clinical and Diagnostic Research* 2010;4(6):3337-43.
8. Malviya S, Voepel-Lewis T, Tait AR, Merkel S, Tremper K, Naughton N. Depth of sedation in children undergoing CT : validity and reliability of University of Michigan Sedation Scale (UMSS). *Br J Anaesth*, Feb 2002;88(2):241-5. [\[PubMed\]](#)
<http://dx.doi.org/10.1093/bja/88.2.241>
9. 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. [\[PubMed\]](#)
<http://dx.doi.org/10.4103/0970-9185.125701>
10. Winnie AP. Brachial Plexus Block. In: Winnie AP, ed. *Plexus Anesthesia*. Philadelphia: W.B. Saunders, 1993;1:117-88.
11. Rudolph H, Jong, Irving H, Wagman. Physiological mechanisms of peripheral nerve block by local anesthetics. *Anesthesiology* 1963;24:672-84.
12. McCartney CJ, Duggan E, Apatu E. Should we add clonidine to local anesthetic for peripheral nerve blockade? A qualitative systematic review of the literature. *Reg Anesth Pain Med* 2007;32(4):330-8. [\[PubMed\]](#)
<http://dx.doi.org/10.1097/00115550-200707000-00010>
13. Eledjam JJ, Deschodtt J, Viel EJ, Lubrano JF, Charavel P, d'Athist F, du Cailart J. Brachial plexus block with bupivacaine: effects of added alpha adrenergic agonists : comparison between clonidine and epinephrine. *CAN J Anesth*. Oct 1991;38(7):870-5. [\[PubMed\]](#)
<http://dx.doi.org/10.1007/BF03036962>
14. Esmooglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. *Anaesth Analg* 2010;111:1548-51. [\[PubMed\]](#)
<http://dx.doi.org/10.1213/ANE.0b013e3181fa3095>
15. Ammar AS, Mahmoud KM. Ultrasound-guided single injection infraclavicular brachialplexus block using bupivacaine alone or combined with dexmedetomidine for pain control in upper limb surgery: a prospective randomized controlled trial. *Saudi J Anaesth* 2012;6:109-14. [\[PubMed\]](#)
<http://dx.doi.org/10.4103/1658-354X.97021>
16. Sarita S Swami, Varshali M Keniya, Sushma D Ladi, Ruchika Rao. Comparison of dexmedetomidine and clonidine (a2 agonist drugs) as an adjuvant to local anesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. *Indian Journal of Anesthesiology* 2012;56(3):243-249. <http://dx.doi.org/10.4103/0019-5049.98767>