Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2016/305

Original Article

Comparison between 0.5 µg/kg Dexmedetomidine with 0.5% Lignocaine and 0.5% Lignocaine Alone in Intravenous Regional Anesthesia for Forearm Surgeries: A Randomized Controlled Study

M Balamurugan[1], M Shanmugasundaram[1], R Kavitha[2]

[1]Senior Assistant Professor, Department of Anesthesia, Institute of Anesthesiology, Government Rajaji Hospital, Madurai Medical College, Madurai, Tamil Nadu, India, [2]Assistant Professor, Department of Anesthesia, Institute of Anesthesiology, Government Rajaji Hospital, Madurai Medical College, Madurai, Tamil Nadu, India

Abstract

Background: Intravenous regional anesthesia (IVRA) has been used for more than a century. We designed this study to find out the efficacy of 0.5 µg/kg dexmedetomidine when added with 0.5% lignocaine in IVRA.

Materials and Methods: A total of 60 patients were randomly assigned into two groups. Group D (*n* = 30) patients received 40 ml of 0.5% lidocaine with 0.5 µg/kg dexmedetomidine and Group L (*n* = 30) patients received 40 ml of 0.5% lidocaine alone. Times of onset and recovery of sensory and motor blocks, tourniquet pain using visual analog scale (VAS) score, intraoperative sedation score using Ramsay sedation score and post-operative analgesia were recorded.

Results: Demographic details were comparable, and there was no difference in duration of the surgery between both groups. Significantly shorter onset times and longer recovery times of sensory and motor block were recorded in Groups D compared to Group L. Delayed onset of tourniquet pain occurred in Groups D compared to Group L. About 21 patients required fentanyl to control tourniquet pain in Group L while no patients required supplementation in Groups D. Significantly lower post-operative VAS score, longer time to first dose analgesia were recorded in Groups D.

Conclusion: The addition of 0.5 µg/kg dexmedetomidine to lignocaine for IVRA reduced the time for onset of block, delayed the onset of tourniquet pain, improves quality of anesthesia prolonged post-operative analgesia and reduced post-operative analgesic requirement.

Key words: Bier's block, Dexmedetomidine, Intravenous regional anesthesia, Lignocaine

INTRODUCTION

Intravenous regional anesthesia (IVRA) first described by August Bier in 1902 is simple, reliable with high success rate. It was revived in 1963 by Holmes,[1] who used lignocaine because it appeared to give more reliable anesthesia than procaine.[2] Today IVRA with slight technical modifications is an ideal method of providing anesthesia for minor surgical procedures to the extremities performed on an ambulatory basis.[3] It has the advantages of speed of onset, rapid recovery, reliability of blockade and cost effectiveness. An adjuvant to local anesthetics has greatly expanded the potential applications of regional anesthesia by providing faster onset time, inhibition of tourniquet pain, prolonged post-operative analgesia, and improved quality of anesthesia.[4] Dexmedetomidine, a α_2 adrenoceptor agonist has been shown to decrease anesthetic requirements and improve quality of anesthesia.[5]

We designed this study to evaluate the efficacy of 0.5 µg dexmedetomidine when added to 0.5% lignocaine in IVRA. We compared the onset and duration of sensory and motor blokade, onset of tourniquet pain, intraoperative sedation score, and post-operative analgesia

Access this article online

www.ijss-sn.com

Month of Submission : 04-2016
Month of Peer Review : 05-2016
Month of Acceptance : 05-2016
Month of Publishing : 06-2016

Corresponding Author: Dr. M Balamurugan, Department Anesthesia, Institute of Anesthesiology, Government Rajaji Hospital, Madurai Medical College, Madurai, Tamil Nadu, India. Phone: +91-9443135904. E-mail: mbalan75@gmail.com

during IVRA using lignocaine alone and lignocaine with dexmedetomidine.

MATERIALS AND METHODS

This randomized controlled study was conducted after obtaining Institute Ethical Committee approval. 60 patients of the American Society of Anesthesiologists (ASA) Grades I and II age between 20 and 60 years who came for upper limb surgeries lasting for <90 min were included in this study. A written informed consent was obtained from all patients. The detailed preanesthetic check-up was done on all patients and relevant hematological, biochemical, and radiological investigations were carried out for all patients as per surgical requirements. The study populations were classified into two groups. Group D patients received 40 ml of 0.5% lignocaine with 0.5 μg/kg dexmedetomidine and Group L patients received 40 ml of 0.5% lignocaine. The patients with a history of allergy to local anesthetics, sickle cell disease, Raynaud's disease, scleroderma, local infection, Paget's disease, patients with inadequate starvation <6 h, and patients who had a contraindication to dexmedetomidine were excluded from this study.

All patients were premedicated with injection midazolam 0.15 mg/kg, intramuscularly 45 min before surgery. In the operating room, appropriate equipment for the airway management and emergency drugs were kept ready. Non-invasive blood pressure monitor, pulse oximeter, and electrocardiogram leads were connected to the patient. Pre-operative baseline hemodynamic variables were recorded. An IV line was secured in non-operative limb and started with dextrose normal saline.

A 22 G cannula was placed intravenously as distal as possible in the arm to be anesthetized. The arm was exsanguinations using Esmarch bandage. If this was impossible, exsanguinations were achieved by elevating the arm for 2-3 min while compressing the axillary artery. The double tourniquet was applied on the arm with generous layers of padding, ensuring that no wrinkles are formed, and the tourniquet edges do not touch the skin. The proximal tourniquet was inflated to at least 100 mm Hg higher than the patient's systolic blood pressure. Before injecting local anesthetic, radial pulse was palpated and confirmed that there was no pulse. A standard volume of 40 ml of 0.5% lignocaine (Group L) or 40 ml of 0.4% lignocaine with 0.5 μg/kg dexmedetomidine (Group D) was injected over 90 s by an anesthesiologist who was blinded to the drug being administered. The sensory block was assessed by pinprick performed with 22 gauge needle. Sensory block onset time was defined as the time taken from injection of study drug to sensory block achieved in all dermatomes. Motor block was assessed by asking the patient to flex and extend of the wrist and fingers. The onset of motor blockade was defined as the time taken from injection of the study drug to complete motor block. After achieving surgical anesthesia, the distal tourniquet which overlies part of the anesthetized arm was inflated and the proximal one was deflated. After that, the surgeons were allowed to proceed.

Intraoperatively, pulse rate, blood pressure, respiratory rate, SPO_2, and signs of drug toxicity were monitored regularly. Assessment of tourniquet pain scores was made on the basis of the visual analog scale (VAS) (0 = "no pain" and 10 = "worst pain imaginable") and degree of sedation using Ramsay sedation score[6] (scale 1-5, 1 = completely awake, 2 = awake but drowsy, 3 = asleep but responsive to verbal commands, 4 = asleep but responsive to tactile stimulus, and 5 = asleep and not responsive to any stimulus) measured before and after tourniquet application, 5, 10, 15, 20, and 40 min after the injection of anesthetic. Intraoperatively, boluses of 1 μg/kg fentanyl were provided for tourniquet pain treatment when required (when VAS was >3), and intercostobrachial nerve block with a local infiltration around the cuff.

The cuff was not deflated until 30 min after local anesthesia injection even if surgery was completed before 30 min and not inflated more than 90 min. The cuff deflation was performed in cyclic deflation technique. Sensory recovery time was defined as the time elapsed after tourniquet deflation up to recovery of pain in all dermatomes determined by pinprick test. Motor block recovery time was noted. Post-operative pain was assessed by VAS score. The patients received injection diclofenac 75 mg intramuscular when VAS score ≥3. The duration of analgesia was defined as the time from tourniquet deflation to the first injection of diclofenac.

Data analysis was performed with the help of computer using epidemiological information package (EPI 2010) developed by Centre for Disease Control, Atlanta. Using this software range, frequencies, percentages, means, standard deviations, Chi-square, and "*P*" values were calculated. Kruskul–Wallis Chi-square test was used to test the statistically significant difference between quantitative variables and Yate's Chi-square test for qualitative variables. A $P < 0.05$ is taken to denote significant relationship.

OBSERVATION AND RESULTS

A total of 60 patients were enrolled in the study. The flow of participants is depicted by the CONSORT flow

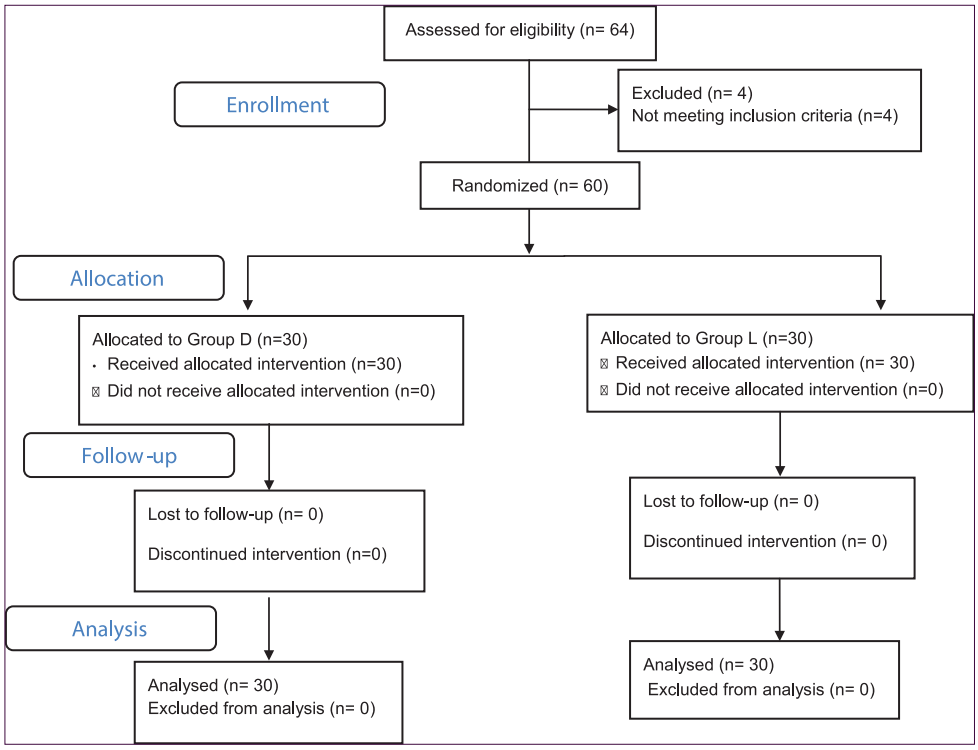

Figure 1: The CONSORT diagram showing flow of participants in each stage of the dexmedetomidine with lignoocaine in intravenous regional anesthesia

diagram (Figure 1). The demographic profiles of two groups were comparable in terms of age, sex distribution, weight, and ASA physical status. The mean duration of surgery is not statistically significant between both groups.

The sensory onset time was shorter in Group D when compared to Group L which was 1.8 ± 0.76 min in Group D and 5.27 ± 0.58 min in Group L and it is found to be statistically significant ($P = 0.0001$) (Table 1). The time of onset of motor block was shorter in Group D when compared to Group L which was 13.63 ± 1.54 min in Group D and 18.07 ± 1.26 min in Group L and it is found to be statistically significant ($P = 0.0001$) (Table 2). 21 cases in Group L required rescue analgesia, whereas none of the patients in Group D required it. This was statistically significant ($P = 0.0001$) (Table 3). The sensory recovery time in Group D was longer (18.87 ± 3.27 min) when compared to Group L (4.8 ± 0.71 min) and it was found to be statistically significant. ($P = 0.0001$). The motor recovery time in Group D was longer (25.6 ± 3.83 min) when compared to Group L (2.53 ± 0.51 min) and it was found to be statistically significant. ($P = 0.0001$). VAS reached a score of 3 at 416.2 ± 45.73 min in Group D and at 11.33 ± 0.96 min in Group L and it was found to be statistically significant. ($P = 0.0001$).

Table 1: Patient characteristics and duration of surgery (mean±SD [range])

Characteristics	Group D (*n*=30)	Group L (*n*=30)	*P**
Age (year)	37.8±8.7 (23-53)	36.8±10.8 (20-56)	0.6148
Weight (kg)	52.5±5.0	52.9±5.5	0.8471
Gender (M/F)	17/13	19/11	0.7921
ASA I/II	24/6	23/7	0.4251
Duration of surgery (min)	46.83±5.07 (40-56)	47.43±4.79 (40-55)	0.6354

*$P \leq 0.05$ is significant, ASA: American Society of Anesthesiologists

Table 2: Characteristics of sensory and motor block (mean±SD [range])

Characteristics	Group D	Group L	*P**
Onset of sensory block (min)	1.8±0.78 (1-3)	5.27±0.58 (4-6)	0.0001
Sensory block recovery time (min)	18.87±3.27 (10-22)	4.8±0.71 (3-6)	0.0001
Onset of motor block (min)	13.63±1.54 (10-15)	18.07±1.26 (16-20)	0.0001
Motor block recovery time (min)	25±3.83 (15-35)	2.53±0.51(2-3)	0.0001

*$P \leq 0.05$ is significant. SD: Standard deviation

In our study, there was no significant difference in pulse rate between both groups, and there is no significant difference in blood pressure. The oxygen saturation monitored throughout the study, and there was no significant difference between the groups.

Table 3: Rescue analgesia, post-operative analgesia and sedation score (mean±SD [range])

Variables	Group D	Group L	*P**
Rescue analgesia Yes/No	0/30	21/9	0.0001
Duration of post-operative analgesia (min)	416.2±45.73 (280-490)	11.33±0.96 (10-13)	0.0001
Sedation score	1.77±0.43 (1-2)	0	0.0001

*$P \leq 0.05$ is significant. SD: Standard deviation

DISCUSSION

IVRA uses local anesthetics administered to one particular limb by occluding the arm proximally to provide conduction blockade. IVRA has many advantages. It is simple, reliable with rapid onset and recovery. Despite these advantages, IVRA has its own limitations like lack of post-operative analgesia and tourniquet pain which causes discomfort to the patient. In this study, we attempted to eliminate these advantages by adding dexmedetomidine as an adjuvant. The pharmacological properties of dexmedetomidine include sedation, analgesia, anxiolysis, perioperative sympatholysis, cardiovascular stability, reduced anesthetic requirements, and preservation of respiratory function have been extensively studied and clinically employed in regional anesthesia. Dexmedetomidine is 8-10 times more selective toward α_2 adrenergic receptors and is 3.5 times more lipophilic than clonidine. It thus prolongs the duration of both sensory and motor blockade induced by local anesthetics, irrespective of the route of administration.

Kol *et al.*[7] compared addition of 0.5 μg/kg dexmedetomidine or lornoxicam with 0.5% lignocaine in IVRA and they conclude that shortened sensory onset time and prolonged sensory recovery time in dexmedetomidine group. These results were correlated with our finding where the sensory onset time was shortened by about 4 min and sensory recovery time was prolonged about 14 min in dexmedetomidine group. Esmaoglu *et al.*[8] in their study concluded that addition of dexmedetomidine with lignocaine shortened the motor block onset time and prolonged the motor block recovery time. This finding was comparable with our study in which the motor block onset time was about 4 min shorter and motor block recovery time was about 23 min longer in dexmedetomidine group. This could be attributed to more selective action of dexmedetomidine on α_2 adrenergic receptors and its lipophilic nature.

Tourniquet pain and lack of post-operative analgesia are major drawbacks of IVRA. In a study conducted by Memis *et al.*[9] showed that incidence of tourniquet pain was less when dexmedetomidine added to lignocaine in IVRA. This result was comparable in our study in which no patients had tourniquet pain in dexmedetomidine group, whereas 70% of patients had tourniquet pain in lignocaine group. The mechanism of tourniquet pain remains unclear despite the role of A fibers and unmyelinated C fiber. Dexmeditomedine depresses nerve action potentials, especially in C fibers, by a mechanism independent of the stimulation of α_2 adrenergic receptors.[10,11] This mechanism accounts for strengthening of the local anesthetic block achieved by perineural administration of the drug and could be implicated in the effect seen in our study.

In this study, we recorded the time for demand of rescue analgesic as a measure of post-operative analgesia. The duration of post-operative analgesia was significantly higher with dexmedetomidine group which was about 400 min longer than lignocaine group. This prolonged duration of analgesia attributed to α_2 adrenergic receptors located at nerve endings may have a role in the analgesic effect of the drugs by preventing norepinephrine release.

CONCLUSION

The addition of 0.5 μg/kg dexmedetomidine to lignocaine in IVRA shortens sensory and motor block onset time and prolongs sensory and motor recovery time. Dexmedetomidine decreases the pain associated with inflation of tourniquet. Dexmedetomidine improves the quality of anesthesia and prolongs post-operative analgesia.

REFERENCES

1. Holmes CM. Intravenous regional anesthesia. A useful method of producing analgesia of the limbs. Lancet 1963;1:245-7.
2. Johnson CN. Intravenous regional anesthesia: New approaches to an old technique. CRNA 2000;11:57-61.
3. Hoffmann V, Vercauteren M, Van Steenberge A, Adriaensen H. Intravenous regional anesthesia. Evaluation of 4 different additives to prilocaine. Acta Anaesthesiol Belg 1997;48:71-6.
4. Acalovschi I, Cristea T, Margarit S, Gavrus R. Tramadol added to lidocaine for intravenous regional anesthesia. Anesth Analg 2001;92:209-14.
5. Kamibayashi T, Maze M. Clinical uses of alpha2 -adrenergic agonists. Anesthesiology 2000;93:1345-9.
6. Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxalone-alphadolone. Br Med J 1974;2:656-9.
7. Kol IO, Ozturk H, Kaygusuz K, Gursoy S, Comert B, Mimaroglu C. Addition of dexmedetomidine or lornoxicam to prilocaine in intravenous regional anaesthesia for hand or forearm surgery: A randomized controlled study. Clin Drug Investig 2009;29:121-9.
8. Esmaoglu A, Mizrak A, Akin A, Turk Y, Boyaci A. Addition of dexmedetomidine to lidocaine for intravenous regional anaesthesia. Eur J Anaesthesiol 2005;22:447-51.
9. Memis D, Turan A, Karamanlioglu B, Pamukçu Z, Kurt I. Adding dexmedetomidine to lidocaine for intravenous regional anesthesia. Anesth

Analg 2004;98:835-40.
10. Abosedira MA. Adding clonidine or dexmedetomidine to lignocaine during Biers block: A comparative study. J Med Sci 2008;8:660-4.
11. Mizrak A, Gul R, Ganidagli S, Karakurum G, Keskinkilic G, Oner U. Dexmedetomidine premedication of outpatients under IVRA. Middle East J Anaesthesiol 2011;21:53-60.

How to cite this article: Balamurugan M, Shanmugasundaram M, Kavitha R. Comparison between 0.5 μg/kg Dexmedetomidine with 0.5% Lignocaine and 0.5% Lignocaine Alone in Intravenous Regional Anesthesia for Forearm Surgeries: A Randomized Controlled Study. Int J Sci Stud 2016;4(3):1-5.

Source of Support: Nil, **Conflict of Interest:** None declared.