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The Efficacy of Adding Lornoxicam-Dexmedetomidine to 0.25% Diluted Lidocaine for Intravenous Regional Anesthesia

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Abstract

Background and objective: Upper limb surgeries under Intravenous regional anesthesia (IVRA) with the traditional dose of lidocaine may lead to side effects incompatible with life safety. Anesthetists attempted many modified techniques of IVRA to use a lesser dose of lidocaine combined with some adjuvants to avoid these side effects.

Aim and work: The primary outcome was to compare the first analgesic requirement time of when adding lornoxicam and dexmedetomidine to lidocaine IVRA in outpatients who underwent upper limb surgery, and the secondary outcomes were to compare the onset of sensory and motor blocks, the tourniquet pain and the sensory and motor block recovery times at postoperative period.

Patient and methods: Patients were randomly into two groups each group with 50 patients. Group I (G I) were given solely 3 mg/kg of 0.5% lidocaine diluted with normal saline in a volume of 40 ml. Group II (GII) were given 1.5 mg/kg of 0.25% lidocaine plus 8 mg of lornoxicam and 0.5 μg/kg dexmedetomidine all diluted with normal saline in a total volume of 40 ml. Numerical Rating Score (NRS) was used to assess the sensory block. Motor blockade assessment was done by Modified Bromage Scale Tourniquet pain was noted by using the Numeric rating scale (NRS) before tourniquet inflation (BT), 5 min after tourniquet inflation, tourniquet inflation, every 10 min after tourniquet inflation, at tourniquet release, after 30 min, 2 h, and 4 h of tourniquet release.

Results: Sensory and motor block onset times (min) were significantly delayed in group II than in group I ($p=0.001$). Sensory and motor recovery times after release of tourniquet (min) after release of tourniquet (min) were more prolonged in group II than in group I ($p=0.001$). Significant differences in the number of patients who had tourniquet pain as more patients in group I showed tourniquet pain ($p=0.007$), Time of onset of tourniquet pain (min) and the first analgesia requiring time after release of tourniquet were significantly delayed in group II than in group I ($p=0.001$), While the total intraoperative fentanyl requirement (μg) was significantly lower in group II than in group I($p=0.001$). More patients developed postoperative complications in group I than in group II, but this was not statistically significant ($p>0.05$).

Conclusion: Adding lornoxicam-dexmedetomidine to 0.25% lidocaine in comparison with 0.5% lidocaine for IVRA alone causes a short delay in the onset and the attainment of complete sensory and motor blocks; however this safe and effective combination can be used in IVRA for upper limb surgeries with better analgesic effect and lesser probability of local anesthetic toxicity.

Keywords: Lornoxicam; Dexmedetomidine; Intravenous regional anesthesia

Introduction

IVRA has been introduced by Karl August Bier in 1908 [1]. It is an easy technique with fast onset of anesthesia, and fast return of the limb motor function and sensation feeling to normal. Quick recovery, early discharge, and lesser cost than general anesthesia make the Bier block a good alternative for surgical operations on the limbs [2].

Effective anesthesia can be achieved by lidocaine during limb surgeries using IVRA as 0.5% solution at the dose of 3 $mg.kg^{-1}$. However, accidental intraoperative release of tourniquet or deliberate postoperative release of tourniquet may cause convulsions, coma, cardio-respiratory depression and even cardiac arrest at this high dose [3]. Anesthetists attempted many modified techniques of IVRA to use a lesser dose of lidocaine combined with some adjuvants to avoid these side effects; NSAIDs, paracetamol, [4-6] ketamine, [7] opioids, [8] α-2 adrenergic receptor agonists, [9] and dexaethasone [10] have been added to abolish the tourniquet pain and to provide longer postoperative analgesia.

Lornoxicam is a NSAID belongs to the oxicam class, it has anti-inflammatory analgesic, and antipyretic properties [11]. Adding lornoxicam to local anesthetics provides better postoperative analgesia and patient comfort, and decreases the need for opioid [12].

Dexmedetomidine is a potent a 2-adrenoceptor agonist. It has sedative, analgesic, and perioperative sympatholytic and hemodynamic stabilizing effects that favours reduction of the anesthetic requirements [13].

The primary outcome was to compare the first time of analgesic requirement of lornoxicam-dexmedetomidine when added to diluted lidocaine IVRA in a group of patients who underwent upper limb surgery, and the secondary outcomes were to compare the onset times of sensory and motor blocks, the tourniquet pain and the recovery times of sensory and motor block at postoperative period.

Patients and Methods

This randomized, double-blind study was conducted on 100 patients of ASA physical status I and II, 18-65 years old scheduled for hand , wrist or forearm surgery (Carpal tunnel syndrome, fracture finger , radius, ulna or metacarpal bone and tendon or nerve repair) between August 2016 and March 2017 at Tanta University Hospital. After a written informed consent was taken from every patient, patients were randomly assigned by the closed envelope system into two groups, each group with 50 patients. Group I patients received only 3 mg/kg of 0.5% lidocaine, normal saline was added to dilute it in a volume of 40 ml. Group II patients received 1.5 mg/kg of 0.25% lidocaine plus 8 mg of lornoxicam and 0.5 μg/kg dexmedetomidine all diluted with normal saline in a total volume of 40 ml. The preanesthetic check-up was done for all patients and their investigations were carried out for as per surgical requirements.

Patients had a history of allergy to the used drugs, diabetic neuropathy, uncontrolled hypertension, peripheral limb ischemia, morbid obesity, sickle cell disease, epilepsy or any psychological disturbances were excluded from the study.

An intravenous cannula was inserted in the non-operating hand as an emergency vital protocol in case of complications. Patients were premedicated by midazolam 0.15 mg/kg through IV line in the non-operative limb, and were given 5 mL/kg/h dextrose normal saline. In the operation room 22 gauge IV line was inserted on the dorsum of the operative arm as distal as possible. Nasal cannula oxygen 4 l/min was inserted for all patients. Routine monitoring included peripheral oxygen saturation (SpO_2), electrocardiography (ECG) and non-invasive blood pressure (NIBP). Evaluation of the extremity that will undergo operation was done for 3 min before exsanguinations using Esmarch bandage. The pneumatic double tourniquet (Tourniquet 5800 ELC, VBM Medizintecknik, GMBH, Germany) was applied on the operative arm with multiple layers of padding, then inflation of the proximal cuff of the double-cuffed tourniquet was done to reach 100 mmHg more than the systolic arterial pressure of the same limb (to at least 250 mmHg), Esmarch bandage was removed after the tourniquet inflation. Cessation of the radial pulse and pulseoximetry trace confirmed the existence of the occlusion pressure.

The medications were injected by the anesthesiologist who was didn't know their content in the IV line on the limb that would be operated over 90s periods. Then the time of sensory block was evaluated by pinprick testing from the median, radial and ulnar dermatomes every 30 sec. Onset time of sensory block is the time from the finishing of injection of the drug solution to the time that all dermatomes of the arm and forearm are negative for pinprick testing. Numerical Rating Score (NRS) was used for the sensory block assessment. The onset time of motor block is the time from the finishing injection of the drug solution to the time of inability of the fingers on the hand to move. Motor block was assessed by Modified Bromage Scale. After the sensory block, the distal tourniquet was inflated then the proximal tourniquet was deflated and surgery was started.

Tourniquet pain was noted by using the Numerical rating scale (NRS) before tourniquet inflation (BT), 5 min after tourniquet inflation, every 10 min after inflation of the tourniquet and After 2 h and 4 h of tourniquet release. Once the NRS score exceeded 4, Fentanyl 0.5 μg/kg intraoperative rescue analgesia would be administered to the patient. During the surgery, 5 mg of IV ephedrine would be given to the patient if the systolic BP dropped to lower than 90 mmHg, and if the heart rate dropped to lower than 50 b/min, the patient would receive 0.5 mg of IV Atropine. Deflation of the cuff was done in cyclic deflation technique. All the side effects during the anesthesia and surgical procedure were noted. The cuff of tourniquet was not deflated until 30 min and no longer than 90 min regardless of the length of the operation. After the deflation of the tourniquet, time to the positive pinprick test on median, radial and ulnar dermatomes were noted as sensory block recovery time, and time to the start of the movement of the fingers was noted as motor block recovery time. Patients were followed-up in the post-anesthesia care unit and NRS scores for tourniquet pain were noted on 30 min, 2 h, and 4 h of tourniquet release. Diclofenac sodium (Voltaren) 75 mg IM was used for postoperative analgesia. All the side effects as nausea, vomiting, skin rash, tachycardia, bradycardia, hypotension, hypertension, vertigo, tinnitus and hypoxia were noted.

Postoperatively the patient was asked to qualify of the operative conditions as regards to tourniquet pain and surgical pain by using the following numeric scale: excellent (4)=no pain; good (3)=minor pain with no need for supplemental analgesics, moderate (2)=pain which required supplemental analgesic, and (1)=patient needed general anesthesia. Also the surgeon was asked to qualify the operative conditions as regards to disturbing movement of the limb the following numeric scale: 0=unsuccessful; 1=poor; 2=acceptable; 3=good; and 4=excellent [14].

Statistical Analysis

The sample size was chosen after reviewing many randomized control studies on the same subject. The statistical evaluation was performed using SPSS version 17.0 software (IBM). All values were calculated with a 95% confdence interval. The parameters were expressed as mean ± standard deviation and t-test was used for comparing demographic and clinical data. Analysis of variance technique was used for comparison between the two groups for parametric data. Chi-square test was used for nonparametric data. For comparisons, $P<0.05$ was considered statistically signifcant.

Results

There was no statistically significant difference in the dwmographic data, duration of surgery (min), duration of tourniquet application (min), or type of operation between the two groups ($p>0.05$) as shown in Tables 1 and 2.

Variable	Group I (n=50)	Group II (n=50)	Test	P value
Age (y):	36.5 ± 15.7	35.7 ± 16.8	t: 0.025	0.806
ASA I/II	40/10	42/8	X^2: 0.274	0.603
Sex (male/female):	33/17	29/21	X^2: 0.274	0.603
Weight (kg):	68.7 ± 9.3	70.3 ± 13.4	t: 0.682	0.41

Duration of surgery (min):	45.6 ± 8.7	44.1 ± 8.6	t: 0.872	0.388
Duration of tourniquet application (min):	53.8 ± 9.1	54.9 ± 10.5	t: 0.564	0.577

Table 1: Demographic data.

Type of operation	Group I (n=50)		Group II (n=50)		X^2	P-value
	N	%	N	%		
Carpal tunnel syndrome	22	44	25	50	3.382	0.184
Fracture (finger , radius, ulna or metacarpal bone)	20	40	12	24		
Tendon or Nerve repair	8	16	13	26		

Table 2: Type of operation.

Group II showed more significant decrease in heart rate and blood pressure at 40, 60, and 90 min after local anesthetic injection as shown in Figures 1 and 2.

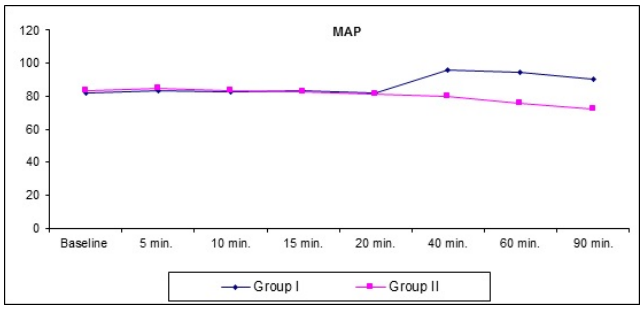

Figure 1: Comparison of mean arterial pressure between the two groups.

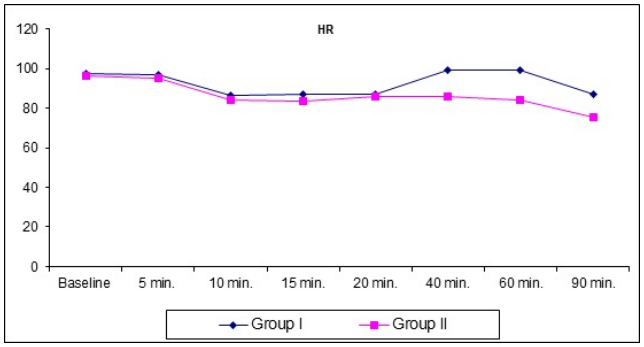

Figure 2: Comparison of heart rate between the two groups.

Sensory and motor block onset times (min) were significantly delayed in group II than in group I (p=0.001). Sensory and motor recovery times after release of tourniquet (min) after release of tourniquet (min) were more prolonged in group II than in group I (p=0.001). There was a significant difference in the number of patients had tourniquet pain as more patients in group I showed tourniquet pain (p=0.007), Time of onset of tourniquet pain (min) and the first analgesia requiring time after release of tourniquet were significantly delayed in group II than in group I (p=0.001).

While the needed intraoperative fentanyl amount (μg) was significantly lower in group II than in group I (p=0.001) Quality of anesthesia for patients surgeons was better in group II than in group I and (p=0.001) as shown in Table 3 (Figure 3). More patients developed postoperative complications such as dizziness, metallic taste, nausea, vomiting, and shivering in group I than in group II, but this was not statistically significant (p>0.05) as shown in Table 4.

	Group I	Group II	t. test	P value
Sensory block onset time (min)	4.7 ± 2.5	6.45 ± 2.78	3.312	0.001*
Motor block onset time (min)	11.2 ± 1.3	16.1 ± 1.92	14.912	0.001*
Sensory recovery time after release of tourniquet (min)	6.7 ± 2.13	17.46 ± 3.21	19.752	0.001*
Motor recovery time after release of tourniquet (min)	10.19 ± 3.28	15.9 ± 4.13	7.663	0.001*
Number of patients had tourniquet pain	9 (18%)	1 (2%)	X^2: 7.312	0.007*
Time of onset of tourniquet pain (min)	25.85 ± 2.74	42.52 ± 7.21	18.032	0.001*
Post op. analgesic consumptions in the first 24 hrs	257.5 ± 60.99	98.67 ± 45.79	14.732	0.001*
Intra operative fentanyl amount (μg)	55.3 ± 2.74	25.1 ± 2.74	15.284	0.001*
First analgesia requiring time after release of tourniquet	33.48 ± 5.91	220.41 ± 9.85	65.328	0.001*
Patient's qualification of the operative conditions	3.02 ± 0.62	3.65 ± 0.75	4.583	0.001*
Surgeon's qualification of the operative conditions	2.97 ± 0.53	3.38 ± 0.45	4.172	0.001*

Table 3: Operative and postoperative data.

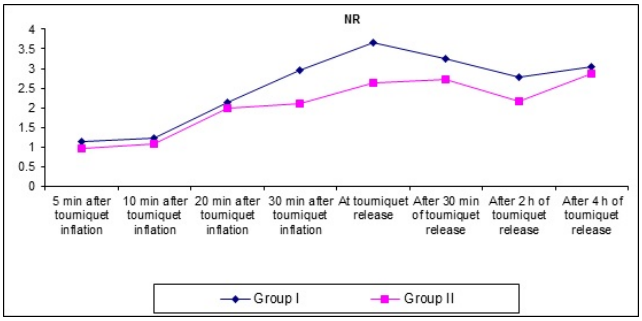

Figure 3: Comparison of the mean value of tourniquet pain by NRS between the two groups.

Complication	Group I	Group II	X2	P value
Dizziness	4	1	1.892	0.169
Metallic taste	2	0	2.043	0.153
Nausea	3	1	1.042	0.307
Vomiting	1	0	1.012	0.315
Shivering	2	0	2.043	0.153

Table 4: Complications.

Discussion

In this study we compared 3 mg/kg of 0.5% lidocaine diluted with normal saline in a volume of 40 ml with the combination of 1.5 mg/kg of 0.25% lidocaine, 8 mg of lornoxicam and 0.5 µg/kg dexmedetomidine all diluted with normal saline in a total volume of 40 ml.

In this study there were significant differences between the two groups in the meantime of onset sensory and motor block. However, there was complete sensory and motor block in both groups within less than 10 min of injection of the anesthetic solution. Thus, the quality of anesthesia was comparable in two groups at 10 min after injection of anesthetic solution. We obtained the same quality of anesthesia as traditional high dose of lidocaine by adding lornoxicam and dexmedetomidine to a lesser dose of lidocaine and the postoperative analgesia was longer with this combination. Some side effects were noticed in patients with lidocaine concentration of 0.5% such as dizziness and tinnitus, arrhythmia, metallic taste, nausea and vomiting, but these complications were less pronounced in the patients with lidocaine concentration of 0.25%, although the difference is not statistically significant, but sour combination with low-dose lidocaine reduces the incidence of potential local anesthetic toxicity. Our results also showed decreased the requirement of the intraoperative analgesia and delayed the onset of the first requirement of postoperative analgesia.

To our knowledge no previous studies used both lornoxicam and dexmedetomidine in IVRA, however Some studies added lornoxicam to the local anesthetic solution for intravenous regional anesthesia; Sen et al. [6] found that using lornoxicam as an adjuvant to lidocaine for IVRA enhanced the onset of sensory and motor block, increased tourniquet tolerance, and provided better quality of anesthesia with lesser analgesic requirements during and after the operation without any side effects. The enhanced onset of sensory and motor blockade have been attributed to the raising of the PH of the local anesthetic solution by adding lornoxicam. Kol et al. [15] used lornoxicam with prilocaine for IVRA, their study showed longer sensory and motor block recovery times, prolonged analgesia and tourniquet tolerance times and decreased the 24 h analgesic requirements in the group with lornoxicam. Jankovic et al. [16] studied the effect of adding ketorolac and dexamethasone to lidocaine IVRA on the postoperative analgesia and tourniquet tolerance for ambulatory hand surgery; they attributed that the analgesic properties of NSAIDs to their antioxidant properties. Sertoz N et al. [17] found that adding lornoxicam to lidocaine IVRA increased the sensory block recovery time without marked side effects and delayed the first analgesic requirement time compared to lidocaine IVRA as well as fentanyl added to lidocaine IVRA. Hande C et al. [18] found that adding tramadol and lornoxicam to prilocaine for IVRA produced favorable effects on sensory and motor blocks and reduced postoperative analgesic consumption.

While other studies used dexmedetomidine as an djuvnat to the local anesthetic solution for IVRA, one of them was done by Gupta B et al. [19] who compared adding either dexmedetomidine or midazolam as adjuncts to lignocaine for IVRA and found no significant difference as regards sensory onset time, motor onset time, quality of anesthesia, and postoperative analgesia, but lesser tourniquet pain was noticed in the dexmedetomidinegroup. Iclal O et al. [20] added either dexmedetomidine or lornoxicam to IRA for upper limb surgeries and found that both of them provided good analgesic and anaesthetic quality without causing adverse effects as no hypotension, bradycardia or hypoxia requiring treatment was seen in any of the patients. Also Ramadhyani U et al. [21] proved that the addition of dexmedetomidine to IVRA solutions improved postoperative analgesia as well as decreased the total local anesthetic dose.

Some studies compared the effect of 0.5% lidocaine solution and 0.25% lidocaine with adjuvants, one of them was done by Santhosh B et al. [22] who showed lidocaine dose was lowered by adding fentanyl and vecuronium to lidocaine, thus, reduced the potential local anesthetic toxicity in IVRA. Another study was done by Sztark F et al. [23] who added fentanyl and pancuronium to 0.25% lidocaine for IVR A and showed that it is possible to inject only 1.5 mg/kg of lidocaine as a solution of 0.25% instead of the usual 3 mg/kg, they showed that their triple combination provided the same quality of anesthesia as the 0.5% lidocaine solution with reduced potential toxicity of the local anesthetic, but there was a some delay noticed with their combination in the sensory and motor block onsets.

Conclusion

Adding lornoxicam-dexmedetomidine to 0.25% lidocaine in comparison with 0.5% lidocaine for IVRA alone causes a short delay in the onset and the attainment of complete sensory and motor blocks; however this safe and effective combination can be used in IVRA for upper limb surgeries with better analgesic effect and lesser probability of local anesthetic toxicity.

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