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Influence of Addition of Ondansetron or Ketorolac on Levobupivacaine in Bier Block for Upper Limb Surgeries

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ABSTRACT

Background: Intravenous administration of a local anesthetic into a tourniquet occluded limb, continued to be in favor due to simplicity and reliability with rapid onset of the technique and decreased systemic toxicity.

Objectives: Our study aimed to compare between the effects of adding ondansetron 8 mg or ketorolac 30 mg to levobupivacaine 0.125% for IVRA on duration of postoperative analgesia

Patients and methods: 60 adult patients of both sex who are matched with American Society of Anesthetists (ASA, I - II). Their ages ranged between 21–60 years old and scheduled for upper limb surgery under intravenous regional anesthesia (IVRA). Patients were randomly divided into three equal groups (20 patients each). Group (L): levobupivacaine (0.125%) + IV saline, (control group). Group (LO): levobupivacaine (0.125%) + IV ondansetron (8 mg/kg). Group (LK): levobupivacaine (0.125%) + IV ketorolac (30mg). All patients received levobupivacaine (0.125%) diluted with 0.9% normal saline to a total volume of 40 ml.

Results: Onset of sensory and motor block was rapid in ondansetron group than other groups. Duration of offset time of sensory and motor block was significantly prolonged in ketorolac group ($p < 0.0001$). Visual analog scale was significantly lower in ketorolac ($p < 0.001$) and ondansetron group than in control group. Duration of postoperative analgesia was longer in ketorolac group and ondansetron group than in control group ($p < 0.001$). Postoperative total analgesic consumption in 24h was significantly less in ketorolac group than in ondansetron group and control group ($P < 0.002$).

Conclusion: The results of the present study revealed that addition of ondansetron or ketorlac to levobupivacaine for IVRA improved quality of anesthesia, reduced postoperative analgesic consumption with rapid onset of sensory block with ondansetron group than with ketorolac group. Moreover, the time to the first analgesic requirement after surgery was prolonged with ketorolac group than with ondansetron group when compared to the control group.

Keywords: Intravenous regional anesthesia, Levobupivacaine, Ondansetron, Ketorolac.

INTRODUCTION

IVRA, commonly known as (Bier's block), includes intravenous administration of a local anesthetic (LA) into a tourniquet occluded limb that diffuses from the peripheral vascular bed to neural tissues such as axons and nerve endings [(1)]. It is continued to be in favor due to simplicity and reliability with rapid onset of the technique and decreased systemic toxicity [(2)]. Ideal IVRA anesthetic should have the following criteria: rapid onset with reduced dose of local anesthetic and reduced tourniquet pain and prolonged post-operative analgesia. This may be achieved by the addition of adjuvants to LA [(3)].

Levobupivacaine is an amino- amide LA drug of pure S (−)-enantiomer of bupivacaine. It is safer and superior than bupivacaine regarding to pharmacokinetic profile with faster protein binding rate. It acts through reversible blockade of neuronal sodium channels [(4)].

Ondansetron is a serotonin 5-HT3 receptor antagonist of ligand-gated sodium ion (Na+) and potassium ion (K+) channels that found in the central and peripheral nervous system in the chemoreceptor trigger one (CTZ), afferent fibers of vagus nerve in GIT and central nervous system (CNS) [(5)]. It possesses anti-inflammatory, antiemetic, anesthetic, and analgesic effects that may have a role in decreasing pain. As, it shares in the pathway of nociception by interfering with peripheral effects of serotonin on nociception. Also, it binds to opioid mu receptors and acts as a potential opioid agonist resulting in analgesic effect [(6)]. Also, it plays a crucial role in pain transmission as it is located in inhibitory interneurons of the pain-modulating descending pathways, which impinge to the substantia gelatinosa of the dorsal horn that inhibits incoming painful impulses from the primary afferent fiber. This allows the anti-nociceptive action of serotonin at spinal levels [(7)].

Ketorolac, an acetic acid derivative, non-steroidal anti-inflammatory drug (NSAID) that acts through inhibition of prostaglandin synthesis. It inhibits action of the cyclooxygenase enzymes (COX-1 and COX-2), which converts arachidonic acid to prostaglandins and thromboxane A2 giving high analgesic and anti-inflammatory effect [(8)].

Study Outcomes: Duration of postoperative analgesia is that the primary outcome. Whereas the evaluation of hemodynamic parameters, onset and offset time of sensory and motor block, visual analogue

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scale (VAS) for postoperative pain, analgesic requirements, quality of anesthesia for patient and surgeon and adverse effect are the secondary outcomes.

PATIENTS AND METHODS

Study design: This study was a prospective randomized double blinded study, which was conducted in Al-Zahraa University Hospital on sixty adult patients of both sex aged between 21- 60 years, matching with the American society of anesthesia (ASA) grade I & II during the period from December 2019 to May 2020 that was scheduled for elective forearm and hand surgeries.

Exclusion criteria:

Un-co-operative or patient refusal, patients with peripheral vascular disease (e.g. scleroderma, raynaud's disease, sickle cell disease, DVT, thrombophlebitis or vascular insufficiency). Local infection at the site of injection. Also, patients with known hypersensitivity to any of the drugs used in the study as well as patients with known cardiac, renal or hepatic disease.

Ethical consideration:

Informed written consent was obtained from each patient, **after approval of the local Ethical Committee from the Research Ethics Committee (REC) of the Faculty of Medicine for Girls, Al-Azhar University.**

***Randomization*:** Patients were randomly allocated into three groups by using a computer-generated number with sealed opaque envelopes, A CONSORT flow chart showed in figure (1).

Study groups: Patient were randomly classified into 3 equal groups (20 patients each).

- **Group (L):** levobupivacaine (0.125%) + IV saline (control group).
- **Group (LO):** levobupivacaine (0.125%) + IV ondansetron (8 mg/kg).
- **Group (LK):** levobupivacaine (0.125%) +IV ketorolac (30mg).
- All patients received levobupivacaine (0.125%) diluted with 0.9% normal saline to a total volume of 40 ml**.**

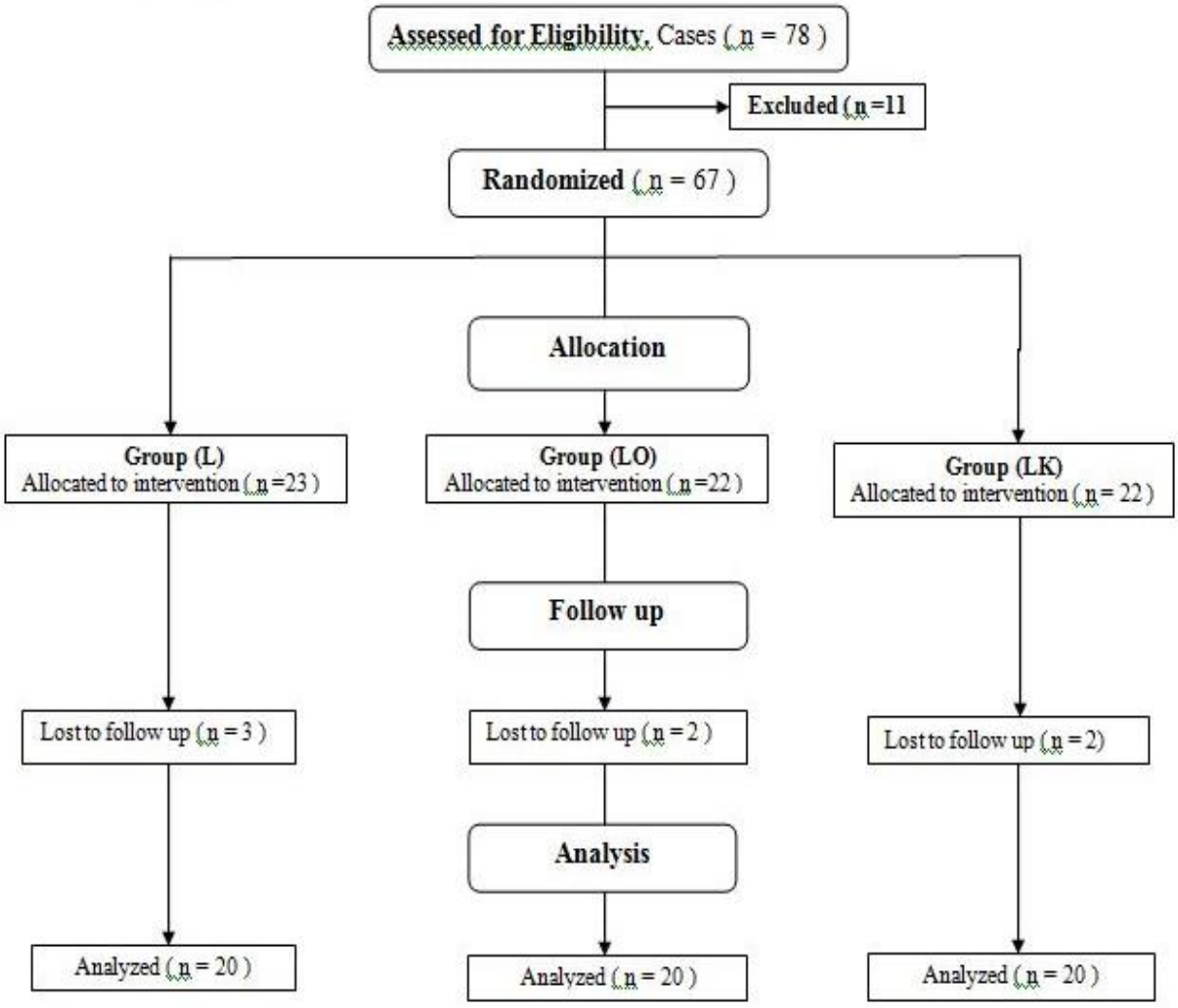

Figure (1): Consort flow chart

- Routine preoperative assessment was done and all patients were kept NPO for 6 hours and received 2mg midazolam and 25µg fentanyl IV as premedication.

Techniques:

Before the start of the procedure, all equipments, drugs for general anesthesia and resuscitation as well as double pneumatic tourniquet and Esmarch bandage for exsanguinations were checked. Also, two IV cannula 20 gauges, infusion set and 5ml and 20 ml syringes were prepared.

Drugs: Chirocaine (levobupivacaine HCL injection 0.5mg/ml, total volume 10 ml, AbbVie Srl, Italy), ***Ketolac*** (ketorolac tromethamine injection 30 mg/2ml Amriya for Pharmaceutical Industries, Alexandria, Egypt), ***Danset*** (ondansetron HCL injection, 8mg/4ml ADWIA Co. S.A.E., Egypt). Normal saline was added to make up a total volume of 40 ml.

Continuous standard monitors for heart rate (HR), mean arterial blood pressure (MAP) and peripheral oxygen saturation (SpO_2) were applied and baseline values were recorded. A 20 gauge cannula was placed in the non-operative hand for crystalloid infusion and emergency drugs. Another 20 gauge cannula was inserted in a dorsal vein of the operative hand. A double pneumatic tourniquet was placed around the upper arm of the operative limb, over a pad of cotton and the arm was elevated for 2 min then exsanguinated with an Esmarch bandage. The proximal cuff was inflated to100 mm Hg above the patient's systolic pressure. Isolation of the arm was noticed by inspection and absence of radial pulse with loss of pulse oximetry tracing in the ipsilateral index finger. 40 ml of block solution (levobupivacaine (0.125%) in control group (L), and levobupivacaine (0.125%) + IV ondansetron (8 mg/kg) in group (LO), and levobupivacaine (0.125%) + IV ketorolac (30mg) in group (LK) were injected slowly within 60 seconds on the operative limb then the cannula was removed. After achieving complete sensory block, distal cuff was inflated 100 mmHg above pre-operative systolic pressure to maximum 250 mmHg and proximal tourniquet was deflated and the operation was started. At the end of the surgery, tourniquet was deflated slowly and gradually over 3 minutes. The least time before tourniquet release was 30 minutes and the maximum time could be allowed was 90 minutes. At the end of surgery patients were transferred to the recovery room for continuous monitoring of hemodynamic state before being referred to ward.

Parameters for assessment:

1- Hemodynamic parameters: (HR), (MAP) and (SpO_2) were recorded before anesthesia as a baseline and intraoperative at 5, 10, 15, 20, 30, and 40 minutes after proximal tourniquet deflation

2- Onset time of Sensory and motor block assessment:

- **Sensory block onset time:** The time elapsed from injection of the drug up to the sensory block was achieved in all dermatomes. Onset of sensory block was assessed by using four points' score every 30 seconds (0 = Pin prick clearly felt as a pain and 3 = Pin pricks not felt at all). Pin prick method was used at dermatomal distribution of ulnar nerve (hypothenar eminence), median nerve (thenar eminence) and radial nerve (first web space) [(9)].

- **Motor block onset time:** The time elapsed from injection of the local anesthetics up to complete motor block.

- **Motor block assessment (Bromage scale):** It was assessed by asking the patient to flex and extend his/her wrist and fingers every 1 minute by using bromage scale (0 = normal muscular function, 1 = Slight depression in muscular function, 2 = very week muscular action persisting and 3= complete block, no movement) [(9)].

3- Offset time of sensory and motor block after removal of tourniquet: The time elapsed from tourniquet deflation up to complete recovery of sensation in all dermatomes and complete return of normal muscular function in the post anesthesia care unit (PACU).

4- Visual analogue scale (VAS) scores for pain: Postoperative pain scores were recorded by using visual analogue scale (VAS), it is a 10-cm horizontal line, patient was asked to mark on this line where the intensity of the pain lies. "No pain" at one end and "worst pain imaginable" on the other end. VAS was measured before induction of anesthesia and then 1, 2, 4, 8, 12, 24 hrs after distal tourniquet deflation [(10)].

5- The time to first analgesic requirement: The time elapsed after tourniquet release up to the first request of analgesia was recorded. Lornoxicam 8 mg vial was given intramuscular when VAS $\geq$ 4.

6- Total analgesic requirement in first 24 h postoperative was recorded

7- Quality of anesthesia as regard patient and surgeon satisfaction: Using four point scale for both the patient and the surgeon satisfaction (1 = Poor, 2 = Fair, 3 = Good, 4 = Excellent) [(11)].

8- Assessment for Presence of any adverse effects (as bradycardia, hypotension, headache, dizziness and skin rash).

Sample size:

MedCalc® version 12.3.0.0 program "Ostend, Belgium" was used for calculations of sample size, statistical calculator based on 95% confidence interval and power of the study 80% with α error 5%**,** according to a previous study of **Atanassoff *et al.* [(12)],** which showed that the recovery time (min) at median 10 (4–25) min and 25 (3–55) min in the lidocaine and levobupivacaine groups respectively with p-value < 0.05 significant. So it can be relied upon in this study, based on this assumption, sample size was calculated according to these values, which produced a minimal samples size of 57 cases that were enough to find such

a difference. Assuming a drop-out ratio of 5%, the sample size will be 60 cases, subdivided into three groups, Group L (n = 20), Group LO (n = 20) and Group LK (n=20).

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage. A one-way analysis of variance (ANOVA) was used to compare between more than two means and Post Hoc test was used for multiple comparisons between different variables. Independent t-test was used to compare between two means and Mann Whitney U test for two-group comparisons in non-parametric data. Also, Chi-square (x^2) test of significance was used in order to compare proportions between qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value ≤ 0.05 was considered significant.

RESULTS

Regarding the demographic and hemodynamic data, there was no statistically significant difference between the 3 groups in age, sex, ASA, and type of surgery (Table 1).

Table (1): Comparison between demographic, hemodynamic data and types of operation.

Variables / Groups	Group (L) (n=20)	Group (LO) (n=20)	Group (LK) (n=20)	F/x2#	p-value
Age (yrs)	31.65 ± 8.93	31.55 ± 10.90	30.50 ± 9.73	0.083	0.920
Sex (%)					
Female	5 (25.0%)	7 (35.0%)	9 (45.0%)	1.190#	0.145
Male	15 (75.0%)	13 (65.0%)	11 (55.0%)		
ASA(%)					
I	16 (80.0%)	17 (85.0%)	16 (80.0%)	0.223#	0.895
II	4 (20.0%)	3 (15.0%)	4 (20.0%)		
HR (b/m)	76.25 ± 8.52	72.50 ± 7.05	75.95 ± 7.27	1.488	0.235
MABP (mmhg)	81.30 ± 15.79	81.80 ± 15.26	80.20 ± 14.98	0.057	0.945
Type of surgery					
-Tendon repair	12 (60.0%)	11 (55.0%)	10 (50.0%)	8.799#	0.720
-Carpel tunnel	5 (25.0%)	6 (30.0%)	6 (30.0%)		
-Amputation &graft	1 (5.0%)	1 (5.0%)	2 (10.0%)		
-Internal fixation of bone fracture	0 (0.0%)	1 (5.0%)	2 (10.0%)		
-K-WIRE Insertion	1 (5.0%)	0 (0.0%)	0 (0.0%)		
-Reduction of colles fracture	1 (5.0%)	0 (0.0%)	0 (0.0%)		
-Ganglion removal	0 (0.0%)	1 (5.0%)	0 (0.0%)		

Data were expressed as mean ± standard deviation (SD), frequency and percentage. F- one way analysis of variance; #x^2: Chi-square test, p-value > 0.05 NS.

There was a significant difference in onset time of complete sensory and motor block. It was more rapid in LO group then in LK group when compared to group L. According to offset time of sensory block and motor block after removal of tourniquet, it showed significant decrease in L group compared to LO and LK groups (Table 2).

Table (2): Comparison between onset and offset time of sensory and motor block (min).

Variables / Groups	Group (L) (n=20)	Group (LO) (n=20)	Group (LK) (n=20)	F	p-value
Onset time of Sensory block (min) Mean ± SD	13.40 ± 1.29	10.55 ± 1.45a	12.23 ± 1.19b	3.458	0.002*
Onset time of Motor block (min) Mean ± SD	18.05 ± 1.28	15.98 ± 1.40a	16.78 ± 1.53a	2.106	0.017*
Offset time of sensory block after removal of tourniquet(min) Mean ± SD	20.35 ± 5.27	26.85 ± 3.77a	28.05 ± 4.54a	5.460	0.013*
Offset time of motor block after removal of tourniquet(min) Mean ± SD	15.28 ± 4.42	21.68 ± 3.08a	23.45 ± 4.07a	4.761	0.016*

Data were expressed as mean± standard deviation (SD). F-One Way Analysis of Variance; *p-value < 0.05 S, Post HOC: a: significant difference with L group; b: significant difference with LO group

There was statistically significant difference between groups according to VAS score (Table 3).

Table (3): Postoperative VAS score.

VAS score	Group (L) (n=20)	Group (LO) (n=20)	Group (LK) (n=20)	F	p-value
After 1 hr	0(0-1)	0(0-1)	0(0-1)	0.819	0.137
2hr	2(0-3)	1(1-3)	0(0-1)	1.842	0.092
4hr	2(1-3)	(1-3)	1(1-2)	7.099	<0.001**
8hr	4(2-4)	3(1-4)	2(1-4)	5.003	0.010*
12hr	4(1-4)	3(1-3)	2(1-3)	10.499	<0.001**
24hr	3(1-3)	2(1-3)	1(1-2)	3.913	0.026*

Data were expressed as inter quartile range (IQR), p-value > 0.05 NS; *p-value < 0.05 S; **p-value < 0.001 HS

There was highly statistical significant difference between groups in time of first analgesic requirement (hrs) in Lk and LO groups than in control group (L**).** According to total analgesic consumption in the first 24hrs, it was significantly lower in group LK than in LO and L groups. According to adverse effects, there was no significant difference between the three groups except in LO group only five cases showed slight skin rash (Table 4).

Table (4): Time of first analgesic requirement, total analgesic consumption and adverse effect.

Variables / Groups	Group (L) (n=20)	Group (LO) (n=20)	Group (LK) (n=20)	F	p-value
Time of first analgesic requirement (hrs) Mean ± SD	4.75 ± 1.41	7.00 ± 2.66a	8.95 ± 3.62a	11.970	<0.001**
Total analgesic consumption in first 24 hrs (mg/hr) Mean ± SD	12.80 ± 4.02	10.40 ± 3.76a	8.80 ± 2.46ab	6.685	0.002*
Adverse effects: Skin rash	0 (0.0%)	5 (25.0%)	0 (0.0%)	10.909	0.004*
Others	0	0	0		

Data were expressed as as mean ± standard deviation and percentage, x^2: Chi-square test; *p-value < 0.05 S, a: significant difference with L group; b: significant difference with LO group.

The quality of anesthesia assessed by the surgeon was significantly different with the best quality detected in group (LO), followed by(LK) group then group (L).Also quality of anesthesia assessed by the patients was significantly better in group (LK), followed by (LO) group when compared with the control group (L) (Table 5).

Table (5): Comparison between groups according to quality of anesthesia.

Quality of anesthesia	Group (L) (n=20)	Group (LO) (n=20)	Group (LK) (n=20)	x2	p-value
To the surgeon					
Excellent	5 (25.0%)	16 (80.0%)	15 (75.0%)		
Good	7 (35.0%)	3 (15.0%)	3 (15.0%)	16.446	0.002*
Fair	8 (40.0%)	1 (5.0%)	2 (10.0%)		
To the patient					
Excellent	8 (40.0%)	15 (75.0%)	18 (90.0%)		
Good	3 (15.0%)	2 (10.0%)	2 (10.0%)	14.639	0.006*
Fair	9 (45.0%)	3 (15.0%)	0 (0.0%)		

Data were expressed as number and percentage, x^2: Chi-square test; *p-value <0.05 S

DISCUSSION

Upper limb surgeries especially plastic and orthopedic surgeries are associated with severe postoperative pain especially in the first 24 hours. Pain control in these types of surgery is very important not only to improve the patients' wellbeing and reduce the potential side effects of opioid but also to facilitate early mobilization and rehabilitation [(13)].

IVRA offers numerous advantages over conventional general anesthesia (GA), including faster recovery time, fewer side effects, no need for airway manipulation during surgery, and a dramatic reduction in post-surgical pain. IVRA reduced nursing time demand in the PACU and early hospital discharge when compared to GA and brachial plexus block but it often did not provide effective postoperative analgesia [(14)]. Levobupivacaine has increasingly been used in the clinical anesthesia practice since last few years because of its safer pharmacological profile with low cardiovascular and neurological toxicity that lead to its application as a local anesthetic in a wide variety of anesthesia [(4)]. **Atanassoff *et al.*** [(12)] found that Levobupivacaine 0.125% may be an alternative to lidocaine 0.5% for IVRA where longer lasting analgesia after release of the tourniquet with Levobupivacaine was observed.

Adjuvants to local anesthetics have greatly expanded the potential applications of IVRA by providing faster onset time, prolonged postoperative analgesia and improved perioperative analgesia apart from decreasing the risk of local anesthetic toxicity [(15)].

Our study aimed to compare between the effects of adding ondansetron 8 mg or ketorolac 30 mg to levobupivacaine 0.125% for IVRA on duration of postoperative analgesia

Regarding the hemodynamic data, our study demonstrated that there was no statistically significant difference between the groups. These results agree with a study done by **Gheit *et al.*** [(16)] who didn't report any significant changes as regards hemodynamics on addition of ketolac 30 mg to local anesthetic block solution for IVRA. Also, our results are similar to **Honarmand *et al.*** [(17)] who studied in 2013 90 patients undergoing hand surgery who were randomly allocated to three groups to receive 3 mg/kg 2% or 8 mg ondansetron plus 3 mg/kg 2% lidocaine or 3 mg/kg 2% lidocaine. All were diluted with saline to a total volume of 40 mL plus 8 mg ondansetron injected alone in the other hand intravenously. There was no statistically significant difference between the three groups.

The present study demonstrated that onset of sensory block and motor block was more rapid in ondansetron group than in ketorolac group. Also the time of sensory and motor recovery was significantly longer in LK group (28.05 ± 4.54) then in LO group (26.85 ± 3.77) in comparison with L group (20.35 ± 5.27). Our results go hand in hand with **El Bahnasawy** [(18)] who compared adding different doses of ondansetron for IVRA and found more rapid onset of sensory and motor block in ondansetron groups compared to control group but more in the group with ondansteron 8 mg than in the group with 4 mg ondansteron. Also, our results are matching with **Gheit *et al.*** [(16)] results in 2016 who studied that the addition of three different doses of ketolac (10, 20 and 30 mg) to lidocaine for IVRA. They reported that the onset of sensory and motor block were statistically significantly accelerated in the three ketorolac groups compared to plain lidocaine and the group in which 30 mg ketolac was added showed the fastest sensory and motor onset time compared to other groups. Besides, **Atanassoff *et al.*** [(12)] provided that the offset time of sensory and motor block persisted markedly longer in the levobupivacaine 0.125% when compared to lidocaine 0.5% and it was attributed to profound and prolonged tissue binding effect of levobupivacaine. The longer

offset time of sensory and motor block in LO group can be correlated to synergistic effect of ondansetron with local anesthetic block solution that matches with previous studies done by **Honarmand *et al.*** [17] and **Farouk** [19] where they showed that when ondansetron added to lidocaine for intravenous regional anesthesia, it showed that the sensory and motor block offset times were significantly prolonged in ondansetron group compared to the plain lidocaine group. Also, as regarding ketorolac **Reuben *et al.*** [20] found that addition of ketorolac to local anesthetic solution has prolonged recovery time of sensation after opening the tourniquet.

In contrast to our results the study done by **El-Desouky and Rashad** [21] showed a significant decrease in onset of sensory and motor block in ondansetron and granisetron groups in contrast to that of the control group. Disagree with the current study, **Seyfi *et al.*** [22] who compared 40 patients divided into two groups undergoing elective upper limb surgeries by IVRA, the first group received 200 mg of lidocaine, and the second group, received 200 mg of lidocaine with 20 mg of ketorolac and suggested that adding ketorolac for IVRA had no important influence on the onset of anesthesia. Other studies by **Reuben *et al.*** [20] and **Singh *et al.*** [23] also indicated that adding ketorolac had no effect on the time of onset of anesthesia.

The current study showed significant difference in the VAS values at 4, 8, 12, 24 hours postoperatively. We found that LK and LO groups showed significant decrease in VAS values at surgical sites in comparison to L group and the duration of postoperative analgesia and the time to first analgesic request showed statistically significant longer duration in ketorolac group (8.95 ± 3.62 hr) then ondansetron group (7.00 ± 2.66 hr) when compared to the control (L) group (4.75 ± 1.41 hr). Also we found that the 24 hr total postoperative analgesic requirement (mg/hr) was statistically significant between the 3 groups. It was significantly lower in group LK (8.80 ± 2.46) than in LO group (10.40 ± 3.76) and (L) group (12.80 ± 4.02).

Regarding postoperative VAS values, the time to first analgesic request (duration of postoperative analgesia), our result regarding ondansetron agree with **Honarmand *et al.*** [17].

Our result come in line with **Seyfi *et al.*** [22] who recorded prolonged duration of analgesia after surgery, decreased VAS score values and reduced consumption of analgesic drugs that is explained by, systemic absorption of ketorolac after opening the tourniquet, which can control the cyclo-oxygenase enzyme and reduce pain.

Also many studies confirmed the effect of intravenous ketorolac in delaying the onset of pain and decreasing its VAS score values after surgery and assigned it to the peripheral mechanism of ketorolac as having anti-nociceptive action [24 25].

As regards the adverse effect, skin rash in LO group in comparison with the other two groups noted in some cases, it is faded rapidly after about 3 to 5 min and was not accompanied by any other symptoms.

In our study, quality of anesthesia was assessed by both the surgeon and patients. It was significantly different in comparing group LO and LK with the L group with the best quality detected in group LO, followed by LK group then group L. This may be due to the rapidity of onset for LO group. However for patients, the quality of anesthesia was significantly better in group LK, followed by (LO) group when compared to the control L group, which may be due to the strong analgesic effect of LK group. This matches with the results of **El-Desouky and Rashad** [21] who found that the addition of ondansetron was effective in improving quality of anesthesia and analgesia during IVRA. Also **Seyfi *et al.*** [22] who showed that ketorolac group experienced better quality of analgesia and the duration of pain after opening tourniquet was lower.

To the best of our knowledge, this is the first study to combine both levopubivacaine and ondansetron in IVRA and this directs us for further future studies on large number of patients.

CONCLUSION

The results of the present study revealed that the addition of ondansetron or ketorlac to levobupivacaine for IVRA improved quality of anesthesia, reduced postoperative analgesic consumption with rapid onset of sensory block with ondansetron group than ketorolac group. Also, there was prolonged time to the first analgesic requirement after surgery with ketorolac group than with ondansetron group when compared to the control group.

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