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Dexmedetomidine as an adjuvant to lignocaine in intravenous regional anesthesia (Ivra or Bier's Block)

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Abstract

Introduction: In this randomized, double-blind, prospective study, the effect of adding dexmedetomidine as an adjuvant to lignocaine in IVRA is evaluated in terms of sensory and motor block onset times as well recovery times, rescue analgesia and postoperative analgesia and sedation score.

Method: After informed consent and ethical committee approval, sixty ASA grade I and II patients scheduled for forearm surgeries were included. Patients divided into two groups, in Group LD 30 ml of 1% lignocaine with 50 mcg dexmedetomidine and in Group B 30 ml of 1 % lignocaine +1 ml of normal saline 0.9% were injected in operating hand after exsanguinated and using double tourniquets technique. Intraoperatively mentioned vital parameters monitored at regular intervals. Sensory and motor block onset times as well recovery times, intraoperative rescue analgesia, hemodynamics, postoperative analgesia using VAS scale, sedation score using modified Ramsay sedation score and side effects were noted if present.

Results: Both the Groups were comparable in respect of age, sex, weight and duration as well as types of surgery. In Group LD onset of sensory block is 1.63±0.55 minutes and motor block is 13.47±1.54 minutes, in Group L it was 5.37±0.80 minutes and 18.6±1.31 minutes respectively. In Group LD sensory and motor recovery time were 19.07±3 minutes and 25.77±3.44 minutes and in Group L they were 4.9±0.84 minutes and 2.57±0.56 minutes respectively. In Group LD postoperative analgesia is *420±37.62* minutes and in Group B were 11.60±0.89 minutes. No side effects were noted.

Conclusion: It can be concluded that Dexmedetomidine when used as adjuvants to lignocaine for IVRA significantly improves the intra-operative conditions by providing superior quality of block, significantly prolongs the postoperative analgesia without affecting hemodynamic parameters .

Keywords: Dexmedetomidine, tourniquet, postoperative analgesia.

Introduction

Regional anesthesia holds an important place in clinical practice because of its simplicity, safety and economy. Intravenous regional anesthesia (IVRA) has evolved as a safe, reliable, and cost-effective technique for providing anesthesia as well as bloodless field during upper limb surgery especially in patients who are not adequately prepared for general anesthesia. [1]

Intravenous regional anaesthesia (IVRA) was first described by August Bier in 1908. He observed that when local anaesthetic was injected intravenously between two tourniquets on a limb, a rapid onset of anaesthesia occurred in the area between the tourniquets. The technique did not become popular until the 1960s when it was reintroduced by Holmes. Today, the technique is slightly modified, using either a single or a double tourniquet at one site and injecting local anaesthetic as distal as possible to the cuff. The double tourniquet is used to increase safety and to reduce tourniquet pain in the awake patient, but there is a possibility of accidental deflation of the wrong cuff, which may lead to toxic systemic levels of local anaesthetic. [2,3]

IVRA is safe, technically simple, and cost effective technique compared to general anaesthesia with success rates of 94 to 98% for upper and lower limb surgeries. It also have some disadvantages i.e. tourniquet pain, sensory and motor blockage onset and duration is less of post-operative analgesia. To overcome these disadvantages various adjuvants have been tried.[4,5] Lidocaine a most commonly used local anesthetic which is also known as lignocaine. Lignocaine is a synthetic amide-linked local anaesthetic of intermediate potency and duration. Lidocaine alters signal conduction in neurons by prolonging the inactivation of the fast voltage-gated Na+ channels in the neuronal cell membrane responsible for action potential propagation. Dose in IVRA 0.5% to 1% (3mg/kg) [6,7,8]

In addition, adjuvant agents are used to improve the quality and duration of nerve blocks and to reduce the need for supplementary analgesics for postoperative pain. There have been several studies concerning opioids, Dexmedetomidine hydrochloride is a 4-((s)-alpha,2,3-trimethylbenzyl) imidazole monohydrochloride or 4-[(1r)-1-(2,3-dimethylphenyl) ethyl]-3h- imidazole hydrochloride, Dexmedetomidine is a new alpha2-agonist used as a short-term (less than 24 h) sedative and analgesic. Used as adjuvant to local anaesthetics in a doses from 0.5mcg/kg to 1 mcg/ kg. It causes hypotention and bradycardia in low doses from 0.5 mcg/kg to 2 mcg/kg and in high doses >2 mcg/kg causes hypertension and bradycardia.[9,10,11]

This study was conducted to determine the efficacy of Dexmedetomidine as an adjuvant in Intravenous regional anesthesia with local anaesthetic Lignocaine, along with secondary objectives like the effectiveness in preventing tourniquet pain, to compare the onset of sensory and motor block, the duration of postoperative analgesia and complications or adverse effects if any.

Materials and methods

After getting approval from institutional ethical committee and informed written consent from the patients, this prospective randomized study was conducted in Department of Anaesthesia, Jhalawar Medical College, Jhalawar, from February, 2021 to October, 2021. this was a Hospital based, Prospective, randomized, and double blinded interventional study.

In this study 60 patients of either sex belonging to American Society of Anesthesiologists (ASA) grade I and II, in age range of 20-60 years scheduled to undergo

upper limb orthopedic elective surgery like ganglion excision, ORIF with plating and CRIF with K-wire fixation were included and devided into 2 groups , Group lignocaine- Dexmedetomidine (Group-LD) - 30 ml 1.0% of lignocaine + 50 mcg dexmedetomidine total 31 ml (diluted in normal saline). Control group (L) lignocaine– 30ml of 1.0% lignocaine (diluted in1 ml normal saline) were administered IVRA.

All patients were pre anaesthetic examined on the day before surgery and Patient's excluded on refusal, with coagulation disorders, pre-existing neurological disease, Infection at local site, known allergy to local anaesthetics, diabetes, received corticosteroids or immunosuppressant drugs in last 6 months, having compromise renal, pulmonary and cardiac status, on medication like hypnotics, narcotic analgesic or sedatives, Presence of hypotension or any vascular disease, having known allergy to anaesthetic agents used in study, History of seizure disorders, with anticipated difficult intubation. All patients are premadicated with inj midazolam iv 1mg, Inj glycopyrrolate iv 0.2mg, Inj pentazocin iv 30mg

After preanesthetic examination, checkup all the patients were explained about the procedure. Preoperative vital parameters were recorded and an intravenous (IV) line was secured in non-operating limb. A 22G IV cannula were secured in the dorsum of the hand which is going to be operated. After the complete exsanguinations of the forearm, two tourniquets were applied as proximal and distal on arm. Proximal tourniquet was inflated 100 mmHg above systolic blood pressure. Study drug according to group was prepared and injected by a resident not participating in the study. Then elicit the pain sensation by pin prick sensation after 2-5 minutes after injecting the drugs. After 10 min, the distal cuff was inflated and the proximal (upper) cuff was deflated and surgery was allowed and vitals noted. Tourniquet pain was assessed by using visual analog scale (VAS) of 0-10 intra operatively. A score of 0 was given for no pain and 10 for intolerable pain. Inj. fentanyl (1µg/kg) IV was given if VAS was>3 as a rescue analgesia. After completion of the surgery, the tourniquet was deflated by intermittent deflation and reflation method over a period of 2-3 min. After deflation of tourniquet blood pressure, pulse rate was noted at 01 minutes and 05 minutes interval. In no circumstances, tourniquet was released before 30 min after injection of drug and should not be inflated after 90 minutes of drug injected. Note the time of 1st requirement of postoperative analgesia and inj diclofenac 1.5mg/kg was given. Note the modified Ramsay sedation score postoperatively. Any signs and symptoms of LA toxicity like peri-oral numbness, giddiness, tinnitus, nausea, vomiting, pain, skin rashes, hypotension, bradycardia, convulsions were noted and treated accordingly.

Onset of sensory block, Onset of motor block was noted. Intra-operative Vitals like Pulse rate, Blood Pressure, Respiratory rate, SPO2 were monitored regularly at 5,10,15,20,30,45,60,75 and 90minutes. Need of Rescue analgesia noted for intraoperative assessment of quality of analgesia was be assessed by VAS score on a 0-10 scale, where a score of 0 represents no pain and 10 is the worst pain imaginable. Time for total duration of surgery was noted.

Post-operatively duration of blockade after cuff deflation both sensory & motor blockade, vital parameters like pulse, BP were noted at 1 min and 5 mins. duration of analgesia, when VAS>3 and assessment of sedation was assessed by Modified Ramsay sedation score Postoperative pain assessment was done every half an hour up to the administration of first systemic rescue analgesic.

Postoperatively, sensory block, side effects if any and vitals of the patients will noted every half an hour. Rescue analgesic was administered in the form of inj. diclofenac sodium intramuscularly in the dose of 1.5 mg/kg. Post-operative nausea and vomiting will be treated with inj. Pentaparazole 40 mg and inj. ondansetron 4 mg IV.

Data was expressed as mean± standard deviation (SD) of statistical analysis. Statistical analysis done by using descriptive and inferential statistics using chi-square test and Student's unpaired t-test. The software was used in analysis will be Statistical Package for Social Sciences (SPSS) 17.0 version and Graph Pad Space Prism 5.0 and results will be tested at 5% level of significance as P value. P=0.05 Normal (N), P> 0.05 Non Significant (NS), P < 0.05 Significant (S) and P<0.001 Highly Significant (HS).

Observations and result

This was a prospective, randomized, and double blinded interventional study included 60 patients of either sex belonging to American Society of Anesthesiologists (ASA) grade I or II, in age range of 20-60 years scheduled to undergo upper limb orthopedic elective surgery like ganglion excision, ORIF with plating and CRIF with K-wire fixation.

Both groups were comparable with respect to age, sex, weight, and duration of surgery [Table 1].

Table 1: Comparison of patients demography

	Group LD (n-30)	Group L (n-30)	P value
Age (Years)	37.8±8.7	36.8±10.8	0.6148
Male:Female	17:13	19:11	0.7921
Weight (Kg)	52.5±5.0	52.9±5.5	0.8471
Total duration of surgery (minutes)	47.57±5.07	47.43±4.79	0.922

Both sensory and motor onset time was earlier in Group LD than Group L (p-0.0001) and recovery time for sensory and motor block was delayed in Group LD than Group L (p-0.0001). Demand for rescue analgesia during surgery (inj Fentanyl 01 mcg/kg intravenously) was statisticaly high in group L than Group LD. Total duration of post operative analgesia was longer in Group LD than Group L. [Table- 02]

Table 02: Comparison of patients anasthesia charecters

Parameters	Group LD (n-30)	Group L (n-30)	P value
Sensory onset time (minutes)	1.63±0.55	5.37±0.80	0.0001
Motor onset time (minutes)	13.47±1.54	18.6±1.31	0.0001
Rescue analgesia during surgery (n)	0	19	0.0001
Sensory recovery time (Minutes)	19.07±3	4.9±0.84	0.0001
Motor recovery time (Minutes)	25.77±3.44	2.57±0.56	0.0001
total duration of postoperative analgesia (minutes)	420±37.62	11.60±0.89	0.0001

The heart rate and mean arterial pressure at 01 minute and 05 minutes post deflation of tourniquet was comparable in both the groups. [Table 03]

Table 03: Comparison of patients hemodynamic parameters

	Group LD	Group L	P value
MAP at 1 minute (mmHg)	94.60 ± 4.7	95.03 ±5.6	0.750
MAP at 5 minutes (mmHg)	95.20 ±4.0	94.8 ±3.6	0.685
Pulse rate at 1 minute (BPM)	82.73± 5.8	81.56 ±5.9	0.447
Pulse rate at 5 minute (BPM)	81.43 ±5.9	82.03 ±4.8	0.66

Postoperative sedation score was observed high in Group LD than Group L and this difference was statisticaly significant (p-0.0001). The highest sedation score observed in Group LD was MRSS 03 (08/30) but maximum no. of patients (22/30) in Group LD observed sedation score of MRSS 02, while in Group L sedation score observed was MRSS 01 (30/30). [Table -04]

Table 04: Comparison of patients according to sedation score.

Sedation score	Group LD		Group L	
	No	%	No	%
MRSS 1	0	0	30	100
MRSS 2	22	73.33	0	0
MRSS 3	08	26.67	0	0
MRSS 4-8	00	00	0	0
Total	30	100	30	100
Range	2-3		1	
Mean	2.27		1	
SD	0.45		-	
‘p’	0.0001 Significant			

Discussion

In the era of day care surgery, rapid induction, recovery time, and minimal hospital stay, intravenous regional anesthesia is a useful, reliable, and cost-effective method of anesthesia. It provides adequate relaxation when used for upper limb surgery. It is also a popular choice in trauma and emergency services as a large number of cases are those of fracture and limb injuries resulting from road traffic accidents and intravenous regional anesthesia would be a useful technique in those patients who are ill prepared for general anesthesia. The relief of pain during surgery is the aim of anesthesia and the expertise required in this field can be extended into the postoperative period to provide postoperative analgesia. Painful stimuli produced by a surgical incision, can lead to a hyper- excitable state in the spinal cord, which can exacerbate the postoperative pain. Once this state has been established, a larger dose of analgesic is usually required. If drugs are administered before the painful stimulus, postoperative pain can be greatly diminished.

Various drugs and techniques of their administration have shown varying degree of success. Intravenous, intramuscular, or epidural opioids have been shown to reduce the severity of the postoperative pain to a greater extent when administered before surgical stimuli rather than following it.

Our results were similar to a study by **Mostafa A et al** [12] where they found that in Group I (40 ml of Lignocaine 0.5%) mean sensory onset time was 6.28±0.47 minutes while in Group II (40 ml of Lignocaine 0.5% with Dexmedetomidine 0.5 mcg/kg) mean sensory onset of time was 5.82±0.47 minutes and this difference was statistically significant (p<0.05). Again our results were similar to a study by **Jain N et al** [13] there they found that in Group L (30 ml of Lignocaine 0.5%) mean sensory onset time was 6.67±0.65 minutes while in Group LD (30 ml of Lignocaine 0.5% with Dexmedetomidine 01 mcg/kg) mean sensory onset of time was 3.50±0.41 minutes and this difference was statistically significant (p-0.0001). This difference may be due to that concentration of Lignocaine used in present study was in higher doses then used in previous studies.

Our results were similar to a study by **Kumar A et al** [5] where they found that in Group L (20 ml of Lignocaine 01%) mean motor onset time was 16.25 ± 2.54 minutes while in Group LK (20 ml of Lignocaine 01% with Ketamine 1 mg/kg) mean motor onset of time was 7.83 ± 1.37 minutes and in Group LD (20 ml of Lignocaine 01% with Dexmedetomidine 1 mcg/kg) mean motor onset of time was 12.46 ± 3.31 minutes and this difference was statistically significant (p<0.0001).

Our results were similar to a study by **Rayan A.A., and El Sayed A.A** [14] where they found that in Group L (40 ml of Lignocaine 0.5%) demand for rescue analgesia (Inj Fentanyl 01 mcg/kg intravenously) during surgery was seen in 15/20 patients, in Group LD1 (40 ml of Lignocaine 0.5% with Dexmedetomidine 0.5 mcg/kg) demand for rescue analgesia (Inj Fentanyl 01 mcg/kg intravenously) during surgery was seen in 04/20 and in Group LD2 (40 ml of Lignocaine 0.5% with Dexmedetomidine intravenous infusion of 01 mg/kg dexmedetomidine in 20 ml NS over 10 min (15 min before IVRA and then dexmedetomidine was maintained at the rate of 0.02–0.06 mg/kg/ min) demand for rescue analgesia (Inj Fentanyl 01 mcg/kg intravenously) during surgery was seen in 05/20 patients and this difference was statistically significant (p-0.0004).

Our results were comparable to a study by **Jain N et al** [13] where they found that in Group LD (30 ml of Lignocaine 0.5% with Dexmedetomidine 01 mcg/kg) mean sensory recovery time was 61.64±5.18 minutes while in Group L (30 ml of Lignocaine 0.5%) mean sensory recovery time was 12.76±4.41 minutes and this difference was statistically significant (p-0.0001).

Our results were comparable to a study by **Jain N et al** [13] where they found that in Group LD (30 ml of Lignocaine 0.5% with Dexmedetomidine 01 mcg/kg) mean motor recovery time was 67.40±4.92 minutes while in Group L (30 ml of Lignocaine 0.5%) mean motor recovery time was 15.25±4.44 minutes and this difference was statistically significant (p-0.0001).

Our results were similar to a study by **Rayan A.A., and El Sayed A.A** [14] where they found that in Group L (40 ml of Lignocaine 0.5%) postoperative analgesia (time to reach VAS 3 or more) was 25.3 ± 15.8 minutes, in Group LD1 (40 ml of Lignocaine 0.5% with Dexmedetomidine 0.5 mcg/kg) postoperative analgesia (time to reach VAS 3 or more) was 207.5 ± 65.4 minutes and in Group LD2 (40 ml of Lignocaine 0.5% with Dexmedetomidine intravenous infusion of 01 mg/kg dexmedetomidine in 20 ml NS over 10 min (15 min before IVRA and then dexmedetomidine was maintained at the rate of 0.02–

0.06 mg/kg/ min) postoperative analgesia (time to reach VAS 3 or more) was 152.0 ± 38.6 minutes and this difference was statistically highly significant (p<0.0001).

Our results were similar to a study by **Jain N et al** [13] where they found that in Group L (30 ml of Lignocaine 0.5%) postoperative analgesia (time to reach VAS 4 or more) was 22.07±4.16 minutes while in Group LD (30 ml of Lignocaine 0.5% with Dexmedetomidine 01 mcg/kg) postoperative analgesia (time to reach VAS 4 or more) was 79.22±4.84 minutes, and this difference was statistically highly significant (p-0.0001).

Our results were similar to **Kumar A et al** [5] where postoperatively Ramsay sedation score was observed more in Group LD > Group LK > Group L and mean Ramsay sedation score was 2.67 ± 0.48, 2.29 ± 0.62 and 1.75 ± 0.44 respectively, and this difference was statisticaly significant (p<0.0001).

Our results were similar to **Rayan A.A., and El Sayed A.A** [14] where postoperatively Ramsay sedation score was observed more in Group LD2 > Group LD1 > Group L and mean Ramsay sedation score was 3 (2–3), 2 (1–3) and 1 (1–2) respectively, and this difference was statisticaly not significant (p-0.134). The difference in sedation score was observed higher as we increase the doses of dexmedetomidine.

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