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Original Research Article

Comparison of 0.5% lignocaine versus 0.2% ropivacaine in intravenous regional anesthesia (Bier's block) in upper limb surgeries

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ABSTRACT

Background: Ropivacaine is a new local anesthetic. it is long acting and it will not affect heart. Its use for epidural anesthesia and blocks for the peripheral nerves is well established. But, data is limited on use and effects of ropivacaine in IVRA.
Objective: To study if Ropivacaine is a better alternative to Lignocaine in Intravenous Regional Anesthesia with respect to efficacy and post-operative analgesia.
Materials and Methods: This was a prospective, double-blind, randomized comparative study carried out among 60 patients of ASA grade 1 or 2 of either sex and age 18-60 years admitted for elective upper limb surgeries. Randomization was done based on computer generated random numbers. Group 1- 30 patients received 0.5% Lignocaine - 40ml and Group 2- 30 patients received 0.2% Ropivacaine – 40ml.
Results: Mean age, mean duration for surgery, weight and Proximal Tourniquet Tolerance time (min) were similar in two groups ($p>0.05$). Motor regression time (min), Onset of action (min), Sensory regression time (min), Rescue analgesia (min) was significantly more in group-2 patients compared to group-1 patients ($p<0.05$). whereas, VNRS and modified Bromage scale reading was significantly more in group-1 patients compared to group-2 patients ($p<0.05$).
Conclusion: Ropivacaine is better than lignocaine. The analgesia i.e. during surgery and after surgery, motor blockade were better with ropivacaine than lignocaine and at the same time there were no complications. Hence, IVRA with ropivacaine should be used.

1. Introduction

Advantages of use of Intra Venous Regional Anesthesia (IVRA) are technical simplicity, early onset and early recovery, reliability, cost effective. Disadvantages are limited time of surgical anesthesia, poor post-operative analgesia, potential for Local Anesthetic systemic toxicity, nerve damage secondary to direct compression by tourniquet, compartment syndrome and loss of limb- rarely. [1–3]

Lignocaine 0.5% is commonly used local anesthetic. it is short acting. Hence, analgesia during the surgery is affected. Plain Lignocaine has a short duration and thus no post-operative analgesia. Additives like Ketamine can provide good post-operative analgesia. [4]

Given this scenario, use of bupivacaine can be useful as it is long acting. but, it may lead to cardiac arrest which is irreversible and hence it is avoided. [5]

2-Chloroprocaine is an ester type local anesthetic that is normally hydrolyzed rapidly in the blood. This anesthetic is the least toxic and, therefore, could be considered an optimal choice for IVRA. However, results of earlier studies suggested an increased incidence of thrombophlebitis with this agent. [6] Therefore, a new, preservative-free preparation of 0.5% 2-Chloroprocaine has been tried but was still

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associated with post-inflation irritation of the exposed veins.[7,8] 2-Chloroprocaine is usually used as a 0.5 – 0.75 % solution. The usual dose for IVRA of the arm for adults is 40 ml, while for IVRA of the foot is 40 to 75 ml. Prilocaine is an amino amide local anesthetic that is less cardio toxic and central nervous system (CNS) toxic.[9,10] than the two other amides with comparable potency, i.e., Lignocaine and Mepivacaine. Furthermore, Prilocaine is the most rapidly metabolized drug among the amides. Thus, Prilocaine seems to be the safest of the amide local anesthetics for IVRA. The safety of Prilocaine for IVRA has been confirmed more recently by results of a large study from Great Britain that had more than 45,000 patients. In this study, Prilocaine was associated with an extremely low complication rate of 0.011% related to minor side effects.[11] For IVRA, Prilocaine is usually used as a 0.5% solution, but higher concentrations have also been used (e.g., 0.75% to 2%). Higher concentrations appear to shorten onset time, but, aside from that, block characteristics are comparable to a 0.5% solution. If the dose is more, there is risk of toxicity to the central nervous system.[12]

Ropivacaine is a new local anesthetic. It is long acting and it will not affect heart.[13] Its use for epidural anesthesia and blocks for the peripheral nerves is well established. But, data is limited on use and effects of ropivacaine in IVRA.

Hence, present study was carried out to find out if Ropivacaine is a better alternative to Lignocaine in Intravenous Regional Anesthesia with respect to efficacy and post-operative analgesia?

2. Material and Methods

Present study was carried out at Department of Anesthesiology, Sunshine hospitals, Secunderabad, Telangana, India among 60 patients of ASA grade 1 or 2 of either sex and age 18-60 years admitted for elective upper limb surgeries. This was a prospective, double-blind, randomized comparative study carried out from November 2016 to October 2017.

Based on previous studies, 60 patients were required considering 95% confidence level and 80% power. They were randomly allocated into two groups of 30 each. Randomization was done based on computer generated random numbers. Group 1- 30 patients received 0.5% Lignocaine - 40ml and Group 2- 30 patients received 0.2% Ropivacaine – 40ml.

Patients posted for upper limb (below elbow) surgeries, undergoing surgeries less than 90-minute duration, age of 18-60 years of either sex, patients with Normal baseline ECG rhythm and patients of ASA grade I or II were included. Patients with history of hypersensitivity to any local anesthetic agent, history of cardiovascular diseases like Arrhythmias, Ischemic heart disease, liver, Respiratory, Kidney, Endocrine diseases, and pregnant patients were excluded.

Approval from institutional ethical committee was obtained, and written informed consent was taken. A detailed history was taken and complete clinical examination was done to exclude patients with history of CNS/CVS abnormalities. Routine investigations like: Blood grouping, CBP, Blood urea, serum creatinine, Random Blood sugar, were done. ECG was done to rule out the presence of any cardiac disease. Pre-operative Vitals like respiratory rate, blood pressure and conditions of heart and lungs were noted. Patients' weights were also recorded. Patients were clearly explained about the procedure of intravenous regional anesthesia in their own language. All required monitors were kept in place as per standard protocol. All the equipment necessary to secure the airway of the patient in case of unforeseen complications was kept ready. Bain's circuit was checked for any leaks and kept ready to ventilate the patient if necessary.

Standard protocol was followed for giving the anesthesia. Surgery was initiated after the block was achieved. distal cuff was inflated and proximal tourniquet was released when pain was experienced on proximal tourniquet pressure. The visual numeric rating scale (VNRS) was used immediately after tourniquet deflation.[14,15] The distal tourniquet was released on a VNRS 10 score.

Pin prick test was used to assess the onset of action. 24G needle was used to assess the sensory block. Cube of ice was kept in sterile test tube and was used to assess the cold sensation. Patients were asked to flex and extend wrist and fingers to assess the motor block. Upon cessation of the voluntary movement, it was taken as complete motor block. Bromage scale[16] was used to assess the intensity of the motor blockade. Verbal Numeric Rating Scale (VNRS) was used to assess the intensity of analgesia. Hemodynamic stability was also assessed.

The data was analyzed using EpiInfo statistical software. Means between two groups were tested by student's t test and p value <0.05 was taken as statistically significant.

3. Results

Majority of patients underwent surgery for implant removal followed by surgery for Fracture both bones forearm (Table 1)

Majority of the patients belonged to the age of 20-29 years. Mean age was 30.3 years (Table 2)

Males were almost more than three times that of females (Table 3)

Mean age, mean duration for surgery, weight and Proximal Tourniquet Tolerance time (min) were similar in two groups ($p>0.05$). Motor regression time (min), Onset of action (min), Sensory regression time (min), Rescue analgesia (min) was significantly more in group-2 patients compared to group-1 patients ($p<0.05$). whereas, VNRS and modified Bromage scale reading was significantly more in group-1 patients compared to group-2 patients ($p<0.05$).

Table 1: Distribution of patients posted for various surgeries

Surgery	No. of Patients
Fracture both bones forearm	15
Carpal tunnel release	10
Fracture shaft of radius	10
Implant removal	35

Table 2: Age distribution ofpatients

Age (Years)	Frequency Group 1	Percent	Frequency Group 2	Percent
10-19	6	20.00%	6	20.00%
20-29	8	26.67%	8	26.67%
30-39	12	40.00%	6	20.00%
40-49	3	10.00%	6	20.00%
50-59	1	3.33%	3	10.00%
60-69	0	0%	1	3.33%
Total	30	100.00%	30	100.00%
Mean ± SD	30.2667 ± 8.9402		33.0333 ± 11.8946	

Table 3: Distribution of patients according to gender

Sex	Frequency- group 1	Percent	Frequency-group 2	Percent
Female	3	10.00%	7	23.33%
Male	27	90.00%	23	76.67%
Total	30	100.00%	30	100.00%

Table 4: Distribution of patients according to gender

Variable	Group 1	Group 2	P value
Age (years)	30.2667 ± 8.9402	33.0333 ± 11.8946	0.3127
Duration of surgery (min)	49.7 ± 7.8175	49.4 ± 7.1996	0.8777
Weight (kg)	65.1333 ± 10.1191	64.6 ± 9.2349	0.8320
Motor regression time (min)	2.1333 ± 1.1059	5.6333 ± 1.0981	**< 0.0001**
Onset of action (min)	2.3333 ±0.5467	7.2667 ± 1.0483	**< 0.0001**
Sensory regression time (min)	4.2667 ± 0.8683	6.5 ± 0.8610	**< 0.0001**
Rescue analgesia (min)	24.333 ± 5.9789	49 ± 5.6324	**< 0.0001**
Proximal Tourniquet Tolerance time (min)	21.5 ± 2.307	21.2667 ± 2.0998	0.6830
VNRS	3.4±0.7701	1.1333±0.6814	**< 0.0001**
Modified Bromage Scale	0.9±0.4807	0.1667±0.390	**< 0.0001**

(Table 4)

4. Discussion

Palve H et al[17] used up to 900 mg of Lignocaine with adrenaline without any toxic symptoms. Ropivacaine can be given in a maximum dose of 3mg/kg. Hartmannsgruber et al[13] used ropivacaine in the dose of 2 mg/ml. they used it in healthy volunteers. They found that there were no symptoms of toxicity associated with it. We also found similar results. Total dose used for each patient in the present study was 80 mg.

The onset of action of analgesia after injection of the drug for IVRA was assessed by loss of sensation to pinprick. With Lignocaine, it was found to be 2.33±0.54 minutes. This observation is comparable to that of Hartmannsgruber,[17] Khanna J et al,[18] Niemi TT et al.[19]

The rapid onset of sensory block with Lignocaine may be attributed to its pKa value (7.86) which is close to the physiological pH. Due to this property the ionized fraction of lignocaine increases, leading to a quicker penetration into nerves and rapid onset as compared to ropivacaine.

In this study, the mean proximal tourniquet tolerance time for 0.5% Lignocaine in IVRA was 21.5+2.307 minutes and for Ropivacaine was 21.2667+2.0998 minutes. Patients of either group were comfortable to the distal tourniquet till the end of the surgery. The mean duration of surgeries of this study was around 49 min. Asik et al[20] found a proximal tourniquet tolerance time of 20.2+4.1 min in group-1,

21.6+5.2 min in group-2 and 19.3+4.3 in group-3 which was not statistically significant. Distal tourniquet tolerance time was found to be 9.1+2.6 min in group-1, 15.3+2.3 in group-2 and 9.0+2.1 min in group-3. 0.2% ropivacaine group and 0.5% lignocaine group had no statistically significant difference in tourniquet tolerance times. 0.25% ropivacaine group had longer distal tourniquet tolerance times.

The degree of pain was assessed by measuring on the VNRS. In the Lignocaine group, 16% patients were at scale <=2, but 84% patients were at scale>=3. However, 100% patients of Ropivacaine group were at scale <=2. These findings were comparable to Bier[2] (1908), who had 100% excellent results in IVRA. Khanna J et al[18] divided the patients into 3 groups. Group-1 received 0.5 % lignocaine. In this group analgesia was excellent in only 37%, good in 43% and moderate in 20%. 6 patients required supplemental analgesics. Group-2 received 0.2% ropivacaine. In this group analgesia was excellent in 73%, good in 24% and moderate in 6%. So only one patient required supplemental analgesia. Group-3 patients received 0.25% ropivacaine. In this group analgesia was excellent in 83% patients and none required supplemental analgesia.

6% of patients in the present study in lignocaine group achieved grade zero motor blockade. Majority i.e. 76% achieved grade one motor blockade. When compared to ropivacaine group, it was seen that majority i.e. 86% of the patients could achieve the grade zero motor blockade. Peng PW et al[21] compared 0.375% ropivacaine with 0.5% lignocaine, concluded that Ropivacaine provided better surgical anesthesia as compared to lignocaine.

In this study the mean duration of sensory block after deflation of tourniquet was 4.2667±0.8683 min in lignocaine group and 6.5±0.867 min in ropivacaine group ($p< 0.05$). it is significantly prolonged in Ropivacaine group. The mean duration of motor block post tourniquet release was 2.1333±1.1059 min in Lignocaine group and 5.6333+1.0981 min in Ropivacaine group. These results are similar to those of Chan et al.[22] They found that the Sensory regression in the high dose ropivacaine group (1.8 mg/kg) was significantly longer than the low dose ropivacaine (1.2 mg/kg) or lignocaine group (3mg/kg). In motor recovery, they had similar findings.

In our study, in group-1 (Lignocaine) the time for rescue analgesia ranged from 24.333±5.9789 minutes whereas it ranged from 49±5.6324 minutes in group-2 (Ropivacaine group). The time to requirement of rescue analgesia was more with Ropivacaine than that of Lignocaine. P<0.001. The results were comparable to that of findings of Singh P et al.[23]

The need for rescue analgesia was more in lidocaine group patients compared to patients from ropivacaine group. The intensity of pain was also lower in the ropivacaine group patients compared to the patients from the lidocaine group.

Hemodynamic changes and side effects were comparable in two groups.

5. Conclusion

We conclude that ropivacaine is better than lignocaine. The analgesia i.e. during surgery and after surgery, motor blockade were better with ropivacaine than lignocaine and at the same time there were no complications. Hence, IVRA with ropivacaine should be used.

6. Source of Funding

None.

7. Conflict of Interest

None.

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