ORIGINAL ARTICLE

A Comparative Evaluation of Ropivacaine in Two Different Concentrations 0.2% & 0.25% with Lignocaine 0.5% in Intravenous Regional Anaesthesia

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Abstract

The present study was undertaken to compare the efficacy of Lignocaine 0.5% with Ropivacaine 0.2 & 0.25% in IVRA. 90 patients of ASA grade I & II, between 20 to 50 years of either sex undergoing forearm surgery lasting less than 1 hour were taken and divided into 3 groups of 30 patients in each group. Double pneumatic tourniquet was placed on affected arm and arm was elevated for 2 minutes and exanguinated with esmarch bandage. Proximal cuff was inflated 100mlHg above the systolic pressure and the drug was given. After 10 minutes, distal cuff was inflated and proximal cuff was deflated. There was a highly significant difference between onset of sensory and motor block in Group I & II, Group I & Group III. Sensory and motor recovery time had highly significant difference between Group I & II, Group I & III. There was a highly significant difference regarding duration of analgesia among the three groups with Group I with least duration and Group III with maximum duration of analgesia. In our study Ropivacaine with two different concentrations 0.2% and 0.25% provided good quality of intra-operative analgesia, delayed motor and sensory blockade and prolonged duration of analgesia as compared to lignocaine 0.5%.

Key Words

IVRA , Lignocaine, Ropivacaine

Introduction

IVRA was first described by Karl August Gustav Bier but the technique fell into disuse due to complications but was re-popularised after some years. It is a technique of producing surgical anaesthesia by Intravenous injection of local anaesthesia into limb whose circulation has been interrupted by tourniquet (1). It has multiple advantages like rapid onset, muscular relaxation and rapid recovery. It remains a popular technique for operations lasting for less than 90 minutes for both upper and lower limb (2). It has a success rate of 94-98% (3). It can cause complications due to technical failures (4). The disadvantage can be tourniquet discomfort, rapidity of recovery, systemic toxicity like hypotension, bradycardia, seizures due to accidental deflation of tourniquet (5). Lignocaine remains the standard local anaesthetic agent. Bupivacaine, long acting local anaesthetic is not used as it can lead to systemic toxicity after deflation of tourniquet. This has led to the development of less toxic agonists such as Ropivacaine and Laevo-bupivacaine (6). Ropivacaine has lower central nervous system and cardio vascular toxicity as it is a pure s- enantiomer (7). Potency of Ropivacaine is three times than that of Lignocane (8). Ropivacaine yielded satisfactory surgical conditions and long lasting analgesia in post-operative period (9). This long lasting analgesia can give the surgeon extra 15-30 minutes (10).

Thus, the current study was undertaken to evaluate the efficacy of Ropivacaine in two different concentrations 0.2% and 0.25% with lignocaine 0.5% in IVRA and to look for any complications.

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Material and Methods

After obtaining approval from hospital ethical committee the study was conducted in department of Anaesthesiology in Govt. Medical college Jammu on ASA grade I & II patients, age 20-50 years, of either sex scheduled for hand or forearm surgery lasting less that one hour. Pre-anaesthetic check-up was done a day before the surgery which included a detailed history, complete physical and systemic examination and relevant investigations.

Following patients were excluded from study:

1.History of seizure or allergy to LA.

2.Patients with liver disease, renal disease, cardiac conduction abnormality.

3.Uncontrolled hypertension, sickle cell disease, diabetic neuropathy.

4.Neurological or vascular abnormalities in operative limb.

Informed consent was taken from each patient and patients were kept fasting overnight before surgery. Patients were given tablet Alprazolam 0.25mg bedtime. Patients were pre-medicated with 0.2 mg glycopyrrolate 45 minutes before surgery. Intra-dermal tests for Lignocaine and Ropivacaine were done to check the sensitivity. Patients were divided randomly in three groups of 30 patients each.

Group I: Patients in this group received 40 ml of preservative free Lignocaine 0.5%.

Group II: Patients in this group received 40 ml of preservative free Ropivacaine 0.2%.

Group III: Patients in this group received 40 ml of preservative free Ropivacaine 0.25%.

In the operation theatre - NIBP, ECG, Pulse oximeter monitors were attached to the patients. Two Intravenous cannulae, were placed one on dorsum of hand to be operated and another in opposite hand for Intravenous line. Ringer lactate was started. Patients received Midazolam 0.03mg/Kg I/V and tramadol 1mg/Kg I/V. Double pneumatic tourniquet was placed around upper arm of operative limb. The arm was elevated for 2 minutes and then exanguinated with esmarch bandage. Proximal cuff was inflated to a pressure of 100mgHg above systolic blood pressure and esmarch bandage was removed. Circulatory isolation of arm was verified by pallor of limb, absence of radial pulse and loss of pulse oximeter tracings. Anaesthetic solution was injected in operating arm over a period of 90 seconds. Mean arterial pressure, heart rate, oxygen saturation were monitored before and after tourniquet application and after every 10 minutes till end of surgery. Distal tourniquet was inflated after 10 minutes and soon after proximal was deflated.

Following parameters were noted:

1. *Onset of sensory block* - It is from the time of drug injection to sensory block achieved in all dermatomes. The scale used was 0-2 and the block was assessed by response to pin prick.

0 - Sharp sensation.

1 - Touch only.

2 - Cannot feel touch.

Score 2 was taken as onset of complete sensory block.

2. *Onset of motor block* - It was assessed with score 0-3.

0 - Able to move arm against resistance.

1 - Inability to move wrist against resistance.

2 - Inability to move wrist and elbow against resistance.

3 - Inability to move arm.

Score 3 was taken as onset of complete motor block.

3.*Quality of intra-operative anaesthesia* - It was assessed according to (11).

4 - Excellent - No complaint from patient

3 - Good -- minor complaints with no need of supplemental analgesics.

2 - Moderate - Complaints that required supplemental analgesics.

1 - Unsuccessful - Patient was given General Anaesthesia.

4. *Sensory Block recovery time* - It was noted as time elapsed from release of tourniquet to perception of pain in all dermatomes.

5. *Motor Block recovery time* - It was noted as time elapsed from release of tourniquet to move arm against resistance.

6. *Duration of analgesia* -- It was noted as time elapsed from release of tourniquet to first demand of analgesic.

7.Complications like nausea, vomiting, allergic reaction, headache, dizziness, tinnitus, loss of consciousness, hypoxemia, convulsions, arrhythmias were noted.

Table-1. Showing Demographic Data Regarding Age and Weight

Characteristics	Group I	Group II	Group III
Age (years)	39 ± 8.92	37.7 ± 8.72	37.97 ± 9.5
Weight (kg)	64.33 ± 6.74	64.06 ± 8.51	66.64 ± 5.67
	p-value	0.842	0.294

Table-2. Showing Onset of Sensory Block (Minutes)

	Mean	Range	P-Value	Remarks
Group I	5.06 ± 0.9	4-7		
Group II	7.80 ± 1.03	6-10	0.0001	HS
Group I	5.06 ± 0.9	4-7		
Group III	8.00 ± 0.74	7-9	0.0001	HS
Group II	7.80 ± 1.03	6-10		
Group III	8.00 ± 0.74	7-9	1.000	NS

Table-3. Showing Onset of Motor Block (Minutes)

	Mean	Range	P-Value	Remarks
Group I	8.63 ± 1.18	7-11		
Group II	10.90 ± 1.06	9-13	0.0001	HS
Group I	8.63 ± 1.18	7-11		
Group III	10.86 ± 0.86	10-13	0.0001	HS
Group II	10.90 ± 1.06	9-13		
Group III	10.86 ± 0.86	10-13	1.000	NS

Table-4. Showing Quality of Intra-Operative Analgesia

	Excellent	Good	Moderate
Group I	11 (37%)	13 (43%)	6 (20%)
Group II	22 (73%)	7 (24%)	1 (3%)
Group III	25 (83%)	5 (17%)	0

Table-5. Showing Sensory Block Recovery Time (Minutes)

	Mean	Range	P-Value	Remarks
Group I	3.83 ± 1.62	2 - 7		
Group II	39.33 ± 6.22	30 - 52	0.0001	HS
Group I	3.83 ± 1.62	2 - 7		
Group III	42.20 ± 3.71	35 - 50	0.0001	HS
Group II	39.33 ± 6.22	30 - 52		
Group III	42.20 ± 3.71	35 - 50	0.034	S

Data was analysed using MS excel and statistical significance was analysed using ANOVA.

Results

The demographic data regarding age and weight was comparable in all the three groups and the difference among the groups was statistically insignificant. (*Table-1*)

Onset of sensory block (minutes): The difference between Group I and II, Group I and III was statistically highly significant whereas the difference between Group

Table-6. Showing Motor Block Recovery time (Minutes

	Mean	Range	P-Value	Remarks
Group I	5.30 ± 1.82	3 - 9		
Group II	21.33 ± 4.35	15 - 30	0.0001	HS
Group I	5.30 ± 1.82	3 – 9		
Group III	22.96 ± 2.76	18 - 28	0.0001	HS
Group II	21.33 ± 4.35	15 - 30		
Group III	22.96 ± 2.76	18 - 28	0.145	NS

Table-7. Showing Duration of Post-operative analgesia (Minutes)

	Mean	Range	P-Value	Remarks
Group I	22.73 ± 4.26	17-30		
Group II	108.0 ± 21.2	80 - 160	0.0001	HS
Group I	22.73 ± 4.26	17-30		
Group III	161.5 ± 13.5	130 - 185	0.0001	HS
Group II	108.0 ± 21.2	80 - 160		
Group III	161.5 ± 13.5	130 - 185	0.001	HS

II and III was statistically insignificant.(*Table-2*)

Onset of motor block (minutes): The difference between Group I and II, Group I and III was statistically highly significant whereas the difference between Group II and III was statistically insignificant.(*Table-3*)

Quality of Intra-operative Analgesia: Quality of Intraoperative analgesia was seen best in Group III followed by Group II and then Group I.(*Table-4*)

Sensory Block Recovery Time (Minutes): The difference between Group I and II, Group I and III was statistically highly significant whereas the difference between Group II and III was statistically significant.(*Table-5*)

Motor Block Recovery time (Minutes): The difference between Group I and II, Group I and III was statistically highly significant whereas the difference between Group II and III was statistically insignificant.(*Table-6*)

Duration of Post-operative analgesia (Minutes): The difference between all the groups was statistically highly significant. (*Table-7*)

Complications: Two of the patients in Group I had headache. No other complication was seen in any other patient.

Discussion

The mean age of patients in Group I (39 ± 8.92), Group II (37.7 ± 8.72) and Group III (37.97 ± 9.5) was comparable and not significant statistically. The mean weight of patients in Group I (64.33 ± 6.74), Group II (64.06 ± 8.51) and Group III (66.64 ± 5.67) was comparable and not significant statistically. Onset of sensory block was quicker in Group I (5.06 ± 0.9) than in Group II (7.80 ± 1.03) and Group III (8.00 ± 0.74). The difference between Group I and II and Group I and III was highly significant whereas difference between Group II and III was statistically insignificant. Quicker onset of Group I may be due to its pka value (7.9) which is close to physiological pH, so unionised fraction of Lignocaine penetrates nerve fibres quickly. This is contrary to study by Peng *et al* (12) who found that the difference between Lignocaine and Ropivacaine was not significant statistically.

Onset of motor block in Group I (8.63 ± 1.18), Group II (10.90 ± 1.06) and Group III (10.86 ± 0.86), the difference between Group I and II and Group I and III was highly significant whereas difference between Group II and III was statistically insignificant. This is in contrast to study by Bigat *et al* (13) where the difference between Lignocaine and Ropivacaine was not significant statistically.

Quality of intra-operative analgesia was best in Group III- Excellent in 83%, Good in 17% and none of the patients required supplemental analgesics. In Group II it was Excellent in 73%, Good in 24% and Moderate in 3% so only one patient required supplemental analgesics whereas in Group I analgesia was Excellent in 37%, Good in 43% and Moderate in 20%, 6 patients required supplemental analgesics.

Sensory Block recovery time in Group I (3.83 ± 1.62), Group II (39.33 ± 6.22) and in Group III (42.20 ± 3.71) the difference between Group I and II and Group I and III was highly significant whereas difference between Group II and III was statistically significant. Longer duration of sensory block with Ropivacaine is attributed to more persistent protein binding (94%) hence slower release into systemic circulation and long elimination half-life 108 minutes as compared to Lignocaine with protein binding (64-70%) and elimination half-life 96 minutes. Attanasoff et al (2001) also found that recovery time of sensory block was earlier in Lignocaine 0.5% Group as compared to Ropivacaine 0.2% & 0.25% and the difference between the two groups was highly significant.

Motor Block recovery time in Group I was (5.30 ± 1.82), Group II (21.33 ± 4.35) and in Group III (22.96 ± 2.76), the difference between Group I and II and Group I and III was highly significant whereas difference between Group II and III was statistically insignificant. Our study was in concordance with Hartmannsgruber *et al* (7) who stated that post deflation motor blockade was prolonged with Ropivacaine group as compared to Lignocaine. Chan *et al* (14) found that recovery of motor block was slowest in high dose Ropivacaine group.

Duration of Post-operative Analgesia in Group I was (22.73 ± 4.26), in Group II was (108.0 ± 21.2) and in Group III was (161.5 ± 13.5), the inter group difference among all the groups was highly significant statistically. Our results correlated with Asik *et al* (15) who found that residual analgesia time and time until first intake of analgesics was prolonged in Ropivacaine group as compared to Lignocaine. Only two patients in Lignocaine group had headache as no other complication was observed in any patient.

Conclusion

Our study concluded that better quality of intra-operative analgesia, prolonged analgesia after tourniquet deflation, delayed requirement of analgesics and negligible side effects make Ropivacaine a potential alternative to Lignocaine. Among the Ropivacaine group's 0.2% and 0.25%, latter was found to be better regarding quality of intra-operative analgesia, prolonged analgesia after tourniquet deflation, delayed requirement of analgesics and negligible side effects.

References

1. Catterall W, Mackie K. Local Anaesthetics - The pharmacological basis of Therapeutics -10th edition - 2001; .pp.367 - 84
2. Simon AM, Gielen MJM, Alberink N, Vree TB, Egmond JV. Intravenous regional anaesthesia with 0.5% Articaine, 0.5% Lignocaine and 0.5% Prilocaine. *Regional Anaesthesia* 1997; 22(1): 29-34
3. Brown EM, McGriff JT, Maliniwski RW. Intravenous regional anaesthesia. *Can J Anaesth* 1989; 36:307-10
4. Rosenberg PH, Kalso EA, Tuominen MK, Linden HB. Acute Bupivacaine toxicity as a result of venous leakage under tourniquet cuff under IVRA. *Anesthesiology* 1983; 58:95-98
5. Greengrass RA, Stelle SM, Moretti G. Peripheral nerve blocks. Textbook of regional anaesthesia 1st edition 2002.pp. 354-56
6. Reutsch YA, Boni T and Borgeat A. The history of local anaesthetic drugs. *Current Topics Medicinal Chemistry* 2001;12:175-82
7. Hartmannsgruber MW, Silverman DG, Halaszynski TM. Comparision of Ropivacaine 0.2% and Lignocaine 0.5% in IVRA. *Anaesth Anal* 1999;89:727-31
8. Reiz S, Haggmark S, Johansson G, Nath S.Cardiotoxicity of Ropivacaine. *Acta Anaesthesiologica Scandinavica* 1989;33:93-98
9. Atanasoff PG, Ocampo CA, Bande MC, Hartmannsgruber MW, Halazynski TM: Ropivacaine 0.2% and Lignocaine 0.5% for IVRA in outpatient surgery. *Anaesthesiology* 2001;95:627-31
10. Niemi TT, Neuvonen PJ, Rosenberg PH. Comparison of Ropivacaine 2 mg/ml and prilocaine 5 mg/ml in IVRA in outpatient surgery. *BJA* 2006;96(5):640-44
11. Palecha S, Gupta HK, Third SS, Sharma S.The use of 0.5% and 0.25% lignocaine with pentazocine and pancuronium for IVRA. *IJA* 2001;45(2):133-35
12. Peng PHW, Coleman MM, McCartney, *et al.* Comparison of anaesthetic effect between 0.375% Ropivacaine verses 0.5% Lignocaine in IVRA. *Regional Anaesth Pain Med* 2002;27(6):595-99
13. Bigat Z, Karsli B, Boztug N, Cete N, Ertok E. Comparison of effect of low dose Ropivacaine and Lignocaine in IVRA: *Clin Drug Invest* 2005;25(3):209-14
14. Chan VWS, Weisbrod MJ, Kaszas Z, Dragomir C. Comparison of Ropivacaine and Lignocaine for IVRA in volunteers. *Anaesthesiology* 1999;90: 1602-08
15. Asik I, Kocum AI, Goktug A, Turhan KS, Alkis N. Comparison of Ropivacaine 0.2% & 0.25% with Lignocaine 0.5% in IVRA. *J Clin Anaesthesia* 2009; 21:402-07