A Comparative Study of the Anesthetic Efficacy, Post Tourniquet Release Analgesia and Side Effects of Ropivacaine 0.2% & Lignocaine 0.5% in Intravenous Regional Anesthesia for Hand Surgeries

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Abstract
Intravenous regional anaesthesia technique in which analgesia and muscle relaxation are produced by the injection of an adequate volume of local anaesthetic solution into vein of an extremity with inflow and outflow of the blood prevented by a tourniquet. Ropivacaine 0.2% in intravenous regional anaesthesia improved the anaesthetic efficacy, lengthened post tourniquet analgesia, reduced the amount of post operative rescue analgesia and had less side effects as compared to lignocaine 0.5% which has been proved statistically significant using quantitative and qualitative analysis.

Introduction
The history of intravenous regional anaesthesia had begun with August Bier, who described the technique in 1908. But in 1970 after lapse of 62 years, the technique was modified and popularised by Holmes as Bier block. Lignocaine has been the drug most frequently used for intravenous regional anaesthesia. Lignocaine is considered a less toxic local anaesthetic. It is used intravenously for treating ventricular arrhythmias in the dose of 1-2 mg/kg safely and also used for attenuating stress response to endotracheal intubation. However in intravenous regional anaesthesia, reactions like convulsions, coma, cardiorespiratory depression and cardiac arrest have been reported following injection of the local anaesthetic, because of either tourniquet failure or after the release of the tourniquet. A longer acting agent, such as bupivacaine, initially gained substantial popularity for use of intravenous regional anaesthesia but was laden with potentially serious side effects. Several deaths have been reported from the use of bupivacaine in intravenous regional anaesthesia when high dose of bupivacaine administered.

Bupivacaine has been identified as a fast-in, slow –out type of local anaesthetic that maintains a high affinity and binds tightly to myocardial sodium receptors. Therefore, if high plasma concentrations of bupivacaine are achieved, cardiac arrest may occur, which frequently has proved to be irreversible. Due to the increased potential for central nervous system toxicity for lignocaine and the ration of dosages needed for CVS: CNS toxicity for bupivacaine is low, there is a need for a better drug which could replace these two.
The amide local anaesthetic ropivacaine is a pure

enantiomer and is structurally related to

bupivacaine. The duration of effect of ropivacaine is

similar to that of bupivacaine, and ropivacaine has

been shown to result in less depression of the

cardiac conduction system when compared with

bupivacaine. Intravenous ropivacaine, compared

with bupivacaine and lignocaine in several

volunteer studies, has less cardiac and central

nervous system (CNS) side effects but has achieved

surgical anaesthetic conditions. Therefore, ropivacaine may serve as a local

anaesthetic for intravenous regional anaesthesia that

could provide prolonged and improved analgesia

over lignocaine and has a lower toxicity profile

when compared with bupivacaine. Ropivacine 0.2%

and lignocaine 0.5% were used in intravenous

regional anaesthesia for hand surgeries, and the

anaesthetic efficacy, post-tourniquet release

analgesia and side effects were evaluated.

Aim of the Study
The aim of the study is to compare

1. The anaesthetic efficacy,
2. Post tourniquet release analgesia,
3. Side effects of ropivacaine 0.2% and
   lignocaine 0.5%, when used in intravenous
   regional anaesthesia for hand surgeries.

Materials and Methods
This study was conducted in 40 patients undergoing

hand surgeries in plastic surgery department. After

getting institutional ethical committee approval and

after explaining the procedure in detail, informed

consent obtained from every patient. The patients

were assigned into two groups each containing 20

patients.

Group 1: the patients in this group received 40 ml of

0.5% lignocaine

Group 2: patients in this group received 40 ml of 0.2%

ropivacaine

Selection of patients:
The patients selected for this study were of ASA I

and II, undergoing elective and emergency hand

surgeries.

Exclusion Criteria
Patients with history of any cardiovascular,

respiratory or central nervous system disorders were

excluded from the study. Patients with haematological disorders like sickle cell anaemia

and thalassemia, patients with known

hypersensitivity to lignocaine and ropivacaine and

patients with difficult airway were excluded from

the study.

Pre anaesthetic assessment
Physical status of all patients were preoperatively

assessed. A thorough airway assessment was done.
The following investigations were done on the

patients.

1) Hemoglobin
2) Urine analysis
3) Blood sugar
4) Blood urea and serum creatinine
5) Chest x-ray
6) Electrocardiogram

Procedure
The patients were shifted into the operation theatre. The

pulsoximeter, non invasive blood pressure monitor and electrocardiographic monitor were

connected to the patients. The vital parameters were

recorded

A separate intravenous line was started in the non-
operated limb. A vein in the dorsum of the hand of the

operated limb was cannulated with 22g intravenous

cannula. if the dorsum of the hand involved in the

surgery, a vein higher up in the forearm was chosen.

it was firmly fixed, flushed with normal saline and

stopper applied.

Exsanguination was accomplished by elevation of

the limb for 5 minutes followed by esmarchbandage

from fingertip to arm. in subjects where application

of esmarch bandage was not feasible, emptying of

veins was facilitated with compression of axillary

artery with the limb elevated. 3. At the proximal end

of esmarchbandage, the first tourniquet was applied

around the upper part of the arm over cotton wool

padding. then the tourniquet was inflated to 250

mmhg. circulatory isolation of the arm was verified

by inspection, absence of radial pulse and loss of

pulse oximeter traceing of the ipsilateral index
finger. Then 40 ml of local anaesthesia solution was injected through the cannula at a rate of 1ml/second. After ensuring complete analgesia below the first tourniquet, the second tourniquet was applied distal to the first tourniquet and inflated to 250 mm hg. The first tourniquet was then removed. The patients were observed for any toxic manifestations of local anaesthetics after release of the first tourniquet. The following parameter were recorded.

**Time of onset of sensory block:**
It is the time elapsed from injection of study drug to sensory block achieved in all dermatomes of the operated limb. this was checked by pinprick every minute till the onset of sensory block.

**Time of onset of motor block:**
It is the time elapsed from injection of study drug to inability of voluntary movements in the operated limb. this was checked by asking the patient to flex the elbow and hand every minute till the onset.

**Time of sensory block recovery** (residual analgesia)
It is the time elapsed from tourniquet deflation to recovery of pain in all dermatomes of the operated limb.

**Time of motor block recovery**
It is the time elapsed from tourniquet deflation to ability of voluntary movements in the operated limb.

**Assessment of tourniquet pain**
Assessment of tourniquet pain made on the basis of visual analaogue scale (VAS), where 0=no pain and 10=worst imaginable pain. tourniquet pain was measured after tourniquet application and 5.10.20.40 minutes after injection of the study drug.

**Duration of postoperative pain relief:**
The time elapsed from tourniquet release to the first dose of rescue analgesic inj.diclofenac sodium. Total dose of analgesic inj.diclofenac in mg for the first 24 hours postoperatively.

At the end of surgery, tourniquet deflation was performed using cyclic deflation method, that is the tourniquet was deflated 3 times for 10 seconds separated by 1 minute intervals of reinflation. the patients were carefully observed for possible side effects during and after the release of tourniquet 21.the tourniquet was not deflated before 30 minutes and was not inflated for more than 90 minutes. The total duration of tourniquet and surgery was noted .the patients were followed up for 24 hours postoperatively.

**Observation and results**

**Age distribution**

| Age distribution in yrs | Group I | Group II |
|-------------------------|---------|----------|
| <20                     | 0       | 1        |
| 20-30                   | 2       | 4        |
| 30-40                   | 3       | 9        |
| 40-50                   | 9       | 5        |
| >50                     | 6       | 1        |
| TOTAL                   | 20      | 20       |

**Time of onset of Sensory Block**

| Time of Onset of Sensory Block In Minutes | GROUP I | GROUP II |
|------------------------------------------|---------|----------|
| <3                                       | 2       | 0        |
| 3-5                                      | 16      | 2        |
| 5-7                                      | 2       | 13       |
| >7                                       | 0       | 5        |

Mean time and standard deviation of sensory block onset in group 1 is 4.40+-1.095 (independant sample test)

Mean time and standard deviation of sensory block onset in group 2 is 6.65+-1.182(p value is <0.05 statistically significant)

**Chart Title**

The mean time required for onset of sensory block in group 2 was more than group 1.
### Time of onset of Motor Block

| TIME OF ONSET OF MOTOR BLOCK IN MINUTES | GROUP 1 | GROUP 2 |
|----------------------------------------|---------|---------|
| <3                                     | 0       | 0       |
| 3-5                                    | 0       | 0       |
| 5-10                                   | 20      | 7       |
| >10                                    | 0       | 13      |

Mean time of onset of motor block in group 1 is 7.70 +/- 1.261
Mean time of onset of motor block in group 2 is 11.30 +/- 1.720
(p value is <0.05 statistically significant by paired t-test)
The mean time is required for onset of motor block was more in group 2 than group 1.

### Time of Sensory Block Recovery

| TIME OF ONSET OF SENSORY BLOCK RECOVERY IN MINUTES | GROUP 1 | GROUP 2 |
|---------------------------------------------------|---------|---------|
| <5                                                | 14      | 0       |
| 5-10                                              | 6       | 1       |
| 10-20                                             | 0       | 11      |
| >20                                               | 0       | 8       |

Mean time of sensory block recovery in group 1 is 5.15 +/- 0.933
Mean time of sensory block recovery in group 2 is 18 +/- 3.974 (p value is 0.000 i.e. p<0.05 which is statistically significant by paired t-test)
The mean time is required for sensory block recovery in group 2 is much higher than group 1. These finding showed that ropivacaine 0.2% has longer sensory recovery time than lignocaine 0.5%.

### Time of Motor Block Recovery

| TIME OF ONSET OF MOTOR BLOCK RECOVERY IN MINUTES | GROUP 1 | GROUP 2 |
|---------------------------------------------------|---------|---------|
| <5                                                | 0       | 0       |
| 5-10                                              | 20      | 0       |
| 10-20                                             | 0       | 4       |
| >20                                               | 0       | 16      |

Mean time of motor block recovery in group 1 is 7.20 +/- 0.951
Mean time of motor block recovery in group 2 is 23.50 +/- 3.720 (p value is 0.000 i.e. p<0.05 which is statistically significant by paired t-test)
The mean time is required for motor block recovery in group 2 is much higher than group 1. These finding showed that ropivacaine 0.2% prolongs the motor block recovery time than lignocaine 0.5%.

### Mean Time of Post Operative Analgesia

| GROUP       | MEAN TIME AND STANDARD DEVIATION OF POST OPERATIVE ANALGESIA (MIN) |
|-------------|---------------------------------------------------------------------|
| GROUP 1     | 186.50 +/- 25.500                                                   |
| GROUP 2     | 401.75 +/- 27.638                                                   |

Meantime of postoperative analgesia in group 2 is more than group 1. These findings showed that ropivacaine 0.2% has prolonged post operative analgesia than lignocaine 0.5%.
Mean Dose Requirement of Analgesia Post Operatively

| GROUP    | MEAN DOSE OF ANALGESIC POST OPERATIVELY (mgs) |
|----------|-----------------------------------------------|
| GROUP 1  | 97.50 +/- 30.75                               |
| GROUP 2  | 82.5 +/- 38.1                                 |

Mean dose requirement of analgesic postoperatively in group 2 was less than group 1. P value is 0.05 (statistically significant by Chi-square test).

Side effects

| Side effects | Group 1 | Group 2 |
|--------------|---------|---------|
| Tinnitus     | 0       | 0       |
| Light headedness | 1     | 1       |
| Perioral numbness | 1    | 0       |
| Vomiting     | 1       | 0       |
| Nausea       | 2       | 0       |
| Somnolence   | 0       | 0       |
| Vertigo      | 0       | 0       |
| Skin rashes  | 0       | 0       |
| Arrhythmias  | 0       | 0       |
| Convulsions  | 1       | 0       |

Side effects in group 2 was less than group 1. One patient in lignocaine group had convulsions due to tourniquet failure. Patient resuscitated with Inj Midazolam 3mg and Inj Thiopentone sodium 100mg. Then mask ventilated with 100% oxygen. Patient recovered completely.

**Discussion**

When general anaesthesia is contraindicated, regional anaesthesia would be approach 28.one such regional anaesthetic technique used in upper limb surgeries is intravenous regional anaesthesia .this technique was chosen for this study considering the following merits.

1) Simple technique –insertion of IV cannula is the only necessary skill required.
2) Reliable and effective when properly used
3) Rapid onset of action.
4) Rapid and prompt recovery from tourniquet release.
5) Good analgesia and adequate muscle relaxation.
6) Provides bloodless operative field.
7) Widely applicable to patients of different ages and physical status.

**Contraindication**

1) Patient refusal
2) Absence of resuscitative equipments and drugs
3) Allergy to local anaesthetics
4) Infection and cellulitis in the limb to be blocked
5) Conditions precluding use of tourniquet like
   a) Scleroderma
   b) Hemolytic diseases such as sickle cell anaemia, thalassemia
   c) Raynauds disease
   d) Malignanacy
6) Lengthy procedure
7) Patients with seizure disorders or with cardiac disorders30

Intravenous regional anaesthesia is an ideal technique for short operative procedures on the extremities. Use of intravenous regional anaesthesia has been limited because of local anaesthetic toxicity, slow onset, poor muscle relaxation, tourniquet pain and minimal postoperative pain relief. To improve the quality of intravenous regional anaesthesia, the use of a newer drug has been tried.
In our study it was planned to compare efficacy of ropivacaine 0.2% with lignocaine 0.5% intravenous regional anaesthesia for hand surgery and the sensory block onset time, sensory block recovery time, motor block onset and recovery time, tourniquet pain, post tourniquet release analgesia time, and dose requirement of rescue analgesic postoperatively were observed.

In our study there was no significant difference between the two groups for blood pressure, pulse rate during preoperative and intraoperative time. In our study the sensory block onset time was more in ropivacaine group (6.65+/-1.182 min) when compared to lignocaine (4.40+/-1.095 min) which was consistent with the findings of T.T. Nieme et al (2006)

Our study showed the motor block onset time was more in ropivacaine group than in lignocaine group. The finding coincides with the results found by maxmilian et al. They showed that the motor block onset time in lignocaine (10+/-min) group was lesser than in ropivacaine (15+/-12min).

Sensory block was much prolonged when ropivacaine 0.2% used. This finding correlated with the results found by chan and Vincent et al (1999). Our study showed the mean duration of post tourniquet analgesia was more in ropivacaine (401.75+/-27.5) the duration of post block analgesia after 0.2% ropivacaine was 344+/-28 minutes in the study concluded by chan et al.

Philip peng et al (2002) stated that the motor block recovery time was prolonged in the ropivacaine 0.2% group when compared to lignocaine 0.5% group. Our study also proved that the mean time of motor block recovery in ropivacaine group 23.5+/-3.720) was prolonged than in lignocaine group (7.20+/-0.951)

In our study, there was no difference between the two age groups in scores for pain after tourniquet inflation, and at 5, 10, 15 min but at 20 and 40 min, there was a significant decrease in tourniquet pain score in ropivacaine group. This finding correlated with the findings made by Ibrahim asif et al. in our study. The duration of postoperative analgesia was longer in ropivacaine 0.2% group (401.75+/-27.5 min) than lignocaine 0.5% group (186.50+/-25.5 min). This finding correlated with the results of maximilian et al. and the mean dose of rescue analgesic (diclofenac in mg) was less in ropivacaine group (82.5%+/-38.1) than in lignocaine (97.5%+/-30.75). These findings also coincide with the results of atanaseoff et al who showed that the number of patients taking more than two tablets of tramadol (each 100mg) was less in ropivacaine 0.25% group when compared to lignocaine 0.5% group.

Ropivacaine was found to have less complications in comparison to lignocaine which is consistent with the study of scott et al and kndson et al 23. Hence in our study it was found that ropivacaine 0.2% in intravenous regional anaesthesia improved the anaestheti efficacy, lengthened post tourniquet analgesia, reduced the amount of post operative rescue analgesic and had less side effects with good intraoperative hemodynamics as compared to lignocaine 0.5%.

Summary

Ropivacaine 0.2% in intravenous regional anaesthesia improved the anaesthetic efficacy, lengthened post tourniquet analgesia, reduced the amount of post operative rescue analgesic and had less side effects as compared to lignocaine 0.5% which has been proved statistically significant using quantitative and qualitative analysis.

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