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Research Article

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Evaluation of Anaesthetic Efficacy of Ropivacaine for the Removal of Impacted 3rd Molars- A Randomised Control Study

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Abstract

This study involved 20 healthy patients (ASA 1) with bilaterally impacted mandibular third molar were randomly selected of both Sexes between age group of 20-40 years.

Purpose: *This study was done to evaluate the efficacy of Ropivacaine in comparison with Lignocaine for mandibular anaesthesia for bilaterally impacted mandibular third molars in aspect of onset, duration of anaesthesia, analgesia and postoperative requirement of analgesics.*

Method: *Patients received 2ml of 2% Lignocaine with adrenaline on one side and 2ml of 0.75 % plain ropivacaine on the other side at two different appointments. Pain experiences were measured by Visual Analogue Scale (VAS) and Verbal Rating Scale (VRS).*

Results: In ropivacaine group, the means of onset of anesthesia, duration of anaesthesia, duration of post-operative analgesia and requirement of post-operative analgesics were 5.8±2.33 min, 533.3±142.2 min, 539.6±114.7 min and 4.2±0.8 no's respectively and there was a significant difference between these group (<0.001).

Conclusion: *The efficacy of plain ropivacaine 0.75% is superior to 2% lignocaine with adrenaline 1:1,00,000 in terms of duration of anaesthesia and analgesia, intraoperative and post-operative pain control but the onset of action of plain ropivacaine is slightly higher. We conclude that Plain Ropivacaine 0.75% can be used as an alternative to lignocaine in third molar surgeries and other minor surgical procedures which necessitates longer duration of anaesthesia and analgesia in oral and maxillofacial region.*

Keywords: Anaesthesia, Analgesia, Analgesics, Ropivacaine

1. Introduction

Local anaesthetics (LAs) are used clinically for anaesthesia and analgesia either following surgery or for management of other acute and chronic pain conditions; they only last a few hours. Lignocaine is perhaps most commonly used local anaesthetic agent; it is used either in local or regional anaesthesia, or in epidural or spinal blockade [1]. The need for long-acting local anesthetics were first applied in Surgical practice in the year 1957. Its use proved to be effective for the suppression of both intraoperative and postoperative pain [2].

When performing minor surgical procedures under LA, it may require longer duration of anaesthesia intraoperatively and postoperatively. In addition to the intraoperative nociceptive blockage during the procedure, postoperative pain is common occurrence following surgical dental procedures due to the resulting tissue injury leading to the release of proinflammatory mediators, cytokines signaling and inflammatory cell infiltrate. Increased expression of proinflammatory cytokines and induction of COX-2, which results in increased prostanoid production 2 to 4 hours after surgery contribute to sensitization, resulting in prolongation of pain. Long acting anaesthetics have been recommended for the use in the perioperative period, as they are comparable in onset and efficacy to lidocaine, but because of their longer duration, attenuate pain for hours after the procedure, when acute pain is most intense [3].

Lignocaine is considered as "gold standard" against which all new local anaesthetics are compared. It has a rapid onset of action (2-3minutes), ability to produce profound anaesthesia, has intermediate duration of action and greater potency. The effective dental concentration is 2% [4].

Ropivacaine also belongs to the same pipecoloxylidide group, which were first synthesized in 1957 [5]. Lignocaine is an intermediate acting drug whereas ropivacaine is long acting drug [1]. Ropivacaine is a preferred option because of its reduced central nervous system (CNS) and cardiotoxic potential. It has a high pKa (8.1), molecular weight (274 base) and low lipid solubility that blocks nerve fibers involved in pain transmission (A delta and C fibers) to a greater degree than those controlling motor function (A beta fibres). The drug is less cardiotoxic than equal concentrations of racemic bupivacaine but more so than lignocaine; it has a significantly higher threshold for CNS toxicity than racemic bupivacaine. Ropivacaine had an adverse event profile similar to that of bupivacaine in clinical trials. Comparative data suggest that higher concentrations of ropivacaine (0.75%) may be needed to provide the same sensory and motor blockade as bupivacaine 0.5%. Although the time to onset of sensory block tended to be faster and the duration of motor block shorter with ropivacaine [1]. The concentration and dose of ropivacaine at 0.75%-1% concentration shortened the onset time and prolonged the duration of ropivacaine's nerve block as compared to racemic bupivacaine and levobupivacaine [5].

Ropivacaine is 40-50% less potent than bupivacaine and levobupivacaine because of its lower lipid solubility; however, a reduced potency does not imply that this agent is less effective than the other two, and using an equipotency ratio of 1.5: 1 between ropivacaine and the two other drugs results in a substantially similar clinical profile with a good preservation of motor function [5]. Ropivacaine is extensively metabolized in the liver, predominantly by aromatic hydroxylation mediated by cytochrome P4501A to 3-hydroxy ropivacaine [6].

1.1 Aims and Objectives of the Study

• To evaluate and compare the clinical efficacy of ropivacaine to lignocaine for the mandibular anaesthesia.
• To assess
1. The onset of anaesthesia by pin prick test, by using 0.8 mm sterile injection needle. (DISPOVAN).
2. The intra operative anesthesia by Visual Analogue Scale (VAS).
3. The duration of anaesthesia by Verbal Response Scale (VRS).
4. The need of post-operative analgesics requirement- calculated for 3 days after treatment. The postoperative NSAIDS were standardized – Aceclofenac (ZERODOL-P ; IPCA LABORATORIES LTD).

2. Method

This study was done on 20 healthy patients (ASA 1) between age group of 20-40 years who reported to Department Of Oral And Maxillofacial Surgery, Rajarajeswari Dental College and Hospital, Mysore Road, Bangalore, requiring surgical removal of bilaterally impacted mandibular third molars were randomly selected. Informed consent was taken before the procedure.

Group I (CONTROL GROUP) - 20 IMTM surgeries in which 2% Lignocaine HCl with 1: 1,00,000 adrenaline was used.

Group II (TEST GROUP) – On the other side 20 IMTM were removed with 0.75% Ropivacaine HCl (7.5µg).

Patients in the age group 20 to 40 years, systemically healthy subjects under the classification of ASA 1, patients not receiving any medications that will not alter the perception of pain, and patients requiring extraction of bilateral impacted mandibular third molars were included in the study. Patients with history of allergic reactions to LA of amide group and sulphides, patients with acute infections, patient taking medications like MAO inhibitors, tricyclic antidepressants, phenothiazine, vasodepressor drugs & ergot type oxytocic drugs and pregnant patients were excluded from the study.

Routine radiological and haematological evaluation was done. Classical inferior alveolar nerve block technique was used, IMTM surgeries were performed under standard aseptic precaution. At first appointment 2% lignocaine with 1: 1,00,000 adrenaline was used for the removal of the impacted teeth on one side. During Second appointment plain 0.75% ropivacaine was used on the other side.

Time of injection, onset of anesthesia, amount of anesthetic injected were recorded. The visual analog scale (VAS) profoma was filled by the patient based on their pain experiences peri- and postoperatively. Verbal Response Scale (VRS) proforma was used to assess the duration of anesthesia, patients were told to report to the doctor about time of loss of anesthesia as soon as noticed. All patients were reviewed after 3 and 7 days.

3. Results

20 patients were randomly selected in which 9 were male and 11were female patients with lowest age of 20 years and highest age of 36 years were in the study. The mean age group was 27.22 years in males and 24.72 in females.

The mean onset of anesthesia for the lignocaine group was 4.3±3.7 min in males and 4.2± 1.01 min in females.

The mean onset of anesthesia for the ropivacaine group was 3.6±1 min in males and 6.2±2.7 min in females.

The mean duration of anaesthesia for the lignocaine group was 342.6±95.8 min in males and 286.6±161.9 min in females.

The mean duration of anaesthesia for the ropivacaine group was 469.4±161.9 min in males and 585.5±103.7 min in females.

The mean duration of postoperative analgesia for the lignocaine group was 302±70.5 min in males and 295.8±73.9 min in females.

The mean duration of postoperative analgesia for the ropivacaine group was 497.3±96.6 min in males and 574.1±120.9 min in females.

The mean number of analgesics required for the lignocaine group was 7.7±0.9 nos in males and 8.1±0.6 nos in females.

The mean number of analgesics required for the ropivacaine group was 4.1±1 nos in males and 4.2±0.6 nos in females.

4. Discussion

The application of long-acting local anesthetics is of great importance in oral-surgical practice, as it reduces the need of anesthetics during the intervention, facilitates postoperative recovery and reduce the risk of uncontrolled analgesics taking [2].

According to the El-Sharrawy, et al., The speed with which neural block begins was proportional to the concentration of the local anesthetic solution. The onset of anesthesia was rapid for 0.75% and 0.50% ropivacaine, ranging from 1 to 2.2 minutes. Increasing the concentration of ropivacaine reduces the onset time of peripheral nerve block, presumably because more local anesthetic molecules are available to penetrate the nerve per unit time. Akerman and associates attributed ropivacaine's tendency toward a more rapid onset of action in comparison with bupivacaine to its weaker binding to extraneural fat and tissues and to its greater availability for transfer to the site of action in the nerve. Conversely, the long duration of action of ropivacaine may be related partially to its vasoactivity, as a broad range of ropivacaine concentrations can cause vasoconstriction [7].

According to Brkovic, et al., the onset of anaesthesia was proportional to the concentration of ropivacaine, and occurred at 2.2, 1.7 and 1.5 min after 0.5, 0.75 and 1% ropivacaine, respectively. The results are in accordance with the classification of ropivacaine as a local anaesthetic with moderate onset because of its relatively higher pKa 8.1 [8]. According to Ernberg, et al., the onset of anaesthesia was less than 10 minute. The duration of anaesthesia was 6 hours which was longer than lidocaine with epinephrine. The duration of lip anaesthesia was longer after mandibular nerve block than infiltration [9]. The mean onset of action in ropivacaine group was 5.8±2.33 min and in lignocaine group it was 4.25±2.04 min (Figure 1). There was a significant difference in the onset of action between the ropivacaine group which had moderate onset and lignocaine group which had shorter onset of action.

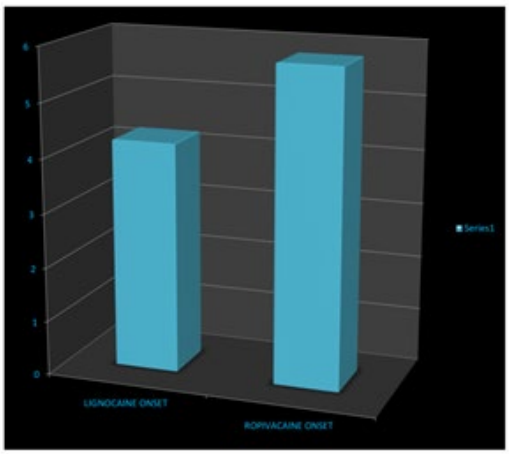

Figure 1: -Shows the comparison of onset of anaesthesia between the lignocaine group and the ropivacaine group

According to Kennedy, et al., the duration of lip anesthesia was shorter with plain ropivacaine because of the absence of a vasoconstrictor. However, the plain ropivacaine solution provided more than 4 hours of lip numbness; complete sensation did not return for more than 6 hours. Therefore, plain ropivacaine did provide a long-acting anesthetic effect for lip numbness. 0.5% ropivacaine with 1:200,000 epinephrine was equivalent to 0.5% bupivacaine with 1:200,000 epinephrine in pharmacologic action [10].

According to El-Sharrawy and Yagiela, 0.5% and 0.75% of ropivacaine provided surgical anaesthesia and postoperative analgesia for extraction of a mandibular third molar after inferior alveolar nerve block. Lower concentrations of ropivacaine may also have a selective analgesic effect because clinically they block thin Aδ and C nerve fibers more readily than large Aβ fibers. The mean durations of soft tissue anesthesia were 3.3 ± 0.3 hours and 3.0 ± 0.3 hours for the 0.75% and 0.5% concentrations, but significantly shorter with more dilute concentrations. The duration of analgesia showed a similar pattern with the 0.75% and 0.5% concentrations producing prolonged analgesia of 6.0 ± 0.4 hours and 5.6 ± 0.4 hours. These results indicate that 0.5% and 0.75% concentrations were effective for intraoral nerve blockade, with both a rapid onset and prolonged duration of pain control [7]. According to Ernberg, et al., the success rate of pulp anaesthesia after infiltration was only 17%, regardless of the dose. Ropivacaine 7.5 mg/mL was an effective local anesthetic with a long duration for mandibular nerve block [9].

According to Meechan J.G, ropivacaine can produce anesthesia of the pulp and adjacent soft tissue when injected into the periodontal ligament. However, this anesthetic effect was inferior to that of lidocaine with epinephrine in terms of obtaining pulpal anesthesia when injected intraligamentarily. These results support the findings of previous studies that have shown that vasoconstrictor-free solutions have poor efficacy in obtaining pulpal anesthesia compared with those containing epinephrine when injected into the periodontal ligament. The rate of anesthetic success did not differ among the ropivacaine alone and the epinephrine- containing ropivacaine solutions [11]. According to Hersh et al reported no difference in the duration of lip and tongue anesthesia between epinephrine-free and epinephrine-containing local anesthetics after inferior alveolar block injections in volunteers [12].

In our study, there was a profound anaesthesia during surgical procedure in both the groups. The mean duration of anaesthesia for ropivacaine group was 533.3±142.2 min (8.8±2.3hrs) and for the lignocaine group was 311.85±92.9 min (5.1±1.5hrs) (Figure 2). There was statistically significant difference in the duration of anaesthesia between ropivacaine group and lignocaine group. The mean duration of anaesthesia in ropivacaine group was 469.4±161.9 min in males and 585.5±103.7 min in females when compared to lignocaine group 342.6±95.8 min and 286.6±161.9 min in males and females respectively.

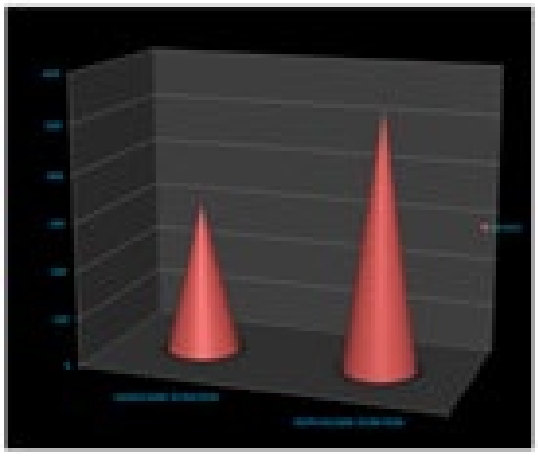

Figure2: Shows the comparison of duration of anaesthesia between the lignocaine group and the ropivacaine group

According to Brkovic, et al., Postoperative pain after third molar surgery reaches its maximum intensity within 6-8 h of surgery. This pain is well controlled after block anaesthesia. In accordance with that, the study shows that ropivacaine achieved successful postoperative pain control [8]. According to Stojanovic S, et al., Prostaglandins (PGE2, PGD2, PGF2a, PGI2 (prostacyclin) and thromboxane (TXA2) as immune mediators, act in many inflammatory processes. As effect of PGI2, vasodilatation and edema occurs. PGE2 acts synergistically with other mediators, which increase during the inflammation. PGE2 has no direct role in emerging of feel of pain. Thromboxane A2 causes vasoconstriction and stimulates platelet aggregation. The use of analgesics, especially from a group of non-anti-inflammatory drugs, blocks the creation of thromboxane A2 in platelets, producing an inhibitory effect on platelet aggregation and prolonging bleeding. Therefore, in the postoperative treatment, it was better to have secured analgesia with LA than to ordinate analgesics [2]. According to Kundaravalli, et al., aceclofenac has a rapid onset and prolonged pain relief and significant analgesic effect in the immediate postoperative period of 8 hours in comparison to diclofenac sodium. Aceclofenac has a better gastrointestinal profile than diclofenac [13].

The mean duration of postoperative analgesia in ropivacaine group was 497.3±96.6 min in males and 574.1±120.9 min in females compared to lignocaine group 302±70.5 min and 295.8±73.9 min respectively. There was statistically significant difference in the duration of post-operative analgesia between ropivacaine group and lignocaine group, 539.6±114.7min (8.9±1.9 hrs) and 298.6±70.5min (4.9±1.1hrs) respectively (Figure 3).

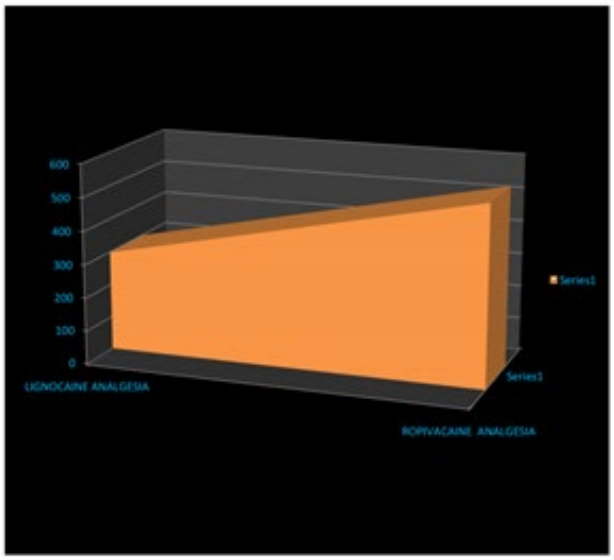

Figure 3: Shows the comparison of duration of post operative analgesia between the lignocaine group and the ropivacaine group

The average requirement of postoperative analgesics in ropivacaine group was 4.2±1 tablets in males and 4.2±0.6 tab in females compared to 7.7±0.9 tablets in males and 8.1±0.6 tablets in females in lignocaine group. In our study, there was a statistically significant difference between the ropivacaine group and the lignocaine group in consumption of analgesics (NSAIDS) postoperatively. The average number of analgesics in ropivavacaine group was 4.2±0.8 tablets. In lignocaine group, the average number of analgesics was 8±0.7 tablets (Figure 4). It shows that there was a significant postoperative pain control in the ropivacaine group and significant increase in duration of post-operative analgesia and also decrease in the number of analgesic requirements there by reducing the economic burden of the patient. In our study we had standardized the use of tab Aceclofenac as an anti-inflammatory agent.

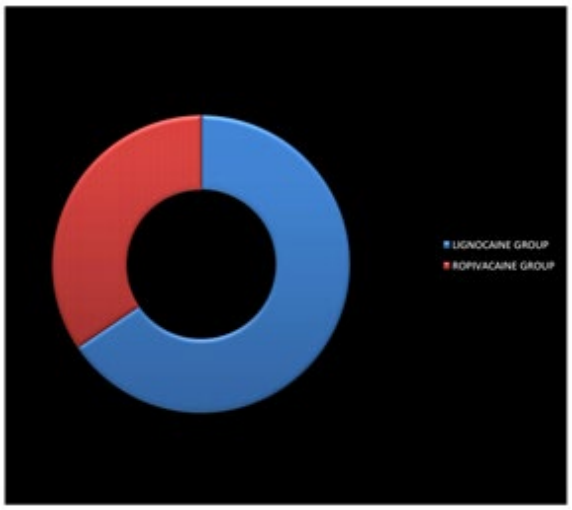

Figure 4: Shows the comparison of requirement of post operative analgesics between the lignocaine group and the ropivacaine group

According to Sisk AL, Ropivacaine has been reported to have approximately a 75% greater margin of safety than bupivacaine [14]. According to Knudsen, et al, at doses producing CNS symptoms, cardiovascular changes, such as depression of conduction and diastolic function, were less pronounced with ropivacaine compared with bupivacaine. Akerman, et al. showed that ropivacaine was less toxic than bupivacaine but more toxic than lidocaine [15]. According to Meechan J.G, the vasoconstrictive properties of ropivacaine alone are not as profound as epinephrine-containing local anesthetic solutions [11].

According to Liddle, et al., the amount of blood loss during reduction mammoplasty showed decreased hemorrhage control when ropivacaine was used as infiltration anesthesia compared with that obtained with a solution of bupivacaine with 1:200,000 epinephrine [16]. According to Kopacz, et al., ropivacaine has the ability to decrease cutaneous blood flow without the addition of epinephrine thereby, eliminating the potential side effects of absorbed epinephrine, whereas other local anaesthetics require the addition of epinephrine to provide vasoconstriction [17]. According to Rohan B et al, the addition of adrenaline to ropivacaine led to earlier onset of the sensory block, but no increase in the duration of analgesia when compared to analgesia using ropivacaine alone. The addition of 150µg clonidine to ropivacaine led to earlier onset of brachial plexus block as well as an increased duration of sensory and motor blocks without unwanted side effects when compared to analgesia using ropivacaine alone [18].

According to Li, et al., Ropivacaine has provided effective anesthesia for surgery and effective analgesia for postoperative and labor pain, and appears to be associated with less motor block, reduced CNS and cardiovascular toxicity, and higher satisfaction compared with bupivacaine. Ropivacaine has particular importance in clinical use as regional anesthesia and the management of postoperative and obstetric pain [19]. According to Liu, et al., lumbar plexus and sciatic blocks with 0.35% ropivacaine along with conscious sedation facilitates faster postoperative recovery than general anesthesia [20]. According to Baptista JF, the addition of clonidine, at a dose of 4 mcg/kg of body weight in epidural anesthesia with 0.75% ropivacaine for hemorroidectomy showed higher analgesic effectiveness in the first four hours. The clonidine group required less postoperative analgesia [21].

In our study we have included only ASA 1 patients and further studies are required to evaluate the effects of this drug in other medically compromised patients and the patients requiring more than 2ml of LA were excluded from the study. In our study we found that ropivacaine has a moderate onset of action, with longer duration of anaesthesia and postoperative analgesia when compared to the lidocaine with epinephrine. The other properties of ropivacaine are anti-metastatic, anti-proliferative, anti-inflammatory, anti-bacterial [22-25]. It has less cytotoxicity, myotoxicity, and is also used in the treatment of trigeminal neuralgia, ulcerative colitis and attenuates tumor progression [26-32]. It is safer anaesthesia in pediatric population chronic liver and renal failure patients [33-37].

In surgical procedures, a long duration of local anesthesia is useful because it may reduce postoperative pain and the need of analgesic drugs. Due to its long duration of both pulp and soft tissue anesthesia and sufficient postoperative analgesia after mandibular nerve block and a lower CNS and cardiovascular toxicity, plain ropivacaine 7.5 mg/mL may be a suitable local anaesthetic without vasoconstrictor for the minor surgical procedure in dental practice and oral and maxillofacial surgery.

5. Conclusion

The efficacy of plain ropivacaine 0.75% is superior to 2% lignocaine with adrenaline with epinephrine 1: 1,00,000 in terms of duration of anaesthesia, analgesia, intraoperative and post-operative pain control but the onset of action of plain ropivacaine is slightly higher.

We conclude that Plain Ropivacaine 0.75% can be used as an alternative to lignocaine in third molar surgeries and other minor surgical procedures which necessitates longer duration of anaesthesia and analgesia in oral and maxillofacial region and also in patients where adrenaline use is to be minimized.

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