A COMPARISON OF EFFICACY OF ARTICAINE VERSUS LIGNOCAINE IN INFERIOR ALVEOLAR NERVE BLOCK DURING SURGICAL EXTRACTION OF IMPACTED LOWER THIRD MOLAR – A RANDOMIZED SINGLE BLIND PROSPECTIVE STUDY

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ABSTRACT

Background and objectives: Surgical extraction of impacted lower third molar is one of the most frequent interventions in oral surgery. This procedure is often associated with significant post-surgical pain that may have both psychological and social impact. In this study, two different local anesthetic agents, articaine & lignocaine were compared for their anesthetic efficacy. Study Design: This study was conducted on an outpatient basis in the Department of Oral and Maxillofacial Surgery, Bapuji Dental College and Hospital, Davangere. 100 patients requiring surgical removal of mandibular third molars were randomly divided into two groups of 50 patients each. Articaine 2% with 1:1,00,000 adrenaline and lignocaine 2% with 1:80,000 adrenaline were used in a double blind manner in each group respectively. All the required parameters were measured during surgery & questionnaires were given to all the patients to assess the time of complete disappearance of numbness, pain perception & analgesic requirement postoperatively. Results: The results of present study showed early onset of anesthesia, longer duration of action, longer period without pain, lesser pain intensity & in turn lesser postoperative analgesic requirement for articaine group than lignocaine group. Conclusion and interpretation: It appeared that more effective pain control was obtained with articaine solution as compared to lignocaine which may be attributed to increased time of numbness, less postoperative pain perception & less need for postoperative analgesics by the patients with articaine solution.

KEYWORDS: Articaine; Lignocaine; Anesthetic Efficacy, Inferior Alveolar Nerve Block, Impacted Mandibular Third Molar.

INTRODUCTION

Pain for every human being is a universal fear which he tries to avoid instinctively. The most important aspect of patient care following surgical treatment would be pain management.[1] Pain control through truncal block of the inferior alveolar nerve is one of the loco regional anesthetic techniques most widely used in oral surgery.[2]

Local anesthetics form the backbone of pain control techniques in dentistry. From cocaine (1884) to procaine (1904) to lidocaine (1948), dentistry has been in the forefront in seeking to provide patients with pain-free, safer and more effective local anesthetics.[3-5]

Lignocaine (diethyl-2, 6-dimethylacetanilid) synthesized in 1943 by Nils Löfgren, diffuses readily through the interstitial tissues into the lipid rich nerve giving a rapid onset of anesthesia of about 2-3 minutes.1 Protein binding is relatively low so its duration of action is predictably short.4 It represents the “gold standard”, the drug to which all new anesthetics are compared.[6-7]

Articaine Hydrochloride (HCl), or 4-methyl-3-[1-oxo-2-(propylamino)-propionamido]-2-thiophene-carboxylic acid methyl ester hydrochloride, was introduced in 1969 by Rusching et al with the name of carticaine and used clinically in 4% concentration.2-8

The main advantage of articaine with respect to other local anesthetics is with regards to its structural characteristics where in an aromatic ring is substituted with a thiophenic ring thus increasing the liposolubility of the drug as well as its potency (1.5 times greater than that of lidocaine). Moreover, articaine is the only amide local anesthetic containing an ester group in its
molecular structure – thus allowing metabolism of the drug both by plasma esterases and by liver microsomal enzymes. [2]

The choice of anesthetic solution should be based on three main clinical considerations: anesthetic potency, latency (time to onset of anesthesia), and duration of the anesthetic effect.

The present study was to compare the anesthetic efficacy of 4% articaine with epinephrine 1:1,00,000 versus 2% lidocaine with epinephrine 1:80,000, with regard to their onset of action, duration of action and pain perception in application to truncal block of the inferior alveolar nerve during the surgical extraction of impacted lower third molars.

MATERIAL AND METHODS

The study was a controlled, randomized, single-blind, parallel group study that was conducted on 100 patients (49 males and 51 females; mean age 26.3±7.06 years) with the inclusion criteria as: subjects between 18 to 40 years age group, without any systemic disorders or antecedents of complications associated with local anesthetics, and presenting impacted lower third molars requiring removal of these impacted teeth were included irrespective of sex, caste, religion & socio economic status. The exclusion criteria were: the existence of acute infection and/or swelling at the time of surgery, patients allergic to lignocaine or articaine, and ASA III, IV, V Category patients.

Prior to the treatment, all the required haematological investigations were done & radiographs were taken. Pertinent data was recorded as per the proforma. Informed consent was obtained from all subjects after the nature and the intentions of the study were explained to them & were asked to return a completed questionnaire following treatment.

The study was approved by the College Ethics Committee for Research, Davangere. All the patients in good health assessed by history, physical examination, blood pressure and pulse rate were included in the study. The patients were allocated to one of two possible treatment groups according to a randomized list on the visit for surgery. Articaine 4% with 1:1,00,000 adrenaline and lignocaine 2% with 1:80,000 adrenaline were used in a single blind manner. As articaine 4% is available in only 2ml cartridges in India, before the administration of local anesthetic, it was aspirated from the plastic syringe from lignocaine vials (SEPTANEST® 4%, SEPTODONT) whereas lignocaine was aspirated in a plastic syringe from lignocaine vials (LIGNOX 2% A, INDOCO REMEDIES LTD). The patients were thus blinded with respect to the type of local anaesthetic treatment given on each occasion.

All the patients were given 2 ml of the local anaesthetic agent for inferior alveolar nerve block using a 5 ml disposable syringe having needle size 0.45 × 38 mm with 26 gauge. If there was a failure of anaesthesia, a repeat of 1ml injection would be given at every 5 minutes interval up to a maximum dosage of 4ml.

Following injection of local anesthetic: 1) The local anesthetic agent used 2) Quantity of the local anesthetic used in ml 3) Time of administration 4) Onset of anesthesia (which was noted as subjective & objective symptoms) 5) Duration of surgery were noted. After the establishment of surgical anesthesia a standard Terrence Ward’s incision was placed. Mucoperiosteal flap was reflected to expose the tooth & bone was removed with burs by Moore-Gillibe Collar technique under copious saline irrigation. Tooth was elevated by using straight coupland elevator & was removed. Bony margins were filed, wound was irrigated, flap repositioned & sutured with 3-0 non absorbable black braided silk. A pressure pack was given to attain hemostasis. The sutures were removed on 7th postoperative day. All the mentioned parameters of the study were recorded during pre-operative and operative period. Post-operatively the patients were asked to record the time of complete disappearance of numbness, time of onset of pain and number of analgesics taken for 24 hours post-operatively at interval of 2 hours, 4 hours, 8 hours, 12 hours & 24 hours on the questionnaires provided to the patients. The patients were also instructed to assess and record their subjective postoperative pain intensity on visual analogue scale (VAS) having horizontal line running from ‘no pain’ (0 cm) to ‘worst pain’ (10 cm) on the questionnaires.

The data obtained in the study was tabulated under two groups assigned to each of the local anesthetic agents used in the study. The statistical analysis of the results was carried out with the Student t- and chi-square tests, using the SPSS version 11.0 statistical package throughout.

RESULTS

The study included total 100 patients (49 males and 51 females) in which 25 males and 25 females were in the group of articaine with mean age 26.3±7.06 years and range between 18-40 years. In lignocaine group 24 males and 26 females were in mean age of group of 28.6±6.52 years with range between 18-40 years. 2 ml of local anesthetic solutions were used for all patients in both groups except in some patients where re-anesthesia was required.

The mean onset of subjective symptoms for articaine group was 2.2±0.5 minutes and for lignocaine group it was 3.0±0.81 minutes. For onset of objective symptoms, the mean time for articaine group was 3.0±0.55 minutes & the mean time for lignocaine group was 4.1±0.90 minutes. The mean difference of subjective and objective symptoms came out to be 0.824 minutes & 1.086 minutes respectively for articaine & lignocaine groups which was found to be statistically highly significant.
(P<0.001) but was not much significant clinically. The duration of surgery was recorded for both groups which ranged from 35 minutes to 90 minutes (Table 1).

The mean values for duration of anesthesia for articaine & lignocaine groups were found to be 357.8±58.8 minutes & 184.7±39.10 minutes respectively with a mean difference of 173.14 minutes which is statistically and clinically highly significant difference (P<0.001). The mean time was 373.20±59.19 minutes for articaine group & 193.60±41.53 minutes for lignocaine group with a mean difference of 179.64 minutes which is statistically highly significant (P<0.001) and is also very significant difference clinically.

The maximum patients in lignocaine group had pain experience within 3 hours generally while in articaine group, period without pain was significantly high and went up to 9 hours & 20 minutes in one patient (Table 2). The quantity of analgesic medications taken post-operatively was significantly different with the two local anesthetics. The mean number of analgesics for articaine group was found to be 2.0±0.14 tablets as compared to 3.2±0.40 tablets for lignocaine group with the mean difference of 1.18 tablets which is statistically highly significant (P<0.001).

Table 1: Comparison of various parameters used in the study between articaine & lignocaine groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Articaine</th>
<th>Lignocaine</th>
<th>Mean Difference</th>
<th>p* Value, sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose Of Local Anesthetic (Ml)</td>
<td>2.0</td>
<td>2.2</td>
<td>0.22</td>
<td>0.007 (S)</td>
</tr>
<tr>
<td>Onset Of Action</td>
<td>2.2</td>
<td>3.0</td>
<td>0.824</td>
<td>&lt;0.001 (HS)</td>
</tr>
<tr>
<td>Onset Of Action</td>
<td>3.0</td>
<td>4.1</td>
<td>1.086</td>
<td>&lt;0.001 (HS)</td>
</tr>
<tr>
<td>Duration Of Surgery (Min)</td>
<td>58.4</td>
<td>55.3</td>
<td>12.89</td>
<td>0.23 (NS)</td>
</tr>
<tr>
<td>Duration Of Anesthesia (Min)</td>
<td>357.8</td>
<td>184.7</td>
<td>173.14</td>
<td>&lt;0.001 (HS)</td>
</tr>
<tr>
<td>Total Period Without Pain (Min)</td>
<td>373.2</td>
<td>193.6</td>
<td>179.64</td>
<td>&lt;0.001 (HS)</td>
</tr>
<tr>
<td>Number Of Analgesics Taken In 1st 24 Hours</td>
<td>2.0</td>
<td>3.2</td>
<td>1.18</td>
<td>&lt;0.001 (HS)</td>
</tr>
</tbody>
</table>

*Student's unpaired t test

Table 2: Comparison of Postoperative pain between articaine & lignocaine groups through median values of Visual analogue scale at various time intervals & p Value, significance.

<table>
<thead>
<tr>
<th>Time of Assessment</th>
<th>Articaine Median</th>
<th>Lignocaine Median</th>
<th>p* Value, sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Hrs</td>
<td>3</td>
<td>0</td>
<td>&lt;0.001 HS</td>
</tr>
<tr>
<td>4 Hrs</td>
<td>4</td>
<td>5</td>
<td>&lt;0.001 HS</td>
</tr>
<tr>
<td>8 Hrs</td>
<td>7</td>
<td>5</td>
<td>0.34 NS</td>
</tr>
<tr>
<td>12 Hrs</td>
<td>7</td>
<td>4</td>
<td>0.86 NS</td>
</tr>
<tr>
<td>24 Hrs</td>
<td>7</td>
<td>3</td>
<td>0.24 NS</td>
</tr>
</tbody>
</table>

*Mann Whitney U test

**DISCUSSION**

Articaine (4-methyl-3-[2-(propylamino)-propionamido]-2-thiophene carboxylic acid, methyl ester hydrochloride) is a unique amide LA in that it contains a thiphene, instead of a benzene, ring. The thiphene ring allows greater lipid solubility and potency as a greater portion of an administered dose can enter neurons. It is the only amide anaesthetic containing an ester group, allowing hydrolyisation in unspecific blood esterases. Articaine’s amide linkage undergoes biotransformation in the liver, a relatively slow process, however articaine is additionally inactivated by serum esterases, a fast process commencing immediately after injection.

In this study 4% articaine was used. An in vitro study showed that 2% and 4% articaine more effectively depressed the compound action potential of all A fibres in rat sensory nerves than 2% and 4% lignocaine and 3% mepivacaine could.[19] Currently it is not known why articaine is only manufactured in a 4% solution given that the limited data show no clinical advantage over a 2% preparation. One reason may be that the lower systemic toxicity of articaine allows it to be used in a concentration higher than other amide LAs.[20-27]

Visual analogue scales (VAS) of pain have been demonstrated to be reliable and generalizable.[13] Hence, in this study VAS was used to measure the pain intensity.
In this study there was statistically highly significant difference for the mean time of onset of action for articaine and lignocaine. The mean onset of subjective symptoms for articaine group was 2.2±0.5 minutes and for lignocaine group it was 3.0±0.81 minutes. For onset of objective symptoms, the mean time for articaine group was 3.0±0.55 minutes & for lignocaine group was 4.1±0.90 minutes (Table 2).

These results were in accordance with the previous study.[2] The probable reasons for these results could be due to the increased liposolubility of articaine.[2,8,16,37] Latency is directly influenced by the corresponding pKa value - smaller pKa values being associated to shorter latency. Accordingly, 4% articaine (pKa = 7.8) would at least in theory present a shorter latency than 2% lidocaine (pKa = 7.9).[2] The thiophene ring of articaine increases its liposolubility.[16,37]

The mean values for duration of anesthesia for articaine & lignocaine groups were found to be 357.8±58.8 minutes & 184.7±39.10 minutes respectively which is statistically and clinically a highly significant difference. These results were in accordance with the previous study.[2,8] The probable reasons for these results could be that the duration of the effect of an anesthetic is proportional to its degree of protein binding. Articaine presents one of the greatest protein binding percentages of all amide local anesthetics, comparable only to ultra-long action substances such as bupivacaine, ropivacaine and etidocaine. This in turn implies a longer duration of the anesthetic effect.[2,8]

Postoperative pain is a common phenomenon after surgery, due to surgical trauma and the release of pain mediators. Regarding the surgical removal of lower third molars, the maximum intensity of pain occurs in the first hours after the end of the surgery, when the local anesthetic has worn off. Postoperative pain control is frequently performed with the administration of short-acting local anesthetics and oral analgesics.[28] Anaesthetics that produce residual analgesia for some time, reducing the consumption of analgesics and improving the patient’s postoperative experience are required in oral surgical procedures for example frequently performed procedures like extraction of third molars.[8]

In this study the mean time period without pain was 373.20±59.19 minutes for articaine group & 193.60±41.53 minutes for lignocaine group with a mean difference of 179.64 minutes which is statistically highly significant and is also very significant difference clinically.[28]

The quantity of analgesic medications taken post-operatively was significantly different with the two local anesthetics used. The mean number of analgesics for articaine group was found to be 2.0±0.14 tablets as compared to 3.2±0.40 tablets for lignocaine group which is statistically highly significant.

In this study pain assessment was done in all patients at 2nd, 4th, 6th, 12th, & 24th hours post-operatively through visual analogue scale scores. At the 2nd and 4th hour the post-operative pain values showed statistically highly significant difference in pain perception between the two groups which showed that there were lower pain perception at 2nd and 4th hour for articaine and higher for lignocaine. At the 8th, 12th and 24th hour the post-operative pain values showed statistically non-significant difference in pain perception between the two groups which showed that there was no difference in the pain perception at 8th, 12th and 24th hour for articaine and lignocaine.

This was in accordance with the previous study.[14] The probable reasons for these results could be that the articaine does possess many of the physiochemical properties of other local anesthetics, with the exception of the thiophene moiety and its degree of protein binding ability which makes it penetrate well into tissues and highly diffusible into the tissues. The thiophene ring of articaine increases its liposolubility.[16] The duration of action of local anesthetic agents may be related primarily to their degree of protein binding. As local anesthetic solutions are believed to act binding to a protein receptor in the sodium channel, the greater protein binding of a specific agent presumably results in a longer period of sodium channel blockade and a longer duration of anesthesia.[28]

In literature, the reported protein binding values for lidocaine and articaine are 65% and 95% respectively.[20] Concentration of articaine in the alveolus of a tooth after extraction was about 100 times higher than in systemic circulation. This saturable local articaine metabolism has been considered as possibly contributing to the observed duration of the local anesthetic effect, despite articaine’s very short systemic half-life.[52] In pharmacokinetic / pharmacodynamic studies, the duration of soft tissue anesthesia produced by 4% articaine with a dose of 1.8ml was reported as 4.3 to 5.3 hours for nerve blocks.[16]

Though few studies show that articaine has possible neurotoxic effects like transient paresthesia, none of the patients in our study showed any such kind of effects and also there is insufficient evidence to believe the underlying cause to be the type of anaesthetic used. Hence, further studies are needed to establish such a possible relationship.[2]

CONCLUSION

This study showed that Articaine has higher efficacy compared to lignocaine during the surgical removal of impacted lower third molar teeth, dosage required for articaine was slightly less compared to lignocaine, articaine showed rapid onset of anesthesia (action) and
prolonged duration of anesthesia compared to lignocaine. There were no signs of any systemic toxicity clinically between both lignocaine & articaine groups.

Thus 2% articaine with 1:100,000 adrenaline can be used safely and effectively in oral & maxillofacial surgery especially in procedures where tissue trauma is more and the procedures where bone removal can cause a lot of physical and mental agony to the patient like third molar surgeries. With careful attention to clinical scenario it can be concluded that articaine might be considered as a suitable alternative to lignocaine in surgical extraction of impacted lower third molars.

REFERENCES


