Research Article

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Anesthetic Efficacy of Buccal Infiltration with 4% Articaine versus Nerve Block with 2% Lidocaine for Endodontic Treatment in Pediatric Patient

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ABSTRACT

Background: It is difficult to achieve adequate anesthesia by infiltration of lidocaine especially into the mandible because of the thick buccal cortical bone. An inferior alveolar nerve block is often used but it is technique sensitive also has a high failure rate. The aim of this study was to compare the efficacy of 4% articaine versus 2% lidocaine, both containing epinephrine, using a single buccal infiltration for endodontic procedure in Pediatric patient. This randomized cross-over clinical trial was performed on 50 children (5–8 years of age), referred to the Department of Pediatric Dentistry, Kalka Dental College and Research Centre, who needed endodontic treatment in mandibular primary molars. The Wong-Baker Facial Pain Scale (FPS), and the sound eye motor scale (SEM) was used to evaluate pain perception. Patients' feeling during injection and their behaviour during treatment and postoperative complications were registered. The heart rate and the blood pressure values were assessed objectively as an indirect measure of physiological pain perception. Mean pain scores, heart rate, and blood pressure in both the groups were compared by Wilcoxon-Mann-Whitney test. A significant level of differences was taken as P≤0.05. Articaine is more successful to provide adequate anaesthesia .Articaine buccal infiltration can be used successfully in endodontic treatment of mandibular primary molars.

Keywords: Lignocaine, Articaine, Nerve block, Local infiltration.

INTRODUCTION

The duties of a pediatric dentist extend from eliminating pain and anxiety to providing treatment with as minimal discomfort as possible in order to instil a positive dental attitude in children. Providing adequate depth of anaesthesia is one of the most important factors in the success of treatment. It is hard to achieve this by infiltration technique in the mandible because of the thick buccal cortical bone.[1] Lidocaine is the most commonly used local anesthetic in most countries around the world and has served as a gold standard for past 5 decades. Anaesthesia of the pulp and lingual soft tissue in the mandible therefore, often requires an inferior alveolar nerve block (IANB).[2] This technique is relatively complex and has drawbacks, including a high failure rate(15%–20%), and complications such as trismus, haematoma, and paraesthesia. Another shortcoming is the unnecessary anaesthesia of all branches of the nerve.[3] Research workers have therefore been in

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search of effective anaesthetic agents to provide adequate depth of anaesthesia by mandibular buccal infiltration.

4% articaine was introduced to the clinical practice in 1976 and has been claimed to be more effective than lidocaine. Articaine is an amide anesthetic solution with an additional ester group; it also contains a thiophene ring which enhances its lipid solubility and allows the solution to easily penetrate into the tissues.[1,4] The molecular structure of articaine allows it to be metabolised by both the cholinesterase in the tissue and hepatic microsomal enzymes. Its clinical advantages include the fact that its effect longer lasting then that of bupivacaine, etidocaine or ropivacaine and its superior penetration into the bone.[5]

In human studies, 4% articaine has been reported to be more successful than 2% lidocaine when used as buccal infiltration.[6] Majority of the studies have been performed on adult subjects and data regarding their effectiveness in children are proportionately sparse. Therefore, the current study was conducted to compare the efficacy of buccal infiltration of 4% articaine with 2% lidocaine IANB for endodontic treatment in mandibular primary second molars.

MATERIAL AND METHODS

Study design: The study was a randomized controlled trial that was conducted at the Department of Pedodontics and Preventive Dentistry, Kalka Dental College after approval by Institutional Ethics Committee, Moradabad, India. The target population were children reporting to the Kalkal dental college and research centre for routine dental treatment. Children not meeting the inclusion criteria were ineligible for the study.

Inclusion criteria-

- Children within age group of 5 - 8 years.
- Cooperative behaviour for dental treatment under local anesthesia.
- Children undergoing pulp therapy of mandibular molars requiring local anesthesia.

Exclusion criteria-

- Children who weigh less than 20 kg.
- History of allergy to any of the constituents of the local anesthetic solution.
- Children requiring pulp therapy of an abscessed tooth/non vital pulp.
- Children who were indicated for treatment under aversive conditioning.
- Children undergoing root canal treatment or extraction of permanent teeth.
- Children who had medical conditions contraindicating the use of local anesthesia or to undergo dental treatment under local anesthesia.

Sample size calculation: The sample size calculation was done using the PASS software. The effect size taken was 0.4, which was calculated by using the mean and standard deviation (SD) of the previous research, error probability taken was 0.05, power (1-β error probability) was 0.80, and the allocation ratio N2/ N1 was one. Total sample size obtained was 100.

Written informed consent was taken from all the participants. Patients were equally and randomly divided into 2 groups: group A (n = 50) and B (n = 50). The method of allocation of patients in the groups was, creating 100 slips of equal size and shape, 50 marked with A and 50 marked with B. The slips were folded and placed in a bowl and shuffled. Each child was asked to pick a slip from the bowl. The subjects who picked up slips with A marked on it were allocated to group A and received single buccal infiltration using 1.8 ml articaine HCl 4 % with epinephrine 1:100,000 (Septanest, Septodont, Saint-Maurdes Fosses, France) and those whose slips had B marked on it were allocated to group B and received 1.8-mL lidocaine HCl 2% with epinephrine 1:80,000 (Lignospan special, Septodont, Saint-Maurdes Fosses, France) A standard cartridge in an Ultra safety plus syringe with 30-gauge, long needle (Septodont, Saint-Maurdes Fosses, France) was used for both groups.

The procedure was performed by the same clinician who had been calibrated to the technique of administering local anesthetic agent. Patient, and their guardian were all blinded to the anesthetic agent as a standard syringe was used.

The tissue at the injection site was cleaned with sterile dry gauze and anesthetized by lignocaine topical anesthetic gel (Lignospan-O, Septodont Healthcare India Pvt. Ltd). In infiltration technique the needle was oriented in such a way that the bevel faced bone. The needle was inserted at the depth of mucobuccal fold and was targeted at the apical region of the tooth to be anesthetized. After achieving negative aspirations, approximately 0.8 ml of articaine was deposited slowly over 20 seconds. 0.8 ml Lidocaine was administered to follow IANB technique. The procedure commenced 5 minutes after the administration of anesthesia.

The Wong-Baker Facial Pain Scale (FPS) was employed in the study for subjective evaluation of pain perception during extraction as it shows good construct and validity. Immediately after the extraction, the participants were questioned about the level of pain they had experienced during the extraction and were asked to select the picture of facial expression that best represented their experience. Each face has an assigned numerical value that was recorded and tabulated.

The hemodynamic parameters of heart rate and blood pressure were recorded using an automatic blood pressure monitor (OMRON HEM-7130) before and during the procedure. They were used for objective evaluation and as physiological indicators of pain response.

Statistical analysis: The data were compiled and subjected to statistical analysis using SPSS 16.0 software (SPSS Inc., Chicago, IL). The data did not follow the normal distribution curve and thus the non-parametric test was applied. The Wilcoxon–Mann–Whitney test was used for comparing the mean pain scores, heart rate, and blood pressure between both the groups.

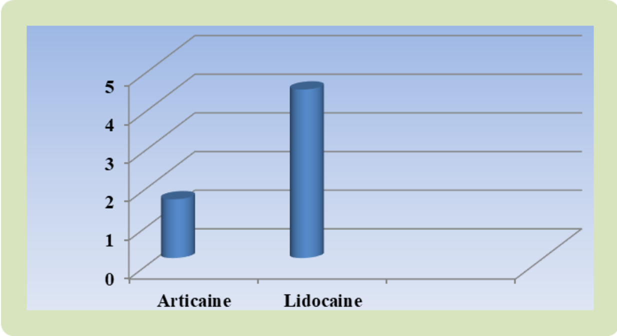

Fig 1: Mean pain score in both the group.

RESULTS

The total 100 children were included in this study with 50 participants and equal number of males and females in each group. The mean age of the participants was 5 years. A total of 22 (44%) first and 28 (56%) second primary mandibular molars were treated following the administration of articaine while in the lidocaine group, a total of 29 (58%) first and 21 (42%) second mandibular molars were treated.

The results of the participation were evaluated by the same experienced clinician who administrated the local anesthetic agent. Successful subjective anesthesia was achieved with single buccal infiltration in all the participants (100%) of the articaine group, and none of them required supplemental injection. 4 members in lidocaine group required an additional anesthetic injection. The statistics of hemodynamic parameters are described in Table 1.

Table 1: Descriptive Statistics of Hemodynamic Parameters in the Groups.

Variables	*Group*	*N*	*Mean*	*SD*
Pulse before procedure	Articaine	50	95.28	11.65
	Lidocaine	50	99.21	12.45
Pulse during procedure	Articaine	50	89.90	11.15
	Lidocaine	50	105.20	13.28
Systolic BP before procedure	Articaine	50	108.30	10.36
	Lidocaine	50	109.20	12.16
Systolic BP during procedure	Articaine	50	108.46	10.25
	Lidocaine	50	117.40	9.13
Diastolic BP before procedure	Articaine	50	67.63	8.72
	Lidocaine	50	70.56	10.42
Diastolic BP after procedure	Articaine	50	75.10	16.55
	Lidocaine	50	81.16	12.84

*BP indicates blood pressure

Table 2: Comparison of Mean Difference of Hemodynamic Parameter in Both Groups Using Wilcoxon–Mann–Whitney Test.

Difference in Variables Before and During Treatment	*Groups*	*N*	*Mean difference*	*SD*	*p-value*
Pulse	Articaine	50	5.38	9.22	0.003*
	Lidocaine	50	-5.99	13.55	
Systolic	Articaine	50	-0.16	6.12	0.304
	Lidocaine	50	-8.2	10.65	
Diastolic	Articaine	50	-7.47	23.15	0.897
	Lidocaine	50	-10.6	10.50	

* Statistically significant

The FPS values (mean ± SD) were lower in the articaine group (1.52 ± 1.64) than in the lidocaine group (4.36 ± 1.8) and it was statistically significant ($p \leq 0.05$) (Figure 1).

The difference in mean ± SD of heart rate recorded before and during the participation in the articaine group was 5.38 ± 9.22, while in the lidocaine group it was -5.99 ± 13.55 and it was found to be statistically significant ($p \leq 0.05$). The difference in mean systolic blood pressure recorded before and during the participation in the articaine group was -0.16 ± 6.12 while in the lidocaine group it was -8.2 ± 10.65, while the difference in mean diastolic blood pressure recorded before and during the intervention in the articaine group was-7.47 ± 23.15, while in the lidocaine group it was -10.6 ± 10.50and they were statistically not significant ($p \geq 0.05$) (Table 2).

DISCUSSION

Pain control is mandatory for reducing the fear and anxiety during dental procedures, particularly in children.[2,7] The aim of this study was to compare the efficacy of Buccal Infiltration with 4% Articaine versus Nerve Block with 2% Lidocaine for Endodontic Treatment in Pediatric Patient. The Wong-Baker FPS was used as a tool for self-reporting of pain by the patients.[2] It measured the unpleasantness or affective dimension of a child's pain perception after the completion of the treatment. The evaluation of heart rate and blood pressure were utilized as physiological parameters as they provide indirect measures of anxiety and pain that are not subjected to clinician bias.[2,8,9] Pulse rate and blood pressure both tend to show variations during stressful treatment. The body's reactions to a painful stimulation can be seen as higher pulse rate levels and higher systolic blood pressure values.[1,10,11]

Articaine is fundamentally different from lignocaine and the other amide anesthetics, due to its possession of a thiophene ring and intermolecular hydrogen bonds in its structure.[1,13] Hydrogen bonds (between the amine nitrogen and oxygen carbonyl ester) are formed when articaine enters into the membrane, and the anesthetic molecule is thought to bend over itself to penetrate better into the nervous sheath, which may account for the reported faster onset of action and the decreased pain during administration.[3] Kuhn et al. showed that such inter-molecular hydrogen bonds increase the solubility of fat, while lidocaine do not have such properties because they do not have a thiophene ring; this is unique to articaine.[14]

Kaufman et al. reported that IANB was significantly more painful than infiltration; however, in this study, there was no difference observed between the two methods.[11] This may be because of pre-application of topical anesthetic gel. Nakanishi et al. reported that the efficacy of topical anesthesia might be related to the location of the injection site; therefore, applying topical anesthetic gel prior to injection was not advantageous when IANB was used as the delivery route.[3,15]

Various factors affect the onset of anesthetic solution, such as the intrinsic properties of the drug, technique used, and its pKa value; smaller the pKa, shorter the latency. As the articaine has less pKa value as compared with the lidocaine, it has a short latent period.[6] In our study, the mean onset of action of 4% articaine was found to be 52 seconds as compared with the 69 seconds for 2% lidocaine. Costa et al. found statistically faster onset with 4% articaine when compared with 2% lidocaine.

The duration of anesthesia depends upon its degree of protein binding, injection site, and the concentration of vasoconstrictor added in the solution. Articaine has the greatest protein-binding values among other amides. In the literature, the protein-binding capacity for lidocaine and articaine is 65 and 95% respectively.[16,17]

The mean FPS value was found to be higher in lidocaine group, which is possibly due to the need for the supplemental injection.[2] The mean FPS values were lower in articaine group as none of the participants in this group required a secondary infiltration, virtually eliminating the need for painful secondary injection. These results were in accordance with various studies that reported lower pain scores for articaine.[18,19]

The mean heart rate value in the articaine group during the procedure was less than the baseline value, while it raised from the baseline values in children who received lidocaine. This can be due to the additional epinephrine in the lidocaine group, which may have accounted for the difference.[4] However, Kambalimath et al. reported a slight increase in heart rate from baseline values in both their lidocaine as well as articaine groups.[15] The mean systolic and diastolic blood pressure recorded during the intervention was raised from the baseline values in both the groups, which could be attributed to painful stimulation.[19,20] The mean systolic and diastolic blood pressure value of the articaine group recorded during intervention was less than the lidocaine group which may be due to effective analgesia in articaine group.[2,3,21]

Similar to the results of previous studies, dverse effects like facial edema, infection, hematoma and Paraesthesia were not reported in any of the 2 groups as children and parents accompanying them were properly instructed against lips biting post operatively.

Similar to the results of Araliet et al., Zain et al. in the current study, 4% articaine BI was more effective than 2% lidocaine IANB in achieving pulpal anesthesia in 5–8-year-old children, although the treatment and the target teeth were different from the current study.[5,17]

CONCLUSION

Based on the results of this study, the data show that articaine BI is more likely to achieve successful anesthesia than lignocaine IANB. So, it can be concluded that articaine BI could be a valuable alternative to the lidocaine IANB for endodontic treatment of mandibular primary molars.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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