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RESEARCH ARTICLE
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ENDODONTIC AND EXTRACTION SUCCESS WITH BUCCAL INFILTRATION USING ARTICAINE AND LIGNOCAINE IN IRREVERSIBLE PULPITIS

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Abstract

Objective: Assessment of onset of anesthesia and success of procedures in Root Canal and Extraction Procedures Using Articaine and Lignocaine Buccal Infiltration in Maxillary First Molars with Irreversible Pulpitis

Methodology: Randomized double blind clinical study

Place and Duration of study: Pharmacology department, Islamic International Medical College Rawalpindi in collaboration with Margalla Institute of Health Sciences.
Study duration was one year.

240 patients being managed for irreversible pulpitis for maxillary first molars were randomly divided into two Groups, Group 1 and 2. Group 1 were the patients given the specific local anesthesia for pulp extirpation (root canal treatment). Group 2 were the patients given the local anesthetic for exodontia (dental extractions). These groups were further subdivided into four groups. Group A and Group B were managed by pulp extirpation (root canal) and were given Lignocaine and Articaine respectively. Group C and Group D were managed by exodontia (dental extraction) and were anesthetized using Lignocaine and Articaine respectively. The onset of anesthesia was determined by measuring the time required in minutes to achieve the maximum reading on the pulp tester without experiencing any pain. The success of the procedure was determined by the dentist by establishing if any additional dental cartridge was required by the patient during the procedure.

Results : the time required for the onset of anesthesia for Group B and D was significantly less than that required by Group A and C. The dentist also reported significantly more successful procedures for Group B and D as compared to Groups A and C
Conclusion: Articaine is conclusively more effective than lignocaine in providing rapid onset of anesthesia and results in lesser need for additional anesthesia.

Keywords: Articaine, Lignocaine, Irreversible Pulpitis, Maxillary First molars

Introduction

Untreated cavitated caries was one of the most common dental diseases internationally affecting 2.4 billion people in the year 2010.(1) Amongst the teeth most commonly affected by dental caries and irreversible pulpitis maxillary first molar teeth are the most affected teeth(2). The two major methods of treatment for irreversible pulpitis are root canal treatment and in the case of a non-salvageable tooth a dental extraction(3). For both dental extractions and root canal treatment pain control is one of the most important aspects of patient management(4). Local anesthesia plays a vital role in controlling pain in patients of general dentistry intraoperatively(5) The most commonly used dental anesthetic in Pakistan is lignocaine. However, articaine has been used as a dental anesthetic and has yielded better results than lignocaine. Due to its structural difference from lignocaine, articaine has better lipid solubility than lignocaine. This improved lipid solubility results in a more potent drug and a lesser risk of overdosage. Since it is used in a lesser dose than lignocaine articaine can also prove to be a cost-effective agent.
There is limited data that measures the therapeutic effect of lignocaine and articaine in the management of irreversible pulpitis in maxillary first molar. Since the maxillary molar is the most commonly affected maxillary tooth for irreversible pulpitis hence a study is designed to compare the effect of lignocaine and articaine in the management of irreversible pulpitis in maxillary first molar teeth.

Methodology

It was a randomized double blind clinical study which was carried out in Pharmacology department, Islamic International Medical College Rawalpindi in collaboration with Margalla Institute of Health Sciences.
Study duration was one year.
A total of 240 adult patients of irreversible pulpitis were included in the study who were divided into 4 groups each having 60 patients in the group(6)
The sample size was determined using the formula

$$\frac{Z^2pq}{E^2}$$

Confidence level= 95%
Precision =5%
Simple Random Sampling was done using a randomization software to generate codes for allotment of patients to groups. The codes were known to the principal researcher only.
The study was conducted after approval by the Ethics Review Committee (ERC), Islamic International Medical College Rawalpindi (IIMC) and ethical review Committee of Margalla Institute of Health Sciences (MIHS) Rawalpindi. Only the patients fulfilling the inclusion criteria were included in the study.
To ensure blinding, anesthetic cartridges were labeled with either black or red tape, with the allocation code known exclusively to the principal investigator
The inclusion criteria included
1. Prolonged response to an electric pulp tester
2. Absence of any periapical radiolucency on radiographs, except for a widened periodontal Ligament
3. Permanent upper first molar(4)

The exclusion criteria included

1. The presence of suspected allergy to either lignocaine or articaine
2. H/O significant medical conditions such as diabetes mellitus, hypertension, known cardiac disease etc.
3. Presence of abscess, sinus opening
4. Pregnant females(7)

The patients were divided into the 2 main groups

Group 1:

Local anesthetic used for patients undergoing root canal (pulp extirpation) of the maxillary first molar

Group 2:

Local anesthetic used for patients undergoing extraction of the maxillary first molar

Subgroups

These groups were further subdivided into four groups A, B, C and D as follows

Group A (N=60 patients)

Patient undergoing Root canal (pulp extirpation) of the upper first molar tooth under lignocaine

Group B (N=60 patients)

Patient undergoing Root canal (pulp extirpation) of the upper first molar tooth under articaine

Group C (N=60 patients):

Patients undergoing upper first molar extraction under lignocaine

Group D (N=60 patients):

Patient undergoing upper first molar extraction under articaine

Baseline pulp sensitivity of teeth diagnosed with irreversible pulpitis was recorded using an electronic pulp tester prior to the administration of local anesthesia. To validate the accuracy of the readings, a contralateral, non-anesthetized maxillary tooth was selected as a control and subjected to a single pulp sensitivity test before anesthetic injection. Base line pulp testing was done to ensure that the pulp is only inflamed and not necrotic. Once the baseline pulp testing was done and it was determined that the pulp is only inflamed the anesthesia was administered.

Groups A and C received lignocaine while groups B and D received articaine under the standard technique.

Onset of anesthesia as determined by pulp tester

Once the Infiltration anesthesia was administered as per standard technique, the tooth was tested with the pulp tester to determine effective anesthesia. The time required by pulp tester to show no response after maximum stimulation was recorded

If the pulp tester showed the maximum reading (80 reading) without any discomfort, it was concluded that the anesthesia is effective. The testing was repeated until the maximum reading was achieved and the time in minutes required to achieve this reading was recorded using a stop watch. This was done to determine the time taken by the anesthetic agent to anesthetize the tooth. In all cases, the pulp tester was placed on the buccal surface of the tooth.

Only if there was no response at maximum stimulation (successful pulp anesthesia) treatment commenced. Patients who did not secure successful pulpal anesthesia within 10 minutes were categorized as failure of pulp anesthesia, and were managed according to the local best clinical practice, with further supplementary injections as needed.

In the patients who achieved successful pulp anesthesia, the treatment was then provided. The treatment provided to these patients was either pulp extirpation or extraction of the tooth. This was an informed choice made by the patient in consultation with the treating clinician. A supplemental palatal injection was provided to the patients of Group C and Group D. Since the study was restricted only to infiltration anesthesia, Lignocaine was always chosen for palatal anesthesia to limit the number of variables that could affect the primary outcome measure. No palatal anesthesia is required for the patients of pulp extirpation as per the requirements. Up to 5 minutes were allowed to elapse for anesthesia of the palatal soft tissue to be confirmed by sharp probing, and only then extraction commenced.

Success of the procedure as determined by the dentist

The success of the procedure was determined by the dentist by assessing if any additional cartridges was required by the patient for the management and completion of the procedure. If any further cartridge was needed to complete the procedure, the procedure was termed as a “failed procedure” whether it was pulp extirpation or dental extraction. If the procedure was performed with only a single cartridge successfully then it was termed as a “successful procedure”.

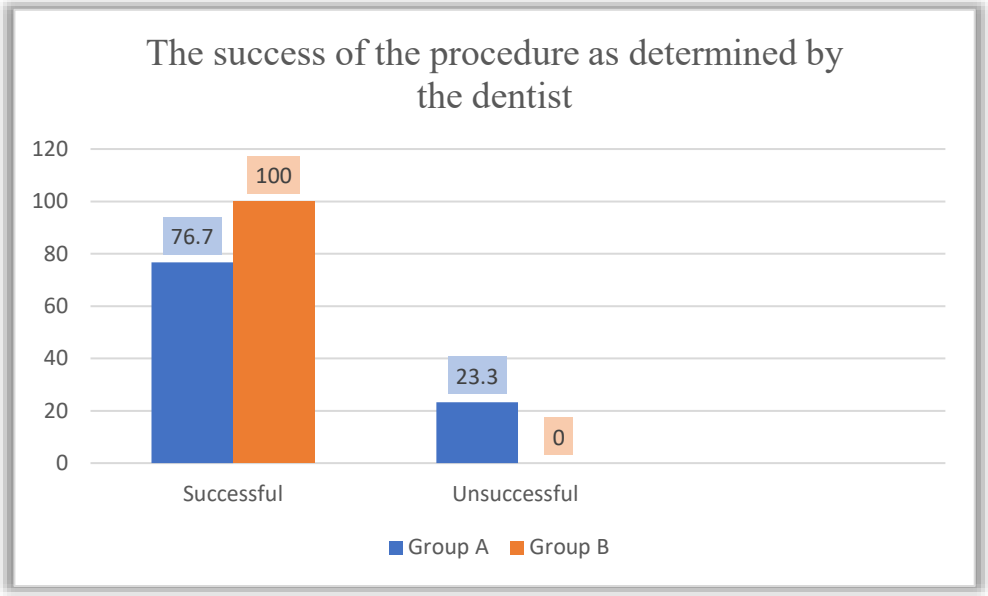
Results

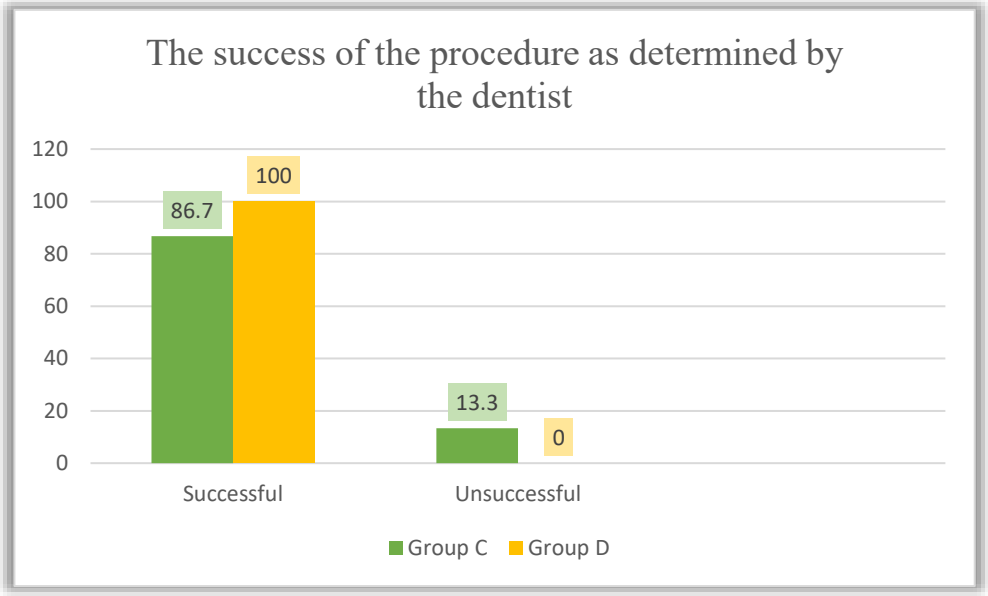
Difference between time required in onset of anesthesia in the groups was analyzed by independent sample T test which yielded highly significant result with the p- value <0.001 for the Groups A and Group B. The Independent Sample t test also showed significant difference in mean onset time when the group C was compared with group D. The mean difference was found to be highly significant with the p-value <0.001.

The mean time required for the onset of anesthesia			
Groups	Sub groups	Mean ± SD	P value t test
Anesthesia used for pulp extirpation (Group 1)	Group A	5.27±1.37	<0.001**
	Group B	3.07±1.13	
Anesthesia used for extraction (Group 2)	Group C	6.27±1.44	<0.001**
	Group D	3.37±1.24	

The success of the procedure as determined by the dentist 76.7% of the Group A patients did not require any additional anesthesia and were declared successful procedure by the dentist whereas 100% of the Group B patients were determined to be successful by the dentist and did not require any additional anesthesia. This difference in success rate was statistically significant as determined from the chi square test and had a p value of 0.001.

86.7% of the Group C patients did not require any additional anesthesia and were declared successful procedure by the dentist whereas 100% of the Group D patients were determined to be successful by the dentist and did not require any additional anesthesia. This difference in success rate was statistically significant as determined from the chi square test at a p value of 0.003





Discussion

The quicker the onset of action of the anesthetic agent, the better the anesthetic agent.
The more potent an agent the lesser number of additional cartridges should be required for the management of the given patient. Similarly, lesser pain should be experienced by the patient during the treatment hence making the procedure smoother and less anxiety inducing for both the patient as well as the dentist.
An anesthetic's disassociation constant determines the pH at which the drugs ionized and non-ionized forms are in equal concentrations. This value is crucial for effective anesthesia because the local anesthetic molecule diffuses more readily through the lipid membrane in its uncharged form. Conversely only the charged form can dissolve in water and diffuse through extracellular fluid and intracellular cytoplasm. Therefore, the diffusing capacity of an anesthetic agent and, consequently, the onset of anesthesia for the local anesthetic are determined by the pKa of the local anesthetic. Since amides have a pKa in the range of 7.6-8 less of the drug is in ionized form, cross the cell membrane more easily and have rapid onset of action(8).
The pKa of articaine is 7.8 whereas that for lignocaine in 7.9. The onset of action of articaine was quicker than that for lignocaine in root canal patients in this study shown by a more rapid onset in group B as compared to Group A. This result was in accordance with the study by Costa CG et al where the onset of anesthesia was much quicker for articaine in root canal patients as compared to lignocaine(9).
Saraf et al also showed a rapid onset of anesthesia for root canal patients with articaine as compared to Lignocaine and it was consistent with the results of this study(10).
Similarly, an early onset of anesthesia was also observed in Group D as compared to Group C, hence showing a more rapid onset for articaine than lignocaine for extraction patients in this study. This was also observed by Kumar K et al where they compared the onset of anesthesia in oral surgical procedures by lignocaine and articaine(11). Bansal et al. also studied the efficacy of articaine and lignocaine in the management of maxillary extractions. Their study also determined a faster onset for articaine as compared to lignocaine(12).
Hassan et al compared the onset of anesthesia of articaine and lignocaine for the extraction of maxillary premolars teeth. They observed a faster onset of anesthesia for articaine as compared to lignocaine during their study(13).
Compared to other local anesthetics, articaine has higher lipid solubility, intrinsic potency, and plasma protein binding due to its unusual chemical structure, which includes the substitution of a thiophene ring for an aromatic ring and the existence of an extra ester ring. This difference in chemical structure and higher protein binding property of articaine, clinically reflects as a shorter latency and earlier onset of action for articaine. Due to its increased lipid solubility and its rapid diffusion within tissues and bones, articaine has a faster onset of action as compared to lignocaine(14).
The success of the anesthesia during the procedure whether root canal therapy or extraction was determined by the absence of significant pain during the procedure and ability of the dentist to complete the procedure without requirement of any further cartridges of local anesthesia. This was in accordance with the factors determined by Weinstein et al where it was determined that the greater the number of extra injections required, the higher the likelihood of anesthesia failure(15). The more potent an anesthetic agent the requirement for additional anesthetic cartridges would be reduced for it. Similarly, the patient should experience lesser pain during the procedure after the use of such anesthetic agent.

Conclusion

Thus, it can be safely concluded that articaine can be used in the management of irreversible pulpitis in maxillary first molars. Due to its better onset of action and significant potency it results in marked therapeutic success as compared to lignocaine

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