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Comparison of Articaine and Lidocaine Used As Dental Local Anesthetics-A Research Article

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I. Introduction

Effective control of pain during dental procedures has been one of the most important pre-requisite of dentistry.

In 1943, Löfgren synthesized the first modern local anesthetic agent, lidocaine - an amide-derivate of diethylamino acetic acid. Lidocaine was marketed in 1948 and is presently the most commonly used local anesthetic in dentistry worldwide. In 1969, articaine was synthesized by the chemist Muschaweck and was approved in 1975 as a local anesthetic in Germany. [1]

Articaine differs from the previous amide local anesthetics in that it has a thiophene ring in its molecule instead of the usual benzene ring. It was first named *Carticaine*, but its generic name was changed to *Articaine*in 1984. Articaine is the most widely used local anesthetic in a number of countries including Canada, Norway, Italy, France and the Netherlands. In Germany more than 90% of the local anaesthesia used by dentists is Articaine. [2,3]Patients treated with articaine will be 'drug free' more quickly than those who receive other local anesthetics. Articaine is claimed to be superior to lidocaine owing to its better diffusion through soft tissue and bone, the rapid onset , the excellent quality of the anaesthesia, and the lower degree of toxicity. [4]

The aim of this study is to evaluate the safety and efficacy of Articaine in the bilateral extraction of premolars for orthodontic reasons, compared to that of lignocaine.

Purpose

To compare and evaluate the efficacy of ArticaineHClanaesthesia in palatal region without palatal injection with Lignocaine HCl using a visual analogue scale (VAS) for pain.

1. Time of onset of anaesthesia
2. Duration of action
3. Intra or post administration complication

II. Materials and Methods:

Materials Used In This Study

1. 0.5 to 0.6 ml of 4% ArticaineHCl with 1: 100000 adrenaline.
2. 1 to 2 ml of 2% Lignocaine HCl with 1: 100000 adrenaline.
4. Disposable syringe with 1.5 inch, 26 gauge needle.
3. Standard extraction instruments.

METHODS:

The study was carried out in 20 patients visiting department of oral and maxillofacial surgery, Govt. Dental College & Hospital Srinagar needing bilateral extraction of maxillary premolars

CRITERIA FOR SELECTION OF PATIENTS FOR STUDY

Inclusion criteria:

- Age group of 16 to 26years
- Both males and females
- ASA Grade 1 patients were selected for the study

Exclusion Criteria

- Medically compromised patients
- Hypertensive patients
- Diabetic patients
- Pregnancy

Patients needing to undergo bilateral extraction of maxillary premolars for orthodontic reason were selected. Volume of 0.6 -1 ml. of 4% Articaine HCL was injected in the buccal vestibule on one side and 1-2 ml of 2%

Lignocaine HCL was injected on other side. After attaining adequate anaesthesia extraction procedure was carried out under aseptic conditions.

Techniques Used In Administration Of Local Anaesthesia:

Local infiltration:

In local infiltration technique (submucosal), small nerve endings in the area of the dental treatment are flooded with local anesthetic solution, preventing them from becoming stimulated and creating an impulse. Local infiltration technique is commonly used in anaesthesia of the maxillary teeth.

Volume of the drug **4% ArticaineHCl with 1: 100000 adrenaline for** anaesthetizing the maxillary premolar in our study used was 0.5 to 0.6 ml in the buccal vestibule(submucosal) only. Palatal anaesthesia was achieved **without palatal infiltration** when objective symptoms were checked before the extraction procedure. Volume of 0.5 to1 ml. **2% Lignocaine HCl with 1: 100000 adrenaline was injected** in the buccal vestibule (submucosal) foranaesthetizing premolar (control side) in our study. Palatal anaesthesia**was not achieved** when objective symptoms were checked, therefore **an additional palatal infiltration** was given to anaesthetise the palatal mucosa before carrying out the extraction procedure.

After achieving complete anaesthesia normal extraction procedure was carried out. During the extraction procedure patients were periodically questioned about pain. Each patient was evaluated using 100mm visual analogue scale during and after the extraction.

III. Results

The study group consisted of twenty patients who underwent extraction of bilateral maxillary premolars for orthodontic purposes. All subjected were evaluated preoperatively. All of them received 4% articaine with 1: 100000 epinephrine and 2% lignocaine with 1: 100000 epinephrine bilaterally.

The amount of anaesthetic injected, the time of injection, the onset and duration of anaesthesia and post injection complications was recorded for all patients. Pain experiences is analyzed with a visual analog scale. The values were compared and statistically analyzed (**T-Test-drug volume-ml;Paired Samples Statistics ;T-Test-time of onset of anesthesia –mins;T-Test-duration of anesthesia-mins ;wilcoxon Signed Ranks Test-pain score**). The results are tabulated in the tables and are depicted in the graphs.

Demographics

Twenty (20) patients were treated with 4% articaine hydrochloride (HCl) (study group) and 2% lignocaine hydrochloride (HCl)…. (control group).

5 male and 15 female patients with a mean age group of 21 years were included in the study.

Drug volume (fig1)

The study compared the amount of local anaesthetic solution that was injected to achieve adequate anaesthesia. The mean volume of articaine administered was 0.710^{+} 0.1252 ml and mean volume of lignocaine was 1.880^{+} 0.2042 ml. The volume used is less in articaine group, which is statistically significant ($P<0.0005$)

The volume of anesthetic administered is summarized in the table I a and I b

Drug volume (milliliters): Table Ia

no	Group I (articaine)	Group II (Lignocaine)
1.	0.6	2
2.	0.7	1.5
3.	0.7	2
4.	0.8	2
5.	0.6	2
6.	0.7	1.8
7.	0.6	2
8.	0.7	2
9.	0.6	1.5
10.	0.7	2
11.	0.8	2
12.	0.7	2
13.	0.6	1.8
14.	1	2
15.	0.6	1.5
16.	0.6	2
17.	1	2
18.	0.8	1.5
19.	0.6	2
20.	0.8	2

Paired Samples Statistics Table I b

		N	Mean	Std. Deviation	t	p-value
Pair 1	Group I (articaine)	20	0.710	0.1252	-24.015	<.0005***
	Group II (Lignocaine)	20	1.880	0.2042		

The drug volume in Lignocaine is significantly more than articane (P<.0005)

Time of onset (fig2)

The study showed the onset period ranging between 0.5 to 1 minutes in articaine group and between 2 to 4 minutes in lignocaine group. The mean onset time of anaesthesia in the study group was 0.975 $^{+}$ 0.1118 minutes and 2.950 $^{+}$ 0.5104 minutes in test group as shown in table II a and II b. The time of onset of anesthesia in Lignocaine is significantly more than articane (P<0.0005).

Table 11a

Paired Samples Statistics Table IIb

Sl no	Group I (articaine)	Group II (Lignocaine)
1.	1	3
2.	1	4
3.	1	4
4.	1	3
5.	1	3
6.	1	3
7.	1	3
8.	0.5	3
9.	1	3
10.	1	2
11.	1	3
12.	1	3
13.	1	3
14.	1	3
15.	1	3
16.	1	3
17.	1	2
18.	1	3
19.	1	3
20.	1	2

		N	Mean	Std. Deviation	t	P-value
Pair 1	Group I (articaine)	20	0.975	0.1118	-16.823	<0.0005***
	Group II (Lignocaine)	20	2.950	0.5104		

The time of onset of anesthesia in Lignocaine is significantly more than articane (P<.0005)

Duration of anaesthesia**(fig3)**

A mean duration of 72 $^{+}$ 17.275 min was seen with articaine group and 49 $^{+}$ 5.026 min with the lignocaine group. The difference is statistically significant (P<0.0005) giving an inference that the articaine has longer duration of anaesthesia compared to that of control group. The values are depicted in table III a and III b.

Table 111a

Sl no	Group I (Lignocaine)	Group II (articaine)
1.	45	60
2.	45	90
3.	50	60
4.	45	60
5.	40	90
6.	50	90
7.	55	90
8.	60	60
9.	45	90

10.	50	90
11.	45	60
12.	55	60
13.	55	90
14.	50	90
15.	45	45
16.	45	60
17.	45	45
18.	50	60
19.	55	90
20.	50	60

Paired Samples Statistics Table III b

		N	Mean	Std. Deviation	t	P-value
Pair 1	Group I (Lignocaine)	20	49.00	5.026	-5.954	<.0005
	Group II (articaine)	20	72.00	17.275		

The duration of anesthesia in articaine (P<.0005)is more compared to lignocaine

Pain ratings(fig4)

We included VAS evaluation for efficacy analysis. We found no significant difference in pain score in articaine-palatal buccal group (P=0.564) but a significant difference in pain score in Lignocaine-palatal buccal group (P<.0005).

The ratings are tabulated in table IV a and IV b.

Table1Va

Sl no	Group I (articaine) buccal	Group I (articaine) palatal	Group II (Lignocaine) buccal	Group II (Lignocaine) palatal
1.	0	0	0	100
2.	0	0	0	100
3.	0	0	0	100
4.	0	0	0	100
5.	0	0	0	100
6.	0	0	0	100
7.	0	0	0	100
8.	0	0	0	100
9.	0	10	0	98
10.	0	10	2	100
11.	0	0	0	100
12.	0	0	0	100
13.	0	0	0	100
14.	0	0	0	99
15.	0	0	0	100
16.	0	0	0	100
17.	10	0	2	100
18.	10	10	0	100
19.	0	0	0	100
20.	0	0	0	100

Table 1Vb

wilcoxon Signed Ranks Test-pain score

		Mean	Std. Deviation	P-value
Pair 1	Group I articaine-buccal	1.00	3.078	.564 ns
	Group I articaine-palatal	1.50	3.663	
Pair 2	Group II Lignocaine-buccal	.20	.616	<.0005***
	Group II Lignocaine-palatal	99.85	.489	

No significance difference in pain score in articane- palatal buccal group (P= .564)
Significance difference in pain score in Lignocaine-palatal buccal group (P<.0005)

Post injection complications

We did not find any complications either in the articaine group or in lignocaine group.

IV. Discussion

Articaine unlike other amide local anaesthetics undergoes biotransformation in both liver and plasma and is thus cleared more quickly from the body. The available literature indicates that articaine is equally effective when statistically compared to other local anesthetics.[5]

It is essential to standardize the procedure when comparing the efficacy of two anaesthetic drugs. In this study we compared the efficacy of Articaine hydrochloride (HCl) 4% with Lignocaine hydrochloride (HCl) 2% both with vasoconstrictors during the extraction of maxillary premolars bilaterally. The volume of 0.5-1ml of 4%Articaine HCL was deposited buccally on one side and other side 1-1.5 ml of 2%Lignocaine HCL was deposited. Parameters including the time of onset of anaesthesia and the duration of anaesthesiawere studied. It was observed that on the side where Lignocaine was injected an additional palatal infiltration was required in order to perform painless extraction and where Articaine was used palatal infiltration was not required.

Articaine is an amide derivative with a "thiophene ring" in its molecular structure instead of usual benzene ring, making it more lipophilic thus accounting for its diffusion properties within tissues and bones resulting in faster onset of action compared with lignocaine.[4] This is the reason we could achieve anaesthesia on palatal side only with infiltration of 4%Articaine HCL on buccal side.

In comparison with other amide-type local anaesthetics, articaine contains a carboxylic ester group. Thus, Articaine is inactivated in the liver as well as by hydrolization in the tissue and the blood. Articaine is the only local anesthetic agent, which is inactivated in both ways. Since the hydrolization is very fast and starts immediately after injection, about 85 to 90% of administered articaine is inactivated in this way. Main metabolic product is arti-cainic acid (or more accurately: articainic carboxylic acid), which is nontoxic and inactive as local anesthetic.

When Articaine is injected, the concentration of active drug at the site of injection is nearly twice that obtained when Lignocaine is used,hence half the volume of Articaine was sufficient to achieve similar anaesthesia.

In our study, the mean volume of articaine administered was 0.710+0.1252 ml and mean volume of lignocaine was 1.880+0.2042 ml. We found that less amount of Articaine was required to achieve profound anaesthesia when compared to lignocaine.

It is well documented that palatal injection is a painful experience to the patientseventhough surface anaesthesia does allow for atraumatic needle penetration, because of the density of palatal tissues and their firm adherence to the underlying bone, palatal injection is still painful.

Our study showed no significant difference in pain score in Articaine group while significant difference in pain score in Lignocaine group, and an additional palatal infiltration was required for lignocaine group to perform painless extraction of maxillary premolars. Pain measurement is difficult to establish, because its perception and intensity are multifactorial, encompassing sensorial and affective factors.

In our study of 20 patients, there were no adverse effects or complications observed. Keeping the efficacy in mind, articaine is a safer local anesthetic agent similar to other group of local anesthetic agents.

A study was carried out to examine an interaction of lidocaine, articaine and mepivacaine with some antihypertensive drugs clonidine and reserpine on the pentylenetetrazole induced seizures and the conclusion drawn was articaine is the most safe local anesthetic and can be used in epileptic patients.[6]

For the efficacy of local anaesthesia multiple variable factors exist like technique variability, anatomic variations, complexity of procedure and reporting error. Pain itself is multifactorial; perception and pain reaction varies greatly among individuals. Further controlled clinical trials, comparative studies with similar local anesthetic agents in other areas of oral cavity in the form of infiltration and nerve block is necessary to evaluate the safety and efficacy of articaine.

V. Conclusion

Articaine can be used as an alternative to lignocaine in extraction of maxillary premolars for orthodontic reason avoiding palatal injections which are painful.Reports of toxicity reactions are extremely rare when Articaine is used. Rapid inactivation of plasma esterases may explain the apparent lack of overdose reactions even though it is marketed as 4%.[7] Clinical advantages like a shorter time of onset, longer duration of action and greater diffusing property over lignocaine could be proved.

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Legends:
Fig.1: Drug Volume
Fig.2: Time of Onset
Fig.3: Duration of Anaesthesia
Fig.4: Pain Ratings

******** The ETHICAL clearance was taken from the ethical committee which was formed in the college itself.**

Fig1(Distribution of amount of local anaesthesia used among the study)

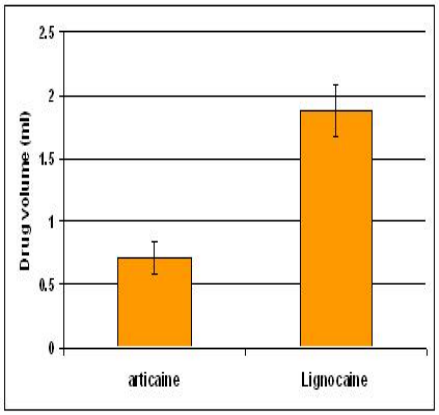

Fig2(Distribution of time of onset of anaesthesia among study group)

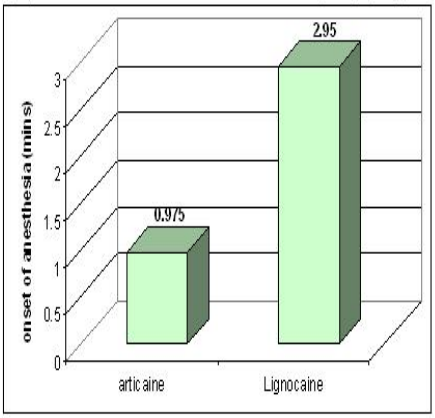

Fig 3(Distribution of duration of anaesthesia among study group)

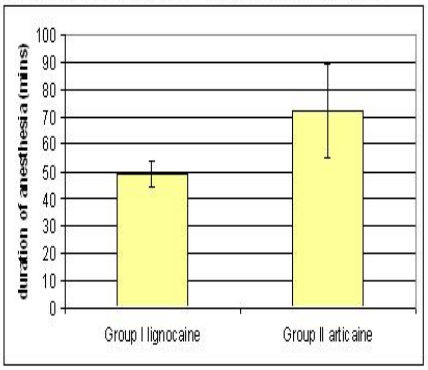

Fig 4(Distribution of VAS among study group)